SEPTEMBER 1986 • Volume 9 • Issue 9

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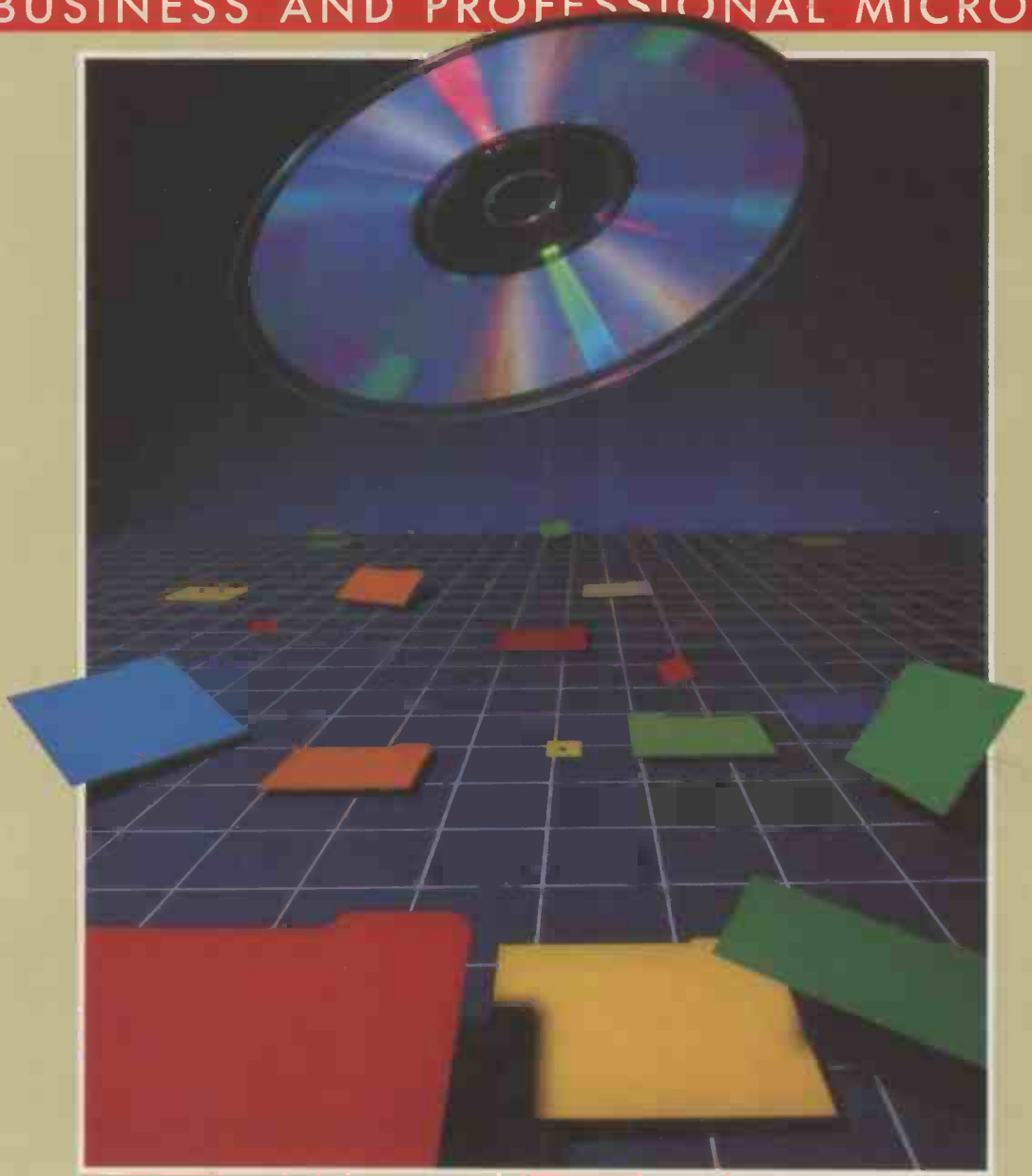

MEMORIES OF THE FUTURE

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COVER FEATURE

MEMORIES OF THE FUTURE

Mass-storage technology is currently making rapid advances. Where megabytes once seemed a king's ransom, today it is the gigabyte barrier which is being breached. In this special section we look at some of the latest developments in the field. On page 94 *Carol Hammond* introduces the exciting world of CD-ROMS — half a gigabyte on a 5in. disc. Then *Ian Stobie* looks at some of the alternatives to Winchester hard discs on page 97. As other technologies have moved on, hard discs themselves have become smaller and are now available on plug-in cards. *Glyn Moody* tries some out on page 101. Finally on page 104 *Steve Malone* looks at the state of silicon memories, and how they too are breaking new ground **93**

CD-ROMs Data on compact disc — page 94.

INSIDE

Xen-i Apricot goes IBM compatible — page 48.

PRACTICAL COMPUTING

SEPTEMBER 1986 **CONTENTS**

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NEWS

Low-cost integrated package.

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Every effort is made to check articles and listings but *PC* cannot guarantee that programs will run and can accept no responsibility for any errors.

LONG LIVE COMPATIBILITY

Recently we witnessed the end of an era in British microcomputing. After years of trying to emulate its fellow fruit, Apple, and to engender its own alternative micro standard, Apricot has bowed to the inevitable with the launch of its Xen-i IBM compatible. Since ICL seems to be concentrating on the multi-user market, this leaves the U.K. with no major player going it alone with a mainstream micro.

National pride apart, perhaps this last, reluctant defection is not such a tragedy. After all, it seems to be agreed that compatibility is a Good Thing. It means that software houses can write for a common standard, and so do not have to worry about endless ports and patchings to cope with the alternatives. It means that the clone makers have been able to move in and turn the whole PC arena into a commodity market.

The user has benefited enormously from the resulting price war. Clones are currently ducking below the £500 barrier for the first time, and they show no sign of stopping there. But with everyone so keen on this compatibility, few have stopped to consider what exactly it is that things are supposed to be compatible with. Does compatibility even exist?

Initially, of course, there was just the IBM PC — or rather, various versions of it. The first U.S. entry-level system had 16K RAM and stored its software on a cassette. In the U.K. there was a version with 160K floppies, and another with 320K floppies. Now the standard has been increased to 360K. The launch of the hard-disc IBM PC/XT brought with it a few more divergencies: the BIOS was slightly changed, as was the operating system. The PC/AT represented a more divergences: the BIOS was slightly changed, as quite different from the PC's 8088, and the AT uses a full 16-bit architecture internally and for the expansion slots. Then there is the 1.2 Mbyte floppy: although it can read old-style 360K discs, trying to write to one can be catastrophic.

The introduction of a new machine would have been perfectly justified in a fast-moving market, had it represented a fundamental advance on the older IBM PC. But the AT does not. There is no software which can take advantage of the 80286 chip's superior specifications, other than its greater speed. As a result, many users have been reluctant to upgrade, and have instead stuck to their IBM PC, achieving extra performance by the micro equivalent of turbocharging. This has led to a proliferation of co-processors and go-faster cards, memory-expansion boards, plug-in hard discs, and special video and colour boards. In effect, the PC has become little more than a card cage with a power-supply.

Unfortunately, no standard has evolved in any of these areas. It has become necessary to test each program individually to discover whether it will function properly with a particular collection of extras. For example, you might need to know whether a particular package will work with the 8087 maths co-processor; with Above Board or Rampage memory-expansion cards; with IBM's EGA colour board or Olivetti's own version. If it works with one it may not work with a rival product. In other words, you can no longer take any package for the IBM PC and be sure that it will run with such systems. So much for compatibility.

Unlike manufacturers such as Apricot who concentrate purely on micros, IBM has no interest in pushing its technology to the limits. A full-power version of the AT would have threatened sales of its low-end minis like the System 34 and 36 machines. Yet there is no doubt that the evolution of standards works to the advantage of manufacturers and users alike. Even one created by IBM is preferable to no standard at all, though the original PC standard is creaking under the weight of the multitudinous add-ons that are coming to negate its basic principle.

What is needed is a new standard. It should be a natural outgrowth of the old one, and must address the growing needs of users who are taking up the myriad options for expansion. The new standard will not be based around the 80286 chip, as it is by now hopelessly compromised. Instead we must look to the next generation of the IBM PC, based around the 80386. And this time, for its own good, IBM must respond to the market, rather than dictate to it. That way it will preserve its linchpin position in the industry, while allowing the rest of us to reap the benefits of a truly common and viable standard. Compatibility is dead: long live compatibility.

5 YEARS AGO...

A new venture has been set up to manufacture and sell a British microcomputer, designed to compete with international best-sellers like the Apple and the Pet. The machine is the Z-80 based Gemini 801 which was originally launched at Compec 80, and has since been modified.

British Micros is the new name behind the Gemini microcomputer and was formed when John Marshall, managing director of Gemini, joined forces with Manus Heghoyan of Hegatron (EC) Ltd of Watford. The new company will be based in Watford.

The Gemini microcomputer is competitively priced at £1,195 plus VAT, which is for a complete system less the video monitor. Software is at present being developed for the system, although the machine is supplied complete with CP/M and a 24K Microsoft Basic, Microsoft Cobol, Fortran and a special APL, will all be available as well.

PC Volume 4 Issue 9

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Computer sceance?

FOLLOWING your news item about Rair's upgrade boards for the ICL PC range in your April issue I wrote to them requesting more information. In May I repeated the letter, and again in June. There is still no reply by letter or by phone. Perhaps they Rairly exist. Was their Black Box ever a coffin? Do you think I should study computer sceance to contact them on the other side?

ALEX K GODDEN,
Oxford.

Computer consultants

I WELCOMED and agreed with the majority of comments made by Carol Hammond in her article about computer consultancies in the July issue. However, I feel that some of your readers may be misled regarding the cost of consultancy fees — the fees quoted were upwards of £60 an hour.

The fees of the Hertfordshire Microsystems Centre are well below this figure at £250 per day. As the article states, being members of the Federation of Microsystems Centres, our advice is totally unbiased as all centres work to a strict code of practice laid down by the DTI. Most of the other 25 members of the Federation will quote comparable fees, with the possible exception of the NCC whose substantial overheads result in their centre being forced to charge significantly higher fees.

Incidentally, like ourselves the NCC are just members of The Federation of Microsystems Centres. The Federation is not a franchise operation; it has its own administration and is not run by the NCC.

C L COCKRILL,
Hertfordshire
Microsystems Centre,
De Havilland College,
Elstree Way,
Borehamwood,
Hertfordshire WD6 1JZ.

Kermit on the Mac

IN YOUR June issue the article on Kermit omitted to say that it is also available for the Mac. We have a copy on a PDS disc if anyone is interested.

JOHN LEWIS,
Macintosh User Group,
55 Linkside Avenue,
Oxford OX2 8JE.

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,

The Quadrant, Sutton, Surrey SM2 5AS

A MORAL TALE

YOU know the way it is, I'm sure. First of all you cosset and nurture your new computer, then after a while you forget what an uncomplaining little asset it is. You start to leave it switched on and grumble when it doesn't understand. Even worse, you forget its intrinsic value and leave it exposed to the less principled classes.

So it was with my poor little Epson HX-20, which had served me well for nigh on two years. Rashly, I did not bother to insure it, and even more rashly left it in the car where those self-same unprincipled classes could see it. They took it without asking me.

As I was half-way through a piece of research work, for which most of the data was compiled on the HX-20, the loss of my machine was disastrous. The car insurance did not cover me, so there was no way I could claim on that. I hadn't been paid for the work and so was pretty hard up. Things looked grim.

In desperation I wrote a letter to Epson at Wembley, and told them of my plight. No doubt you, like myself, would have tried them with very little hope of success. But guess what happened about 10 days later? Yes, one of those supposedly hard-nosed executives at Epson sent me a new HX-20! O.K. so it was only on loan, but after all it was my fault that I lost mine, and I wasn't exactly a plum account with one HX-20 in two years.

So what's the moral? First, never skimp on computer insurance. Second, at least one computer company still has the capacity for compassion, even for idiots who lose their precious hardware!

JEREMY TORR,
Telford,
Shropshire.

IBM 5110

I NOTED with interest the 5 Years Ago item in your November 1985 issue which referred to the IBM 5110. I have recently been given a 5110 model 2 with a 5114 disc drive and a 5103 printer.

Although I have a selection of manuals there is no information about machine code or the sort of technical manual available for all modern micros. Do you know of any such information?

The machine has RS-232 asynchronous comms and ASCII conversion on disc but it does not seem to work properly. IBM will help at an exorbitant cost — they offered me a printer/plotter program for £532.

I find the machine and its Basic quite fascinating and would like to know more about it. Can you help?

A H POTTER,
Witham,
Essex.

THE EDITOR ADDS: Any offers?

Sanyo user group

I WOULD like to bring to the attention of Sanyo users like P A Duval — whose letter appeared in July's Feedback — that there is an active Sanyo MBC-550/555 user group with a monthly newsletter and a public-domain software library. Members help each other and are encouraged to form local groups to hold meetings, etc., but there is no official hotline.

Those who read *Soft Sector* — an American monthly magazine for Sanyo personal computer users — may have seen our name in the list of Sanyo user groups it publishes every three months. We have no connection with *Soft Sector* except that, as far as I know, it is the only monthly dedicated to Sanyo users.

M H SYED,
Sanyo MBC-550/555 User Group,
Wistaria,
53 Acacia Grove,
New Malden,
Surrey KT3 3BP.

The paperless office

COLIN DAVIS of Coda Systems made some valid comments concerning the paperless office in the Feedback section of the July issue. But I wonder if at a time when "sell cheaper" seems to be the operative buzz-phrase a system such as he advocates — which couldn't possibly be low-priced — would find much of a welcome in this volatile marketplace?

Indeed is there actually any manufacturer out there prepared to put in the R&D effort and expenditure which would be required to develop such a hardware system?

DAVID M BARKER,
Ipswich Business Computers,
Ipswich,
Suffolk.

Fair treatment for lap-helds

I FELT that the advice given on lap-held micros to A L Lakin in July's Ask PC was rather discouraging. Over the last two years I have moved from typing manuscripts to word procesing them. I use a lap-held NEC PC-8201A in combination with an Apricot PC, a Sirius and an IBM PC.

Progress has been smooth and comparatively untroubled. The PC-8201A is fine for straightforward text entry, not only in libraries but also on journeys and during otherwise unproductive situations such as committee meetings. The legibility of the LCD screen matters less if the material will later be edited on a normal monitor, and only a giant would find serious difficulties with the size of the keys.

One of its great advantages for a person new to computing is that although — or because — it has limited possibilities, learning to use it is simple. The handbooks are good. The machine does not have to be left switched on to preserve files if they are going to be transferred to another micro in a few days or even weeks time. If a lot of material has to be entered at once some files might have to be saved on cassette, but this is an easy process.

The communications setup is manageable for a beginner. I have had no problems uploading files to the other micros. If text is going to be edited with a word processor some adjustments have

(continued on next page)

NEXT MONTH

SPECIAL SECTION

DATABASES

The database market is currently undergoing something of a renaissance. While users might have begun with a spreadsheet or word processor as their first programs, they are now moving on to more advanced applications involving databases. We look at the whole field, from the simple pop-up flat files to the powerful application generators.

SOFTWARE

Equals 22 is a program which will solve equations — a kind of inverse spreadsheet. We try it out. And we take a look at Word Perfect Library, a program which offers memory-resident utilities as well as a complete program environment.

HARDWARE

The IBM Convertible has not yet arrived in this country, but we provide a sneak preview and compare it with the new Zenith lap-top. There is also a look at the advanced graphics boards you can choose from.

FEATURES

Are you damaging your discs every time you use them? We explain the day-to-day perils of the floppy world. Plus a report on how Microsoft's Windows is starting to hit the big time in the City — just in time for the Big Bang.

TOP 10 SURVEY

More and more people are buying modems: we give our best 10.

FEEDBACK

(continued from previous page)

to be made to line endings, but this problem, though annoying, is soluble — see, for instance, Mike Lewis on page 125 of December 1985's *Practical Computing*.

I imagine that other similarly priced lap-helds would do a similar job. Of course pessimism is desirable, and careful pre-purchase testing essential where any computer is concerned. But I do feel that computing magazines should not be unnecessarily forbidding when potential computer users ask for advice.

SANDRA CAIRNS,
Birkenhead,
Merseyside.

Hitachi PC upgrades

HITACHI 16002 PC owners can obtain more information on upgrading to 512K or 640K main memory and to MS-DOS 2 or 3 by sending an s.a.e. to me. Prices come to between one-third and one-half of those available elsewhere.

JOHN D BEVAN,
46 Queens Road,
Hertford,
Hertfordshire SG13 8AZ.

Compulink

FOLLOWING Ben Knox's article about Compulink which appeared on page 32 of your July issue I felt compelled to write to explain further the subtleties of our bulletin-board system. The theme of Ben's article was quite unexpected, and slightly misleading.

The "BBS purists" whom Ben refers to are almost certainly users as opposed to sysops. We modelled Compulink on user groups and bulletin-board systems we experienced while living in the U.S.A The idea of the pay-to-play BBS is nothing new.

Ben's statement about Compulink being a charging BBS is not strictly true either. You don't have to pay to use the Compulink BBS; we have several access levels, from New User to Subscriber. The only restricted areas are the IBM PC specific areas. The non-restricted public-access areas are generally special interest groups run by volunteer co-sysops.

We are always open to new ideas for SIGs, and we would like to make an offer to anyone who would like to run a SIG on the Compulink system. If you have an idea for a SIG, or would like to use an area on the Compulink BBS as a forum for a club or a non-commercial organisation we should be delighted to help.

As its log-on screen shows, Compulink is a user-supported bulletin board. We borrowed the term from the world of public-domain software, as our ideals are similar. The authors of user-supported software classics such as PC-Write, Procomm, etc., request that anyone who uses their products and feels that they have benefited from their use should consider making a contribution to support the author. We make the same plea to users of our BBS.

We are firmly committed to the concept of public-access databases. We have in the past, and will in the future, always have some part of the Compulink BBS open to the public. We have a much more liberated view regarding access to the general public than other dial-up systems, both commercial and non-commercial. The worst thing of all, in our opinion, is to have our computers sitting idle.

FRANK THORNLEY,
Compulink User Group,
Guildford,
Surrey.

Paperlogic Limited

IN THE article headed "IBM Compatibles Top 10" on page 88 of our July issue we showed a photograph in error of a Paperlogic Turbo PC alongside a paragraph headed "PC Clones from £500.00". We advised readers when buying a cheap clone to bear in mind that there will be little support forthcoming and that these companies come and go with distressing frequency. We now wish to point out quite categorically that we had no intention of implying that these statements related specifically to Paperlogic Limited. Indeed we can confirm that Paperlogic Limited is a well established and reputable company which has been in existence since 1978.

The Paperlogic Turbo PC cost some £1,495.00 and was not a cheap clone. It was withdrawn from the market in August 1985 and we were wrong therefore to publish the picture in the July issue. We now apologise for our error and for any embarrassment caused to the company or its directors.

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But if you've already invested in personal computers – whether Apricots, IBM®'s or IBM® compatibles – you can link them into XEN Multi-User right away.

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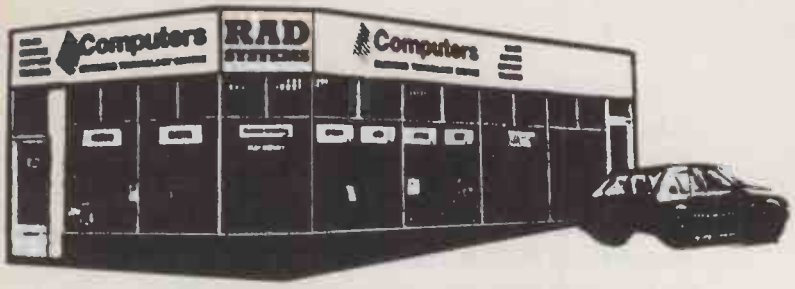

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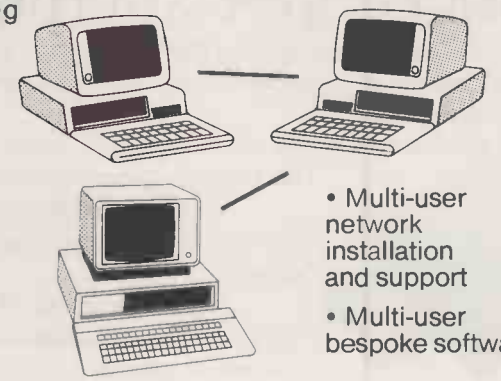

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IBM-PC is a trademark of International Business Machines Corp. MsDos is a trademark of Microsoft Corp.

AT clone breaks £2,000 barrier

PERSONAL COMPUTER COMPATIBLES has launched a full-function AT clone for £1,995. The machine, known as the AT-1020, features a 20Mbyte hard disc, a 1.2Mbyte floppy disc and an EGA colour monitor as standard.

Other features of the AT-1020 are a 640K memory, 8MHz and 10MHz switchable clock speeds, Phoenix BIOS, two serial and two parallel ports, and eight full-length expansion slots.

Further details available from Personal Computer Compatibles, Mayo House, Mayo Road, Walton-on-Thames, Surrey KT12 2QA. Telephone: (0932) 231199.

Built-in modem for Penman

THE Penman plotter is a low-cost robot plotting device which was reviewed in last September's *Practical Computing*. It is now available with a built-in modem, allowing data to be downloaded and used to create maps and diagrams instantly.

Details from Penman Products Ltd, 8 Hazelwood Close, Dominion Way, Worthing, West Sussex BN14 8NP. Telephone: (0903) 209081.

Keeps it with Kodak

KODAK is making its first move into the personal-publishing market with a system known as Kodak Ektaprint Electronic Publishing System or Keeps. The whole system comprises Unix-based software, a file server, a terminal and a mouse, and is aimed at department level or higher.

Keeps is based around the Composition Workstation, a standard terminal fitted with the file-server unit. It can be networked to a number of work stations, and connected to one of a range of Kodak laser printers.

Further details from Kodak Copy Products, Kodak House, Station Road, Hemel Hempstead, Hertfordshire HP1 1JU. Telephone: (0442) 61122.

HERCULES UPGRADES MONOCHROME CARD

A NEW monochrome video controller card from Hercules Computer Technology is now available. It combines the speed of text displays with the versatility of graphics displays. Known as the Graphics Card Plus, the company claims that it will radically alter the appearance of applications.

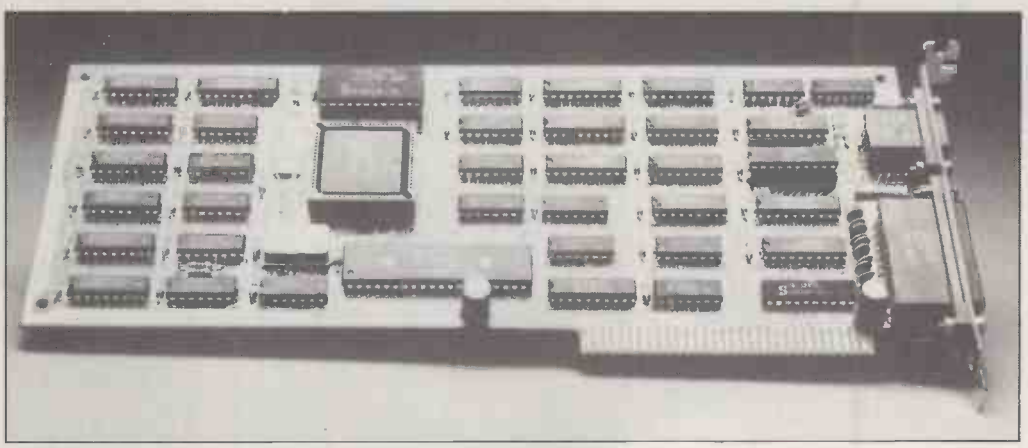
The Graphics Card Plus is based around a custom Hercules chip called the V-112, which the company claims is unclonable. It can store up to 3,072 user-defined character cells in RAM. Under the new Ramfont mode, each of the character cells can be bit mapped by software and combined together by the V-12 to form text or graphics.

Although the new card is not compatible with the IBM Enhanced Graphics Adaptor card, Hercules says it is compatible with its earlier video cards. Supplied with the card is Fontman software which contains a number of founts and enables users to define their own founts.

The bundled disc also contains Ramfont drivers for a number of popular application packages such as Lotus 1-2-3 release 2.0 and Microsoft Word. The card has been made available to a number of software houses. Hercules expects the new generation of software, including the next release of WordStar, to have the new Ramfont drivers built-in.

Hercules emphasises that the new card is an extension to its range and is not intended as a replacement for the previous video cards, which will still be available. The Graphics Card-Plus is distributed by Softsel and First Software and is expected to be priced at just over £300. The earlier Hercules Graphics Card has been reduced in price and is now expected to retail at around £250.

First Software is at Intec-1, Wade Road, Basingstoke, Hampshire RG24 0NE. Telephone: (0256) 463344. Softsel is at Softsel House, Syon Gate Way, Great West Road, Brentford, Middlesex TW8 9DD. Telephone: 01-588 8866.



Multi-compatible graphics board from Atlanta

ATLANTA DATA SYSTEMS has introduced a graphics board which it claims is fully compatible with the IBM MDA, CGA and EGA formats, as well as with Hercules. This enables the device to support Lotus 1-2-3 and Symphony, Framework, and a number of other products.

Known as the ADS Proboard-EGA, the graphics adaptor has flicker-free soft scrolling, RAM-based character generator and an eight-page display memory. The board is being offered at £291.65 as a special introductory offer. For further details contact Atlanta Data Systems, 350/356 Old Street, London EC1V 9DT. Telephone: 01-729 1411.

Hard disc on to tape

TEAC has launched a cassette streamer kit for the IBM PC through its U.K. distributor, Tekdata. The MT-2ST system is claimed to be able to dump a 20Mbyte hard disc on to cassette tape in four minutes.

The kit comes with a half-height tape drive and plug-in controller board; the necessary software is supplied on floppy disc. Teac says that a 45Mbyte version will be available shortly. Further details can be obtained direct from Tekdata, Federation Road, Burslem, Stoke-on-Trent, Staffordshire ST67 4HY. Telephone: (07082) 813631.

Miracle modem

MODEM manufacturer Miracle Technology has added another model to the range, called the WS-4000. The new modem, priced at £149.95, is Hayes compatible.

The standard WS-4000 offers both V-21 and V-23 standards and can run at 300 baud, 600 baud 1,200 baud, 1,200/75 baud and 75/1,200 baud. In addition, Miracle is releasing a number of optional extras, which can be purchased either in the original machine or later as factory upgrades. These include V-22 and V-22bis support, a battery-backed internal phone directory and Bell-standard protocols to allow access to the U.S. telephone network. The WS-4000 has received BABT approval.

Further details can be obtained from Miracle Technology (U.K.) Ltd, St. Peters Street, Ipswich, Suffolk IP1 1XB. Telephone: (0473) 216141.

MS-DOS AND XENIX GET TOGETHER AT LAST

USERS uncertain whether to opt for an MS-DOS or Xenix system can now have both in the form of the Compucorp Connection. It runs both operating systems concurrently, and provides the power of Xenix, yet is able to run IBM PC-DOS applications.

The Connection is based around two processors. A National Semiconductor 32032 32-bit processor is configured to run Unix, while a standard Intel 8088 is dedicated to running IBM PC software. The machine comes with a monitor and is supplied with 1.64Mbyte of memory.

The entry price for the Connection is £2,750. For details contact Compucorp Ltd, Cunningham House, Westfield Lane, Kenton, Middlesex HA3 9ED. Telephone: 01-907 0198.

Compucorp's Connection: separate processors for PC-DOS and Unix.

Wyse PC-286 launched

WYSE TECHNOLOGY, the well-known manufacturer of terminals, has launched the Wyse PC-286 through its U.K. distributor, Kode Ltd. Like other recent AT clones, the PC-286 has a switchable clock speed of up to 10MHz.

The Wyse PC-286 is fitted with 640K RAM, a 1.2Mbyte floppy disc, serial and parallel ports and a choice of a 20Mbyte or 40Mbyte hard disc. Prices start at £1,995 for the single-floppy version, rising to £2,495 with the 20Mbyte hard disc and £3,395 for the 40Mbyte version.

Wyse has also announced the launch of three monitors. The monochrome WY-530 is priced at £192, the WY-630 colour display costs £490, with the WY-640 EGA-compatible model at £610. All the monitors come with a tilt-and-swivel stand. Further details from Kode, Station Road, Calne, Wiltshire SN11 0JR. Telephone: (0249) 813771.

Olivetti plug-in disc

OLIVETTI has launched a plug-in 20Mbyte hard disc for the IBM PC and compatibles. Priced at £599, the device will initially be distributed through Personal Computer Upgrade Ltd.

The OPE Hard Disk Card fits into a single long slot and takes its power directly from the bus. The device will be bundled with the QDOS file-management system, which would normally cost a further £39.95.

The dimensions of the hard disc mean that although it fits comfortably inside the Olivetti M-24 series, it is unsuitable for the M-19. PSU says that the exceptionally low price is due to Olivetti's and its own desire to capture a substantial part of the expanding plug-in hard-disc market.

For details contact Personal Computer Upgrade Ltd, Voss House, Thames Street, Walton-on-Thames, Surrey KT12 2PU. Telephone: (0932) 231100.

Extra expansion for the PC

IF YOU have run out of slots on your PC, or have bought a clone with few available expansion slots, you can purchase an expansion chassis from RCS Computer Services. There are two models in the current range.

The PCX-6A base model, priced at £675, has a capacity of six PC slots available for use, which are connected to the computer via a ribbon cable fitted to a short-slot card in the PC. The other model in the range is the PCX-6AHD, which can handle 10Mbyte or 20Mbyte hard discs. RCS was unable to quote a current price for the HD version as the price of hard discs is falling so rapidly.

Contact RCS Computer Services at Headway House, Christy Estate, Ivy Road, Aldershot, Hampshire GU12 4TX. Telephone: (0252) 333575.

HARDWARE SHORTS

- Ivy Microcomputer Corporation has introduced a portable AT clone. Known as the Ivy 2, the base machine costs £1,995; this does not include the cost of disc drives or MS-DOS. Details from (U.S. area code 617) 853-6914.
- The U.K. distributor for Corvus has begun shipments of an interface which allows the Apple Macintosh to be fitted to Omninet. Suitable for 512K versions of the Mac, it is claimed to be a high-performance alternative to Appletalk. Details on (0332) 40085.
- Torch Computers has introduced a disc-less work-station version of its Unix-based Triple-X microcomputer. The work station comes with a colour monitor and is intended for use with Ethernet. Contact (0223) 841000.
- The Unity modem from Datalines is a V-21 and V-23 modem on a card for the IBM PC. The device features autodial and auto-answer, and is Hayes compatible. Information from (0908) 311077.
- Systems Constructors is one of the first U.K. companies to offer a 3.5in. drive for the IBM PC range. Available in internal or external versions, the drive will allow PCs to read MS-DOS 3.5in. data discs. For details phone (0202) 297315.
- The 6300 Colourwriter is a high-resolution plotter from Advance Bryans Instruments. The machine is supplied in seven-pen and 10-pen versions, enabling a wide variety of colours to be used. Details from 01-640 5624.
- Measuring just 115mm. by 60mm. by 12mm., the AM-0101 is claimed by its manufacturer, Astec Europe Ltd, to be the smallest V-21 modem available. BABT approval for the device is still pending but details can be obtained on (0734) 509411.
- Ramgate is a multi-function card for the AT from Intelligence Research Ltd. The plug-in card is fitted with two serial ports, one parallel port and a joystick port, and is available in a range of memory configurations from 512K up to 3Mbyte. Details from (0273) 420196. PC

PERSONAL-PUBLISHING PACKAGES BOOM

BOTH Micropro and Software Publishing Corporation plan to launch personal-publishing packages for the IBM PC by the end of this year.

Micropro's product, code-named Prism, is a full-function page-layout package developed in conjunction with Island Graphics Corporation. It will be WordStar compatible, accepting files from all Micropro's word processors as well as supporting any file in IBM's DCA format. Micropro is likely to pitch Prism at the top end of the market.

Software Publishing Corporation will be introducing two personal-publishing products. One is an existing IBM package, Clickart Personal Publisher, which the company is buying from T/Maker. This will become its simpler, lower-cost offering, possibly going out under the PFS brand name.

For the professional user, Software Publishing has signed a deal with Bestinfo Inc. to develop a Postscript-supporting product which will come out under the Harvard brand name. Users will be able to move data between the two products.

Both Micropro and Software Publishing Corporation have decided to support the Postscript page-description language, which means these new products will be capable of driving certain types of full-scale typesetting machine in addition to office laser printers.

For more details contact Software Publishing Europe at 85-87 Jermyn Street, London SW1Y 6JD. Telephone: 01-839 3864. Micropro International Ltd is at Haygarth House, 28-31 High Street, London SW19 5BY. Telephone: 01-879 1122.

Meanwhile several other new personal-publishing packages have been launched for IBM compatibles. The rival Macintosh system is of course already well catered for in this application area.

Sclaserplus is designed to handle lengthy documents, using a command-language approach whereby you embed commands in your text files. To help you get tables and charts out of other applications into your document it also comes with a memory-resident screen-grabbing utility. Sclaserplus works with the HP Laserjet and Laserjet Plus, and costs £345. Contact Software Ltd on 01-278 2377.

Fontasy is simpler but costs a mere £70. It will do text charts, newsletters and reports. You can output to a matrix or laser printer in a wide variety of founts and incorporate headlines and graphics in multi-column layouts. Details from Ctrl Alt Deli on (0980) 662759.

Finally Mirrorsoft intends to launch Fleet Street Editor for the IBM in September, priced at £149. This is not the BBC package of the same name; in fact in it is a lightly modified version of Clickart Personal Publisher, the program Software Publishing is buying. According to Mirrorsoft this will pose no problems. Contact Mirrorsoft on 01-377 4837.

SOFTWARE SHORTS

● SQZ reduces the amount of disc space a Lotus 1-2-3 or Symphony file occupies. It also allows you to transmit worksheets through text-orientated email systems. SQZ costs £66 from 4-5-6 World. Ring (0473) 50771.

● Laser Font Master lets you create and download your own character sets to the Canon A1 and A2, and the Hewlett-Packard Laserjet Plus printers. The utility costs £150. Contact Vuman Computer Systems 061-226 8311.

● Diskoptimiser speeds up hard-disc operations on IBM or compatible systems by collecting each file into a contiguous block. It costs £56 from Ideal Software. Telephone: 01-399 2066.

● D-Analyst converts dBase III programs to multi-user dBase III Plus programs. You can then run them on dBase-supported LANs with full file- and record-level locking. D-Analyst costs £49.95 from ICCT Ltd on 01-398 9636.

● Modula-2 is the latest language available for the Mac. The Macmeth package includes a compiler, all the standard Modula-2 libraries and special libraries to support the Mac interface. It costs £175 from Real Time Associates on 01-656 7333.

Presentation graphics choices

VCN INTERNATIONAL is launching Concorde, a new high-end presentation product. Concorde combines the idea of a large library of images with more powerful chart-drawing facilities. Text charting has also been improved, so that you can now choose from 15 built-in founts and import data in Lotus, DIF and Multiplan formats. The new VCN package costs £550. Existing Execuvision users can upgrade for £295. VCN International can be contacted on 01-948 5771.

A new home-grown contender is Microchart Plus from Praxis Software Ltd. This package can read Lotus, Multiplan, DIF and ASCII files, and has its own spreadsheet-like data-entry mode. For £145 it offers control over the final appearance of business charts. Contact Praxis Software on (0892) 42267.

Computer Support Corporation has released new versions of Picture Perfect and Diagraph. Picture Perfect, price £340, is a charting package, while the £440 Diagraph is more suitable for text charts, forms and flow charts These packages are available from Tekware on (0562) 882125.

PFS product range to be restructured

SOFTWARE PUBLISHING CORPORATION is revamping its PFS software range for the IBM PC. Out go best-selling products like PFS Write and PFS File, to be replaced by two separate lines of software. One is targeted at the beginner, the other at more experienced users.

PFS First Choice is aimed at newcomers, although it should also appeal to many occasional computer users. It combines word processing, database, spreadsheet and comms in a single environment with plenty of context-dependent help. First Choice costs £149 and should be available in September.

For more experienced users the company is launching the PFS Professional Series, three individual applications which can exchange data if required. Professional Write, the word processor, costs £189. It has a built-in spelling checker, thesaurus and its own mail-merging function. It can also accept charts from Harvard Presentation Graphics.

The Plan spreadsheet offers built-in graphics and an easy-to-use record and playback macro system. The record-handling and

report-writing package, File, features a cross-tab report view similar to Reflex, and the ability to interchange data with Lotus and dBase as well as with other PFS products. Both Plan and File cost £299. All three packages are due out later this None of the new PFS products are copy protected, a change from previous Software Publishing Corporation policy. An upgrade product to allow users to run Professional Series packages on local area networks is promised for October.

Contact Software Publishing Europe at 85-87 Jermyn Street, London SW1Y 6JD. Telephone: 01-839 3864.

Freeware hit list

THE table below lists the 10 most popular public-domain software products according to the Compulink User Group.

1	Procomm	Comms
2	PC Write	Word processor
3	PC Outline	Thought processor
4	PC Deskmate	Sidekick clone
5	PC File	Database
6	PC Calc	Spreadsheet
7	Kermit	Comms
8	Fansi-console	Screen improver
9	Utilities	Various
10	Games	Various

Most of the programs run on the IBM PC or clones. The software is available to Compulink members at a cost of £3 per disc. Membership costs £30 per annum.

Details available from Compulink User Group, 67 Woodbridge Road, Guildford, Surrey GU1 4RD. Telephone: (0483) 65895. For the V-21 and V-23 bulletin board dial (0483) 573337. PC

Borland introduces the library of affordable quality software for your IBM PC or compatible

At Borland our philosophy is best described in four words: **Quality, Speed, Power and Price.** Two of our products were recently nominated for a "British Micro Award". One, Sidekick, received a "British Micro Award". In the United Kingdom, Borland products are now available at your local dealer or through Softsel (01) 568 8866, P & P Micro Distributors (0706) 217744, Altor Ltd (041) 226 4211 and First Software (0256) 463344.

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Pascal Programming:

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High-speed Pascal compiler and integrated programming environment.

Turbo Tutor £29.95
Basic through advanced Turbo Pascal programming concepts and techniques.

Turbo Graphix Toolbox £49.95
High-resolution graphics for Turbo Pascal.

Turbo Editor Toolbox £49.95
Word processor construction set for Turbo Pascal.

Turbo Gameworks £49.95
Chess, Bridge and Go-Moku in Turbo Pascal.

Turbo Database Toolbox £49.95
Complete library of database routines for Turbo Pascal.

Business Productivity:

Reflex: the Analyst £99.95 Nominee British Micro Award!
The analytical database manager.

Reflex Workshop £69.95 (Available August 15th, 1986)
25 different Reflex applications.

Sidekick £69.95 British Micro Award!
Complete desk-top management. Includes notepad, calculator, telephone dialer and more.

Superkey £69.95
Cuts down keystrokes and encrypts files for confidentiality.

Traveling Sidekick £69.95
Professional time-management binder, includes software that works with Sidekick.

Artificial Intelligence:

Turbo Prolog £69.95
High-speed compiler for the Artificial Intelligence language, Prolog.

Electronic Reference:

Turbo Lightning £69.95
Electronic reference work access system. Includes on-line spelling checker, Random House Dictionary and Thesaurus.

Lightning WordWizard £49.95 (Available August 15, 1986)
Turbo-Lightning's technical reference manual and applications.

BORLAND
INTERNATIONAL

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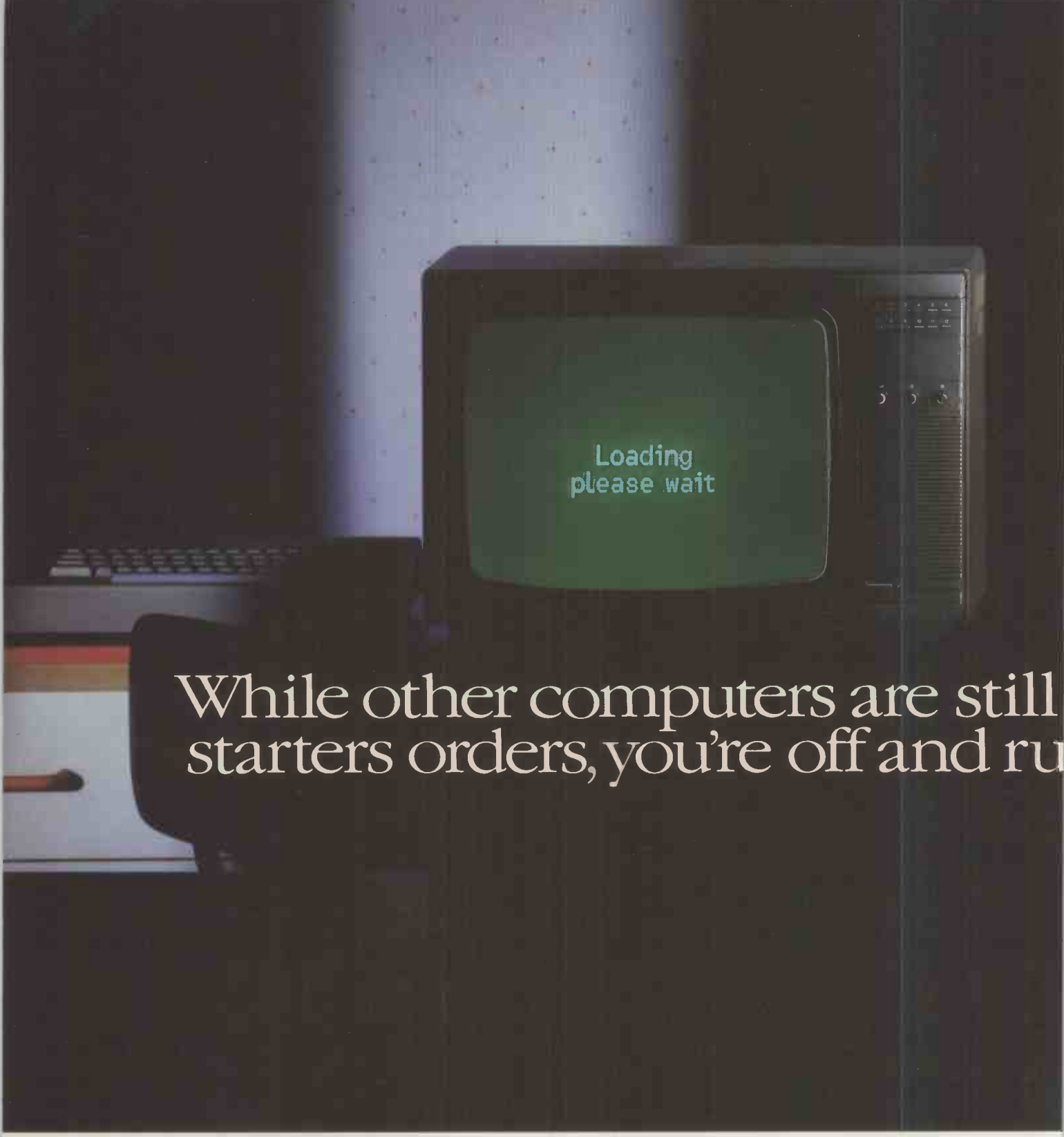

While other computers are still
starters orders, you're off and ru

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

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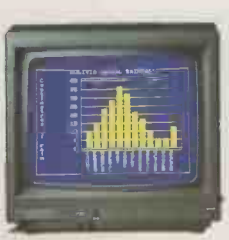
And it also means you can quickly get into more sophisticated programmes using more of the 6128's big 128K memory.



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.

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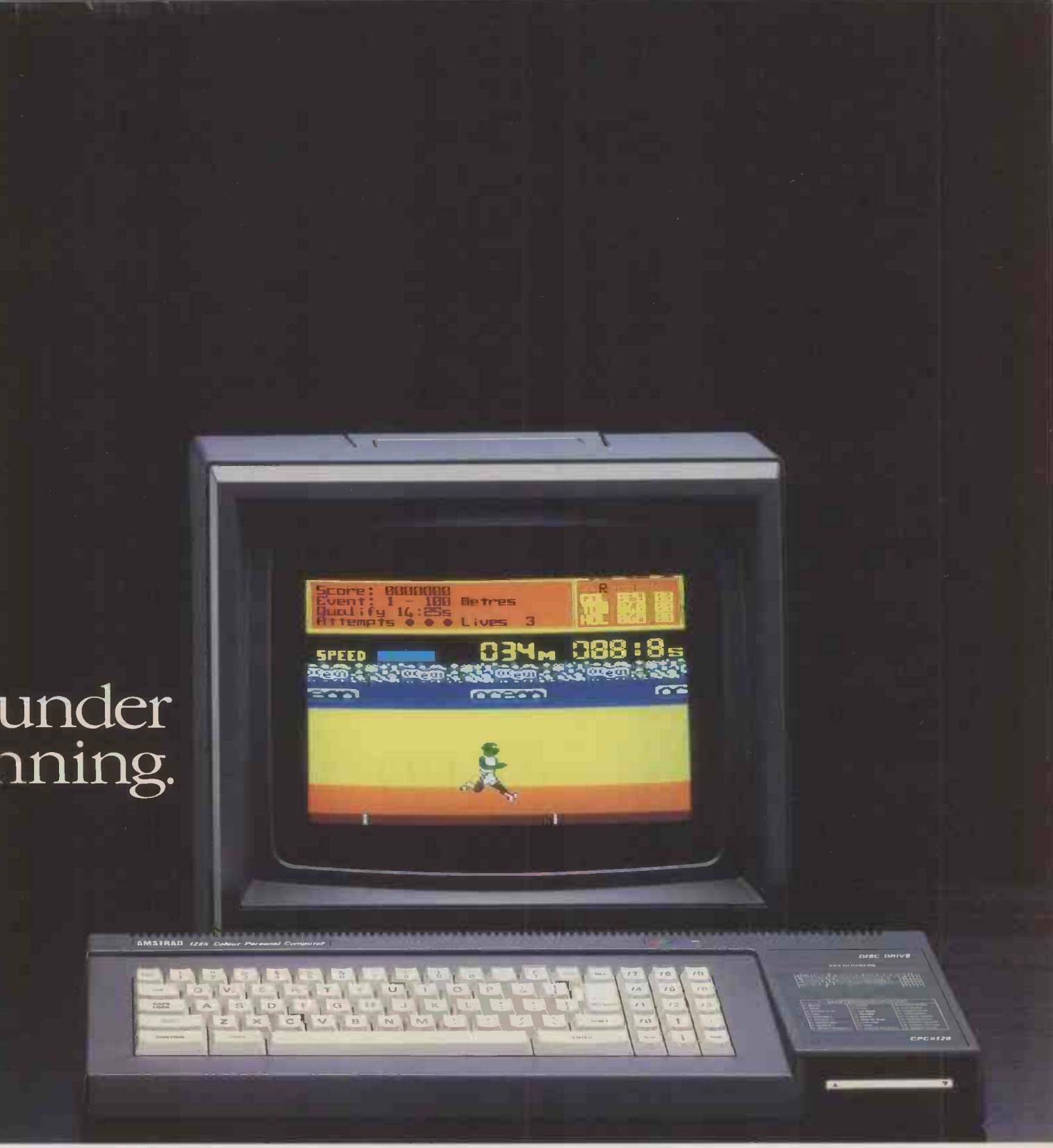
And it will even keep track of rates, mortgage and H.P. payments for you if you want it to.

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



built-in disc drive.

But if you want still more, additional disc drives, printers and joysticks are all available.

You could be off and running on a 6128 for as little as £299 (green screen) or £399 (colour monitor).

At those prices, you won't be surprised to learn that it sells almost as fast as it loads.

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WITH COLOUR MONITOR AROUND	£399

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- compatible with RAM disk

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High-resolution monochrome graphics adapter with printer port

- directly replaces the IBM PC monochrome adapter
- text mode, 80 columns x 25 lines, fully compatible
- software-selectable high-resolution graphics mode 720h x 348v
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- includes our standard one-year warranty

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Full-length RAM card, expandable to 512K maximum in parity-checked banks of 64K. User-selectable base address. One-year warranty, as with our other board products.

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Colour graphics adapter, fully compatible with Big Blue's.

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- 640 x 200 high-resolution mono graphics mode
- 320 x 200 colour graphics mode
- 16 colours each foreground and background
- light pen interface
- Standard one year warranty

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Combination floppy disk controller and multi-function card

- controls 2 floppy disk drives
- parallel printer port
- RS232 (serial) ports
- battery-backed clock/calendar
- game port (for joystick)

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SERIAL CARD

Serial (RS232C standard) interface card for connections to modems, printers etc.

- selectable baud rate – 50 to 9600 baud
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- fully prioritized interrupt system
- controllable from DOS, BASIC, various languages

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These boards are all available for the IBM PC, XT, AT and compatibles. All are provided with our standard 12 month hardware warranty: if it doesn't work, we will replace it.

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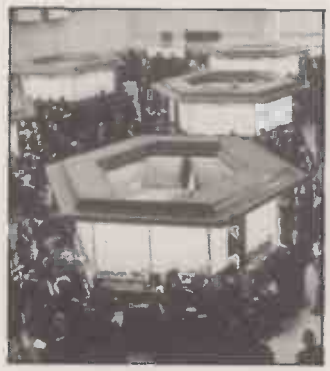
IBM: NO PLANS TO DROP OUT YET

THE PC MARKET has been thrown into confusion following remarks by IBM chairman John Akers in a question-and-answer session in the U.S. Following his remarks, many people have concluded that IBM may be prepared to pull out of the PC market.

Akers' remarks stemmed from a question of how IBM viewed the deluge of low-cost PC clones that have entered the market over the past year. He replied: "If after time, we saw part of the PC market becoming a commodity you would see IBM departing from it."

Although this might seem to be an indication of IBM's intention to withdraw from the low-end PC and XT markets, IBM has been quick to dampen such speculation. The company has stated that it is committed to leadership in the PC industry, adding: "The IBM PC has product features and capabilities that are able to differentiate it from the rest of the market."

What this seems to mean is that while customers buy IBM's reputation and service the company will continue to remain in the market. But if customers forsake IBM for the clones, then the company would reconsider its position.



Big Bang countdown

THE EXHIBITION Systems for the City was held at the Barbican in London between July 15-17. Its purpose was to offer a last chance for city financial firms to examine the competing products and technologies on offer before the so-called Big Bang in the Stock Exchange on October 27.

Central to the exhibition was SEAQ, the Stock Exchange Automated Quotation service. It will enable brokers and investors to view the price movements of all the shares quoted on the Stock Exchanges. They will also be able to interact with the dealing floor of the exchange.

Contact Online International, Pinner Green House, Ash Hill Drive, Pinner, Middlesex HA5 2AE. Telephone: 01-868 4466.

Demand picks up for Apricot

FOLLOWING the launch of the Xen-i and the repricing of the XI and F-series models, Apricot has found its machines in great demand. After reporting poor results for 1985, the company last month announced the discontinuation of the low-end F range and a lower price for the XI, together with the launch of the AT-compatible Xen-i.

As a result Apricot's dealers reported a phenomenal response from customers eager to snap up a bargain. Machines in the Apricot Collection F series are being priced by dealers as low as £450. It appears that many of the machines were bought by educational institutes who already had a number of Apricot machines, and took advantage of the rock-bottom prices while the stocks lasted.

The XI, which Apricot is continuing to manufacture, is also selling well. It is still available from dealers at £899 for the standard version, and at £1,299 for the hard-disc model. Apricot says that the machine does not figure in its plans for 1987.

Initial reaction to the Xen-i from both users and dealers is favourable, with general approval at the performance and design of the machine. We review the Xen-i on page 48 of this issue.

Further details available from Apricot plc, Apricot House, 17 Westbourne Road, Edgbaston, Birmingham B63 3NT. Telephone: 021-501 2284.

Cheap IBM software

THE IBM PC User Group has published its latest catalogue of software. Costing £3, it lists over 200 different discs, each one containing around 15 programs ranging from games to utilities and applications.

The discs cost £5 each to members, plus VAT and a handling charge. The programs provided are either in the public domain — which means they are free — or are user supported. This means that the programs can be copied and passed on, but users are encouraged to send a small contribution to the authors.

Details from IBM PC User Group, PO Box 830, London SE1 2BQ. Telephone: 01-232 2277.

A quiet time at the PC User show

THE PC USER SHOW got off to a sweltering start on July 16. Running for three days, the show attracted most of the big names in the industry, although there was little in the way of major new products.

Among the largest stands were those of IBM, Compaq and Apricot. Notable by their absence were Lotus, Softsel and Digital Research.

A number of visitors were attracted to the Commodore stand, which gave demonstrations of the Amiga with the Sidecar add-on for IBM compatibility. Nearby Ferranti showed off its latest 3D generation package, working under Autocad.

There were a number of Taiwanese clones on show. The cheapest that we came across was a 256K, single-floppy model from a Dutch company called Genisys, priced at £375, although this did not include a monitor. Genisys expects to launch the machine, known as the Competitor, in September.

SHORTS

● Olivetti has announced that its revenues for 1985 were up 34.1 percent over the previous year. Chairman Carlo De Benedetti attributed the increase partly to U.S. sales assisted by its partner AT&T. Details on 01-785 6666.

● Tandon Computers has launched its range of low-cost IBM compatibles in the U.S. The machines have previously only been marketed in Europe, but now the company has made distribution deals with the U.S. chains Entre Computers, Sears Business Systems and Computerland. Details on 01-734 2907.

● Infocheck has upgraded its database of limited companies. It now offers Telecom Gold users a company credit report which can provide information on accounts over four years, financial ratios and a credit rating. Phone 01-377 8872.

● A new study from Intelligent Electronics Europe reports that the installed base of micros in the European education system now exceeds one million, and projects a base of over three million by 1990. It comments that while the U.K. was the forerunner of establishing computers in the classroom, the reliance on eight-bit home micros may prove to be an expensive mistake.

Data Protection report

IN HIS recent report to Parliament, the Data Protection Registrar has reported that registrations under the Act up to the middle of June were around 136,000. Referring to people's reaction to the Act the Registrar says: "Many people support the objectives . . . there may be simpler ways for those objectives to be obtained. It is up to Parliament to determine whether amendments to the Act are necessary."

Around 60 complaints had been received from the public and a team of investigators is being recruited.

Further details from the Office of the Data Protection Registrar, Springfield House, Water Lane, Wilmslow, Cheshire SK9 5AX. Telephone: (0625) 535777.

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QAT-20..QAT	£2477
QAT-40..QAT with 40MB HD and 60MB tape streamer	£3906
QAT-72..as above with 72MB FAST hard disk	£5120
DART-20..DART	£3620

These are typical configurations, hard disk is available in 10,20,40 or 72MB the 72MB being fast read/write. Memory expansion is available for all models. For CGA and colour monitor add £321, for EGA and colour monitor add £607

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Attachmate comms card	£616

Primage 100..Daisywheel printer	£1355
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Alloy slave processor	£640
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Kimtron PC-Terminal	£530
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QAT-5U	£5182
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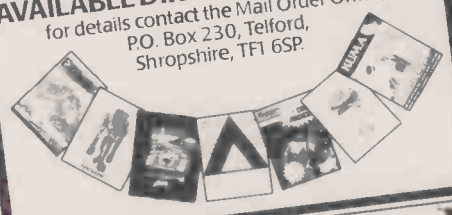

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BY BEN KNOX

WORLD REPORTER

Through Telecom Gold you can now pinpoint any article from the world's major news publications.

One of the major selling points of on-line database and information systems is that they can provide relatively cheap access to professional services which, under normal circumstances, would be prohibitively costly to install as dedicated systems. Unfortunately, it has taken a long time for these professional services to arrive for British users.

Telecom Gold and Microlink are now undoubtedly the leaders in setting up new databases and gateways on their electronic-mail system. A recent addition is the World Reporter database, which is operated by Datasolve Ltd. World Reporter is a large full-text database of international news, current affairs and business information. Its information sources include some of the world's leading news services, newspapers and periodicals.

If you are a Telecom Gold user you can access World Reporter simply by typing WR at the > system prompt. You are then presented with a menu. Before you start to use World Reporter it is a very good idea to order a copy of the Quick Reference Card. On Telecom Gold, this is done by entering

REQUEST-WR

as the system prompt.

Once you enter the World Reporter database, you are asked which file you want to access. At this point you enter the code for the publication you want to search. The files available on the system are Financial Times, The Washington Post, The Guardian, The Economist, New Scientist, Keesing's Contemporary Archives, The Associated Press newswire, Asahi News Service, Tass, BBC Summary of World Broadcasts, BBC External Services News, and Global News Analysis.

Once you have entered the file code, you must start your search. The main searching command is Get, which will search the whole file for items containing a particular term. Once World Reporter has found all the occurrences of the term you specified in the Get command, you can narrow your search down with the Pick command. Pick is used in the same way as Get, except that it is only applied to the items which were selected by the Get command. A typical search sequence is shown above.

Once you have narrowed your search down to a manageable number of items, you will want to display them. The Headline command will give details of the title of the story and the date of its publication.

Next you can use the Text command to get the full text of the items you specify. The last text search command available is Context, which will display the headlines or titles of each item retrieved, as well as paragraphs of text in which the search term occurs. Every occurrence of the search terms — in this case of the example search they are "computer" and "Ben Knox" — is highlighted in capitals. Paragraphs which do not contain the search terms are not displayed.

World Reporter looks a little dated when compared to systems such as Compuserve's Electronic New Service. It would be nice to be able to store search parameters, so that you could carry out a complete search with a simple command. Also useful would be a story tagging feature, where news stories containing particular keywords which have been set up by the account user are automatically scanned for and stored.

A good feature of the World Reporter gateway on Telecom Gold is that it provides a learner database of old news. This allows you to get to know how to work the system at a cheap rate — though it is a pity that World Reporter cannot provide this facility completely free, as happens on many other database systems. Telecom Gold charges World Reporter at £1.15 per minute, or 15p per minute for the learner system.

It is always worth looking around to see if there are cheaper ways of accessing your chosen database. You can often find that another system has a different charging arrangement which might be more suitable for your uses. Shopping around like this has been possible in the U.S. for many years, since many database files are duplicated in different systems. An example of this is provided by Infomatics Daily Bulletin, which is available in the U.K. on Telecom Gold or in the U.S. through Newsnet.

For further information on World Reporter contact Datasolve, 99 Staines Road West, Sunbury-on-Thames, Middlesex TW16 7AH. Tel: (09327) 85566.

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```
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       To search enter appropriate file name,  or
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       For information about a file enter      DETAIL
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GDN
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get computer

GET COMPUTER
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WR >

pick ben knox

PICK BEN KNOX
        3 ITEMS RETRIEVED
WR >
headline all

HEADLINE ALL
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 1    GDN 12 Jun 86 COMPUTER Guardian: Too much learning is a
dangerous thing / Training microcomputer users (1054)
 2    GDN 08 May 86 Computer Guardian: The pagers versus the
scrollers / Comparing videotex with text-based online information
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 3    GDN 24 Apr 86 Computer Guardian: The information war that
delights BT / Telecom Gold challenge to Prestel (1468)

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WR >
context 1

CONTEXT 1
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 1....
      GDN 12 Jun 86 COMPUTER Guardian: Too much learning is a
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  ....

      By BEN KNOX
  ....
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staff. The first introduction might be a 'COMPUTER literacy'
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BY MIKE LEWIS

CHECK IT OUT

There are several simple ways for a system to check the integrity of the data it receives and to correct any errors.

Now that computers are part of everyday life for millions of people, it is no longer possible for sloppy programmers to hide their mistakes behind worn-out excuses like "garbage in, garbage out". Just as most people now know that there is really no such thing as a computer error, so they are realising that it is the programmer's job to stop the garbage from getting into the program in the first place.

Happily, most programmers understand the importance of data validation. If your application requires the user to enter something like a phone number, postcode, or credit limit, the chances are that you will check the input in some way before accepting it. You will want to make sure that the phone number contains only digits and certain symbols, or that the credit limit is within some defined range.

COMMS ERRORS

This is fine for data that is being entered by a person. But what about data coming into your program from an existing disc file, or perhaps via a comms link? After all, errors do arise from defective media, noisy phone lines and faulty equipment. These errors have to be detected — and if possible put right — without human intervention.

The simplest way of verifying data is the familiar parity check. Parity, in this context, means "evenness": the number 4 has even parity, while 5 has odd parity. A parity check involves attaching an extra bit to each unit of data — a byte, a digit, a character or whatever — to force it to be either odd or even, depending on the system in force.

Even on the earliest mainframes, every location in the core memory had an associated parity bit. The system is also widely used on magnetic tape and in data communications. One of the reasons for the popularity of the eight-bit byte — and remember that not all computers have an architecture based on this magic number — is that it caters for the well-established seven-bit ASCII code with an extra parity bit.

But the method is far from perfect. Since the extra bit can have one of only two possible values, there can only be a 50:50 chance of catching an error. It does not cater for bits or bytes becoming transposed, or for random noise that just happens to have the correct parity. And even if you detect the error, the technique does not provide a way of correcting it.

A first step in overcoming these problems is to set up a sort of two-dimensional parity check. Here, the data is treated as a matrix rather than a simple bit stream. For example, on a reel of nine-track magnetic tape, eight of the tracks might hold data bits, with the ninth reserved for parity, thus applying a check to columns of bits. In addition, each row of bits, as viewed longitudinally within a block, has a further parity bit.

In this way, a single erroneous bit can be quickly located, since the parity mechanism will uniquely identify its row/column address. And once it has been found, it can be put right simply by reversing its value. Other minor discrepancies, such as adjacent bits becoming transposed, can be found and corrected in a similar way.

Another approach is a system devised by R W Hamming. In the Hamming method, each unit of information contains four bits of data and has a further three parity bits. The first parity bit is based on the first three data bits, the second parity bit on the first, second and fourth data bits, and the final parity bit on data bits one, three and four.

The advantage of this method is that if any one of the seven bits has the wrong value, a different combination of the parity checks will fail. It is therefore very easy to see which bit is wrong and to correct it. The disadvantage is that it cannot correct multiple errors in the same four-bit unit.

In the world of data communications error correction, as opposed to mere error detection, is much less of an issue. With a tape or disc, once the data has become corrupted it is probably too late for the process which originated it to put it right. It is up to the program that reads the data to sort things out. With comms, the sender is still on the line so you only have to ask it to transmit the suspect characters again.

This is the basis of the so-called "error-free" communications protocols, such as Xmodem, Modem-7, and Kermit. Here the data is sent in blocks of, say, 128 bytes, each block being followed by some form of checking information. In Xmodem there is a one-byte check sum, which is formed by adding the numeric values of every byte in the block, dividing by 255, and taking the remainder.

If the receiving program is happy with the check sum it signals the sender to proceed with the next block. Otherwise it requests a retry. If more than a pre-agreed number of retries are necessary the line is deemed too noisy and the user is advised accordingly.

Of course, the Xmodem method is just one of several ways of arriving at a check sum. It has the advantage of being very simple to implement and it needs only one additional byte for each block of data. Other techniques are more accurate but tend to be harder to program. For example, there are various versions of the cyclical redundancy check. They are virtually guaranteed to spot an error but have to be coded at the level of individual bits.

ERROR TRAPPING

Another well-established method of trapping errors is the check digit, widely used by banks, insurance companies and the like. Check digits are often appended to account numbers, customer codes, and other numbers where accuracy is of great importance. Despite their name, they are not always numeric digits — the method works just as well where letters are involved.

The simplest way of using check digits is to append a digit to the account number such that the total value of all the digits is a multiple of 10. For example, if the number is 954 the appropriate check digit would be 2, making it 9542, since 9 + 5 + 4 + 2 adds up to 20. Provided that customers are only issued with numbers which pass this test, any program which has to deal with such numbers can easily apply the appropriate checks.

In fact this simple method does not go quite far enough. For one thing, it will not trap one of the commonest mistakes made by humans when dealing with long numeric strings: transposition of characters. To get round this, the digits are usually weighted according to their position in the string. If the weights are carefully chosen, a very high proportion of errors can be detected.

An example of this is the system used by the London Stock Exchange. Each of the thousands of securities that are traded in London has a unique serial number, as shown in the Stock Exchange Daily Official List. These so-called SEDOL numbers contain six digits plus a seventh digit for checking. The digits are assigned weights of 1, 3, 1, 7, 3, 9 and 1 respectively. If you multiply each digit by its weight, then total the results, you should arrive at a number which is a multiple of 10.

The programming needed to handle this operation is perfectly straightforward, as you can see from the two subroutines shown in the listing. The first checks an incoming number according to its check digit. The second generates a check digit for a given number. You can easily amend these routines for different weights and a different modulus, and you should have no difficulty in making them work with letters and other non-numeric characters. PC

CHECK ROUTINES

```
1000    'Two subroutines for dealing with check digits in seven-digit
        numbers. The check digit is calculated such that when the digits
        are multiplied respectively by the weights 1,3,1,7,3,9,1, the
        sum is a multiple of 10
1010    'In both routines, WEIGHTS$ is a constant, pre-defined as "1317391".
        This is the only item to alter if different weights are used.
        All variables are integers unless otherwise declared.
2000    'Routine for validating check digit, contained in seven-digit number
        in CHECK.STRING$; returns CHECK.RESULT, which is true if validation
        is ok.
2010    TOTAL=0                                 'Initialise running total
2020    FOR J=1 TO 7:
           WEIGHTED.DIGIT=VAL(MID$(CHECK.STRING$,J,1))*VAL(MID$(WEIGHTS$,J,1)):
2030       TOTAL=TOTAL+WEIGHTED.DIGIT:
        NEXT J                                  'Get total of weighted values
2040    CHECK.RESULT=(TOTAL MOD 10 = 0)         'Return the result
2050    RETURN
2500    'Routine to append a check digit to the six-digit number in CHECK.STRING
2510    TOTAL=0                                 'Initialise running total
2520    FOR J=1 TO 6:
           WEIGHTED.DIGIT=VAL(MID$(CHECK.STRING$,J,1))*VAL(MID$(WEIGHTS$,J,1))
2530       TOTAL=TOTAL +WEIGHTED.DIGIT:
        NEXT J                                  'Get total of weighted value
2540    CHECK.VALUE=10-(TOTAL MOD 10)           'Get value of check digit
2550    CHECK.STRING$=CHECK.STRING$+RIGHT$(STR$(CHECK.VALUE),1)
                                                'Append this to original number
2560    RETURN
```

SYSTEM SHOP

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NCR

The newly released range of computers from NCR are ideal if you are looking for a high performance, high spec and neat looking IBM XT or AT compatible from a large and long established computer manufacturer.

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BY RAY COLES

SPEEDING UP THE NUMBER CRUNCHERS

Most standard CPU chips have a limited repertoire of arithmetic functions, but adding a specialised maths co-processor can hasten things along.

The first thing I learned at school was that mathematical computations are excruciatingly difficult and very prone to error once you get past the 2 + 2 = 4 stage. The reasons for this were not hard to find. Since there are only 10 fingers on the human arithmetic peripheral, the dynamic range and the precision available to me fell lamentably short of the maths teachers' expectations. I could see why the girls did better than me: their open-toed sandals gave them an unfair advantage. But how my fellow classmate Billy Raymond could consistently get better marks despite having lost an index finger in his dad's threshing machine was quite beyond me.

Microprocessor chips are bad at maths too. A glance at the data sheets shows that their arithmetic units will only handle integer binary numbers which fit within the confines of their data registers. The repertoire of arithmetic functions, even on the most sophisticated 16- and 32-bit devices, extends only as far as simple binary addition, subtraction, multiplication and division. For a 16-bit twos-complement binary representation, the dynamic range stretches only from -32,768 to +32,767. Relying on this alone could mean that your Chairman becomes the victim of a rounding error perpetrated by the accounts computer after this year's second salary rise.

Fortunately most micro-processors run software written by mathematical wizards like Billy Raymond. An important constituent of these programs is a maths package which, by repetitive use of the simple abilities of the microprocessor arithmetic unit, manages to perform mathematical miracles to order.

MULTI-PRECISION

A simple way for the system programmer to increase dynamic range and precision is to split the data into several separate words. Each word can then be processed in succession, and the results linked together to give the answer. This is called multi-precision, and it works well if the dynamic range of input data is limited so that overflow is not likely.

But what about fractions? If the dynamic range available has to be split into a fixed-length integer part and a fixed-length fractional part — the so-called "fixed-point" approach — then even more operations are necessary to achieve a result.

In many application programs it is necessary to handle both very small numbers and very large numbers simultaneously — your salary and the Chairman's, for example. To establish a fixed-point format to handle the computation without risk of overflow or underflow would require a long string of simple microprocessor operations and a lot of data shuffling.

TWO PARTS

To overcome this limitation you can use the so-called "floating-point" format, in which the number to be represented is stored as two separate parts: a fraction and an exponent. In this case the dynamic range and the precision of the calculation part company. The range is determined by the number of bits used for the exponent, and the precision by the number of bits used for the fraction.

Taking simple examples, and using decimal representation for the benefit of human readers, the number

123.45

could be represented as

.12345 (fraction)
$\times 10^3$ (exponent)

and

.00012

could be represented as

.12000 (fraction)
$\times 10^{-3}$ (exponent)

A floating-point arithmetic package could multiply these two numbers by multiplying the two fractional parts and then adding the exponents to give:

.00148 (fraction)
$\times 10^0$ (exponent)
=0.00148

In this example, the numbers input from the keyboard had to be converted to floating-point format, a single-precision multiplication and addition was carried out, and the result was converted back to fixed-point notation. It is hardly worth the effort for such a simple sum, but in many practical computations — especially those required to process engineering or scientific data — tremendous savings can be made in computation time. As a bonus the possibility of overflow and underflow errors is practically eliminated by use of the floating-point method.

There are many possible formats for the representation of floating-point numbers. IBM and DEC have their own special formats, but an increasingly popular standard is the IEEE P-754 representation. A 32-bit floating-point number in IEEE format — that is one in which both the fraction and the exponent fit within the 32 bits — has a dynamic range equivalent to that of a 276-bit twos-complement integer; of course the precision is very much less for most numbers.

A modern microcomputer maths software package will include integer and floating-point arithmetic routines, together with format-conversion routines and a range of trigonometric and transcendental functions. The ROM-based Basic interpreter available on most machines will include such a package, and the facilities it makes available can be checked out in the Basic manual.

Unfortunately, the performance achieved by a software maths package is not very spectacular. A few hundred floating-point operations per second is about the best that can be achieved even on a 16-bit machine like the IBM PC. This does not pose a problem if user programs are not computationally orientated. But where the complex processing of large numerical arrays is required — in the modelling of aerodynamic structures, for example — then simple programs can take hours or even days to run.

Fortunately a solution is available in the form of the floating-point co-processor chip (FPC). It does in hardware what the maths package does in software, but with a tenfold to twentyfold increase in speed.

The first FPC to be widely used was the Intel 8087, which is intended to work with the Intel 8086 microprocessor. It is designed to be closely coupled to its parent processor, to the extent that a small daughter board carrying both an 8086 and an 8087 can be plugged into the vacant 8086 socket on a computer's main board. This arrangement provides an immediate increase in arithmetic processing speed, provided that the software you are running is sufficiently smart to recognise the presence of the FPC and make use of it.

INTEL FPC

Intel has added to its FPC range with the improved 80287, designed for use with the virtual-memory 80286 microprocessor, as well as with its other 16-bit cousins such as the 8086 and the 80186. The 80387 will be available soon to mate with Intel's 32-bit processor, the 80386.

Motorola has the MC-68881 FPC available for its 68020 virtual-memory 16-bit processor. This co-processor has the advantage that programs can be written which will automatically use the software maths package if the 68881 is not resident but will switch to make use of the FPC as soon as it is plugged in.

Other FPC devices available include the National 32081 for use with the 32000 series of processors and the NEC uPD-72191 which operate with the 16-bit Intel chips as well as NEC's own V series of microprocessors.

BUILT-IN FUNCTIONS

All current FPC devices reside on the system buses but require the microprocessor to decode instructions and to carry out data transfers. Inside the FPCs there is an array of data registers up to 80 bits long and a hardware processing unit to carry out the maths functions which include format conversion, arithmetic, square root, log, exponential and trigonometric operations, and constants such as as pi, *e*, and zero.

Before you rush to add one of these beauties to your own PC, a few words of warning might be appropriate. First, remember that you can only take advantage of an FPC if your software supports its presence. Secondly, if your programs are written in an interpreted language such as Basic then the time taken to interpret the source text might actually be more of a limiting factor than the basic maths software you currently use. Finally, if your programs are not maths intensive, the FPC will not make much difference. But if you want to run compiled or assembly-language number-crunching software which simulates the world and processes large numerical arrays, then the FPC is certainly for you. PC

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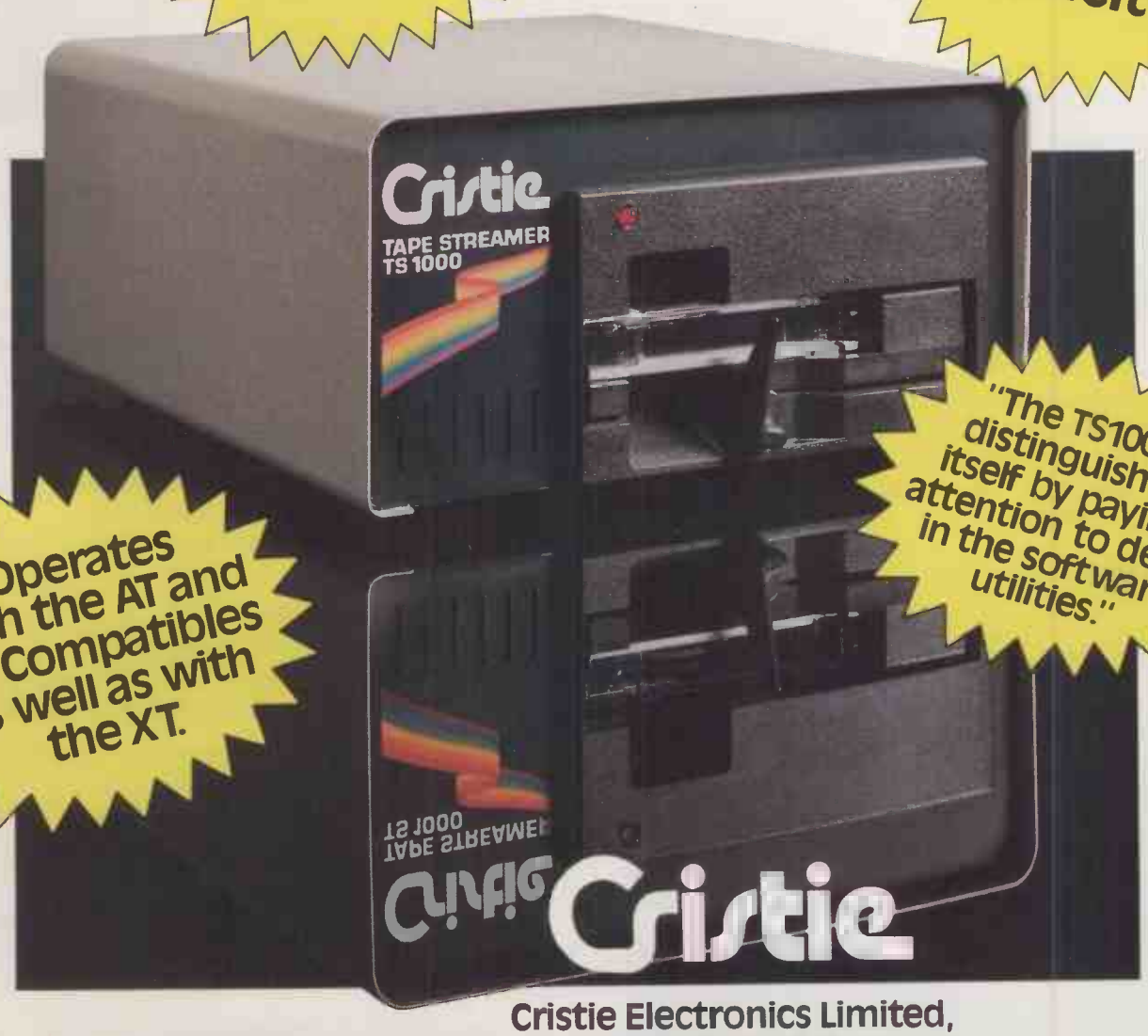

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When you buy one of the new Atari ST computers from Silica Shop, you will receive a large and varied software package free of charge. This package covers several applications and comprises a total of nine titles. All ST's now have TOS/GEM on ROM, and the total list of free software is as follows:

1) GEM - *DR Desktop environment with WIMP (in ROM)*
2) TOS - *Tramiel Operating System (in ROM)*
3) 1st WORD - *Word Processor by GST using the GEM environment and multiple windows*
4) BASIC - *Personal Basic by DR (with manual)*
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6) DOODLE - *Simple paint/doodle drawing package (works on mono or colour systems)*
7) MEGAROIDS - *Asteroids type game by Megamax*
8) NEOCHROME - *A powerful colour paint and graphics package (only useable with colour systems)*
9) CP/M EMULATOR - *Allows the use of DR's Z80 C/PM software to run on any ST system*

3rd PARTY SUPPORT

The power and potential of the ST range of computers is causing a flood of new software titles, peripherals and accessories from third party manufacturers. Titles range from word processing to spreadsheet programs, from graphics and games to database management - all with those easy drop-down menus and windows. With the list of companies producing ST software including dozens of top names, you can expect some first class titles for the new ST range. The following includes a selection of the third party manufacturers who have developed, or are working on, products for the ST range:

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520ST-M

NEW 512K 520ST-M KEYBOARD: The new 520ST-M keyboard costs only £346.96 (+VAT=£399) and is yet another price breakthrough for Atari Corporation. The keyboard now includes both an RF modulator and cable, allowing you to connect it to an ordinary domestic television set. In addition, the keyboard is supplied with 512K RAM, a mouse and a free set of 3½" disks containing applications software. The TOS operating system and the GEM graphics package are now supplied on 192K ROM chips which are already installed in the keyboard. This means that the operating system will automatically boot in when you switch the power on. In addition to the keyboard, you will also need to purchase either a ½Mbyte disk drive (RRP £130+VAT) or a 1Mbyte disk drive (RRP £174+VAT). Either disk drive will provide you with fast information retrieval and a vast amount of storage space. If you prefer not to use your own TV set, you may connect your ST to a monitor. You may purchase the Atari SM124 monochrome monitor (RRP £130+VAT), or one of Atari's two Thomson colour monitors. Alternatively, you may choose one of the many third party colour monitors which are available.

NEW 1024K 520ST-M+ KEYBOARD: In addition to the standard 520ST-M, we have a new keyboard which we are calling the Atari 520ST-M+. The M+ is a 520ST-M keyboard which has been enhanced by a third party RAM upgrade to 1 megabyte of memory. The 520ST-M+ is available from Silica at a retail price of only £433.91 (+VAT=£499). This product will provide you with an alternative to the 1040ST-F, but at a lower price. Additionally, it features the advantage of the 520ST-M's built in modulator.

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1040ST-F

For the businessman and the more serious home user, Atari have introduced the 1040ST-F, a low cost powerhouse which can be introduced to a business environment as a stand-alone system, or can support a mainframe computer as a terminal. The new one megabyte 1040ST-F enhances Atari's 'value for money' reputation in the marketplace as it is the first personal computer available with one megabyte of memory for less than £800. You can purchase the 1040ST-F as a monochrome or colour system. The price of the monochrome system is £799 (+VAT = £918.85), with the colour system at only £999 (+VAT = £1148.85). The new 1040ST-F not only features twice as much memory as the 520ST-M, but also includes a one megabyte double sided disk drive and mains transformer, both built into the console to give a compact and stylish unit with only one mains lead. The 1040ST-F is also supplied with a free software package. Unlike the 520ST-M, the 1040ST-F was manufactured solely with business use in mind and as such is supplied with a monitor. It does not include the RF modulator or lead. We now have stock of the 1040ST-F at all four branches of Silica Shop. Call into your nearest branch for a demonstration.

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THE ATARI EXPLOSION!

If you read the specialist computer press, you will have noticed that there is one company which is getting a large slice of editorial space at the moment, that company is Atari Corporation. Atari have been making the news since the launch of their new 16/32 bit range of ST computers. Led by the powerful figure of Jack Tramiel and under the banner 'Power Without The Price', Atari are manufacturing new computers at unheard of prices, with the power to challenge firmly established market leaders. With the introduction of IBM compatibility, a CP/M emulator, a powerful networking system and a communications package for their new low cost powerhouses, it doesn't look as if it will be long before there is an explosion of the magnitude which will see Atari placed firmly besides such names as IBM and Olivetti in the personal computer marketplace. Read on for more details of what Atari are doing, and how they are putting their 'Power Without The Price' computers beyond the reach of the competition.

FREE CP/M EMULATOR

This newly annouced CP/M Emulation Package, will enable software written under Digital Research's Z80 CP/M operating system to be run on the ST family of computers. There are several thousand applications written for CP/M in the UK alone, and several of the major CP/M software development houses may convert their programs to 3½" disk format for the ST range. The CP/M emulation package is supplied FREE OF CHARGE by Silica Shop with all ST computers.

IBM COMPATIBILITY

To make the ST available to those businesses who currently run IBM systems and are looking for a low cost expansion method, Atari have announced a co-processing unit for ST computers. This processor will open the ST range to all IBM or IBM compatible software applications. The unit, which attaches to the ST computers via the DMA (Direct Memory Access) port, contains an Intel 8088 processor with 512K of RAM and will accept a 5¼" disk drive. In it's ST mode, the unit will also act as a second disk drive, offering the user an additional 500K of memory. The IBM co-processing unit should be available in late Summer 1986. If you would like to be informed when it is released, please complete and return the coupon below. We will send you further details as soon as we have them.

20Mbyte HARD DISK £739

The new Atari hard disk for the ST range has just been released. All ST computers already have a hard disk interface built into them so there is no external interface required. The memory size of the disk is a massive 20 megabytes (unformatted) with a data transfer rate of 1.33 Mbytes per second. At a price of £739 (+VAT=£849), the 5¼" hard disk offers massive storage with fast access at a very reasonable price.

NEW ST SOFTWARE PACKAGES

There are now hundreds of software packages which have been announced for the Atari ST range. Titles available now include DB Man, a DBase 3 clone as well as H & D Base, a DBase 2 clone. 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 Lotus 1-2-3 clone (see paragraph below).

VIP PROFESSIONAL - LOTUS 1-2-3™ CLONE

This is probably the most impressive program to have been released so far for the ST range. VIP Professional is an extremely easy to use, integrated spreadsheet, database and graphics program which is identical both in features and commands to Lotus 1-2-3™. The same spreadsheet analysis, information management and extraordinary business graphics are all combined in one easy to learn, affordable package. What's more, VIP Professional not only has all the features of 1-2-3™, you can also type the same commands to do the same things. Probably the most surprising feature of VIP Professional is not its total compatibility with Lotus 1-2-3™, nor its ease of use, but its price. Lotus 1-2-3™ for the IBM PC/AT costs £395 (+VAT=£454.25), whereas VIP Professional for the ST is a mere £169 (+VAT=£194.35). That's less than half the price! If you would like further details, of VIP Professional, please return the coupon below.

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The ST range of computers already has a large number of software programmes available, including word processors, spreadsheets and databases, as well as a variety of programming languages and specialist business packages.

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UPGRADING MEMORY

Q I use an IBM PC/XT which has 256K RAM on the motherboard. I would like to expand the memory up to 640K, but cannot easily do this in the usual way by adding an extra memory board because all the expansion slots are already in use. I have heard that it is possible to modify the motherboard to take 640K of memory. Do you know anything about how to do this, and does it really work?

D HODGKIN

A You need some technical ability to expand memory on the motherboard as the modification involves replacing two banks of nine memory chips. You must remove the existing 64K × 1 chips in banks 0 and 1 and replace them by 256K × 1 chips. In addition you must fit a decoder/multiplexer chip number 74LS158 into an empty socket, and you must solder a jumper link. The IBM PC/XT technical manual shows the positions of the empty 74LS158 socket and the jumper. Since we have not got an XT we have not tried the modification ourselves, but it seems an incredibly cheap and useful one. Remember that it will invalidate any warranty you have with IBM.

If you are uncertain where to get the parts, or are not quite sure what to do, there are several kits you could use. One is available from Henhouse Electronics of 12061 SW 117 Court, Suite 121, Miami, Florida 33186. It involves no soldering and costs $49.95, plus $64.95 for the 18 new 256K chips. The price of the kit is reduced to $39.95 if you return the old 64K chips you remove. Both this modification and the previous one are for the IBM PC/XT and will not work on a plain IBM PC.

There are kits available in the U.K. for the 256K IBM PC and PC/XT, and for the Compaq Portable. These kits cost £49, £39 and £29 respectively from Dave Watson at Carrera Computing, 12 Lyons Avenue, Hetton-le-Hole, Tyne and Wear DH5 0HS. Telephone: (0783) 267816. For the XT and Compaq conversions you simply plug components into sockets. This is very easy, and can be done by beginners. The PC conversion involves soldering 11 wires to IC pins, and so is not a job for the uninitiated. The new memory chips must be bought separately, and are fitted to banks 2 and 3 on the motherboard.

Members of the IBM-PC Users Group can get a 20 percent discount on these kits, so it could be worth joining. For membership details write to PO Box 830, London SE1 2BQ.

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Q My IBM PC has gone wrong and is out of warranty. I bought it from a discount house, so I cannot get any help there. I have heard various scare stories that IBM will not support machines bought from grey dealers who offer a discount, or that repairs are so expensive that it might be better to buy a cheap look-alike. I would welcome any advice on what to do.

S WEATHERHEAD

A I can well understand the trauma you feel, since our own 15-month-old IBM recently suffered an untimely collapse. This subject jarrs a nerve, and it may be worth relating our experience for the benefit of others.

Our IBM had a 130W power supply, 256K RAM, a colour adaptor and two floppy discs fitted from new. Several third-party parts have been added, including a multi-function board to take the RAM up to 640K, a 10Mbyte hard disc and controller to replace one of the floppies, and an accelerator card.

One day we tried to switch on, and though the fan worked there was no noise from the hard disc, no lights indicating disc activity and no noise from the power supply. Though the monitor screen was illuminated, there were no raster lines. I concluded that the power supply had failed, and that both the 5V and 12V lines had gone.

Our first thought was to get help from the dealer who sold us the machine, but he has ceased trading. We then phoned the IBM regional office, who gave us a phone number in Greenford. On phoning Greenford we were given a list of about 10 dealers in our locality who could do repairs. We contacted one of them.

Without checking the system, the dealer fitted a new power supply — price £160. When the computer still did not work, we were told that a new motherboard costing £430 was needed. There was no guarantee that this would put matters right. The dealer said that a high transient voltage when the power supply failed had probably damaged chips on the motherboard. Since this could equally well have damaged every other board in the machine we declined their offer to fit a new motherboard.

At this stage, rather than spend £700 on a repair with no guarantee that it would be the end of the problem, we considered buying either another IBM PC or a cheap look-alike, salvaging any of the parts we could.

We also wrote to IBM in the hope of getting some help, or at least some sympathy. A forlorn hope! IBM not only disclaimed responsibility, but implied that it was our own fault for fitting third-party extras. We had expected better treatment from a blue-chip company that charges premium prices.

Eventually we settled for the cheapest possible repair, and were delighted to find a small firm called Romtech advertising repairs to IBM PCs and XTs at very reasonable fixed prices. We took our machine to Roy Misters at Romtech, Unit 2, Kingstons Industrial Estate, Eastern Road, Aldershot, Hampshire GU12 4TD. Telephone: (0252) 334881. He checked all the boards carefully, and in next to no time the machine was restored to working condition. Only the power supply needed changing and the machine was thoroughly checked.

We can recommend Romtech without reservation. It was a joy to find someone, apparently from a bygone era where people actually built computers and could mend them. I do not approve of the throw-away society at £500 for a motherboard.

Q I have prepared my thesis with WordStar version 3.30 on a Hitachi MBE 16002 computer and a Star SG-10 dot-matrix printer. While printing the thesis I found that where there was a quoted statement preceded by three dots the printer usually missed the line. I substituted a Panasonic dot-matrix printer to see if the Star printer was at fault but it made no difference. Do you think it is WordStar or the computer that is fault? Or is it some kind of DIP switch in the printer that is the culprit?

A NIXON

A Your problem is really quite straightforward, and it is unlikely that there is anything wrong with your computer or the printer. WordStar uses dot commands such as .LH16 to give double spacing, or .OP to omit page numbers, or .UJ 0 to turn micro-justification off when typing a table. The full stop or dot at the very beginning of the line tells WordStar that it is a command to be acted on, rather than some text to be printed. Similarly, you may put either .IG or two dots to leave a comment in a file which will not be printed but will show on the screen. We do this frequently to record information about a particular file.

Plainly if you use dots in your text there is the possibility that they fall at the beginning of a line. If that happens, the line will show correctly on the screen but the program will treat it as a comment and so it will not be printed. The same situation would occur if you used a complete line of dots to separate one section of work from another.

We cure this problem by inserting ^PB twice before any line on the screen that begins with a dot. The ^PB command actually turns bold on and then off again before printing the full stop, and because the line then no longer begins with a full stop it prints correctly.

Another way of avoiding the problem is to reset the left margin with the command ^OL 2 so that there is one blank at the beginning of every line. This method has the marginal disadvantage of storing unnecessary spaces — thus making the data file slightly larger — and reducing the maximum length of a line that can be displayed. 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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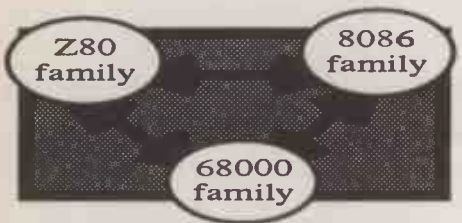

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BRAVE NEW WORLD

Carol Hammond looks at recent books that address themselves to the social implications of information technology.

BOOK REVIEWS

One of the main effects of computers has been to make it easier to hold information, whether it be about the state, a company or an individual. But judging by a recent crop of books, there is an increasing concern that this new-found ability is being abused.

On the Record: Surveillance, Computers and Privacy — The Inside Story by Duncan Campbell and Steve Connor is a frightening dossier of how the individual's privacy is threatened as the police, government and private agencies are putting ever more information on to computers. The authors exercise their skills as investigative journalists to reveal the origins and uses of various computer systems run by the British state, including the Police National Computer. They assert that the Data Protection Act will not curb the threat to civil rights that these databases pose.

The introduction of machine-readable passports, itemised telephone bills and electronic funds transfer will allow close monitoring of people's activities. Even quite innocent actions can have disastrous consequences if information about them is innacurate, obtained unfairly, or handled dishonestly or incorrectly. This can happen all too often, as the authors of this book show by cataloguing case after case of false accusations that have been the result of incorrect information gleaned from a computer.

The authors also point out the possibility that a future combination of automatic surveillance and expert systems may be used to track down target social groups. The possibility of being monitored from the cradle to the grave, with the aid of your birth registration form and your National Insurance card, certainly brings one step nearer a society where Big Brother is watching you. This 348-page book is interesting, entertaining and well worth the money, if only to encourage you not to get caught for speeding. After all, you will end up on somebody's files.

Another book concerned with material held on computers is *Out of the Inner Circle: A Hacker's Guide to Computer Security*, though in this case the author is mainly concerned with how to get the information out. It is written by Bill Landreth, who is billed as "The teenage computer wizard apprehended by the FBI . . . 19-year-old hacking maverick capable of 'cracking' the most secure computers . . . member of the 'Inner Circle' nationwide clique of top-notch hackers . . . indicted by a Federal Grand Jury . . . now . . . author of the eye-opening inside story of America's secretive hacking culture."

Unfortunately the book does not live up to the expectations of government intrigue and excitement prompted by its cover. Bill Landreth describes how he came to hack for the first time and then went on to try his hand at entering increasingly difficult systems. He was eventually invited to join the Inner Circle, a group of hackers with its own code of conduct.

Landreth gives the impression that people hack for the reasons that others climb mountains: "because they are there". It is the challenge to penetrate systems that drives hackers on, rather than a desire to get hold of the information they contain. This may not be true for all hackers of course, but Landreth's adolescent enthusiasm comes across well in the book, and his musketeering attitude seems sincere enough.

One of the interesting points Landreth makes is that people are the weakest link in the security chain. *Compulsive Technology: Computers as Culture* by Tony Solomonides and Les Levidow sees people as increasingly subject to centralised control as organisations link up to computers. It takes the form of a collection of essays that explore how computer design confronts the user as both tool and master. A recurring theme is that computers can inhibit knowledge as users are compelled to submit to the limitations and constraints imposed by the system's design. One essay asserts that AI will standardise knowledge and inference to the point that the unsayable will become the unthinkable, so that technology will eventually supplant human judgement.

Compulsive Technology looks at computers in society from an unashamedly left-wing angle. But it is certainly fun to read, and has a lively and irreverent style. One essay pronounces that the "arch-capitalist of new technology . . . Sinclair may go the way of the hula-hoop and the skateboard".

Providing you don't object too much to its trendy lefty views this book will keep you thinking.

After reading some of the gloomy forecasts of *Compulsive Technology* you may feel you deserve a pick-me-up. John Graves' *Liberating Technology: Steps Towards a Benevolent Society* adopts a more cheery attitude towards computerised technology. Graves extols the virtues of expert systems and their ability to draw on databases in, say, the medical field to help diagnose medical conditions. He welcomes computers and robots as the means of freeing humanity from toil and a routine and humdrum existence.

Graves paints a picture of a society which has finally divorced itself from the Protestant work ethic and revolves around small, friendly communities. And although his attitude can easily be dismissed as Utopian, it is at least heartening to see some optimism about the future.

If it's excitement that you want, Jay Tuck's *High-Tech Espionage* fits the bill. It catalolgues an American journalist's discoveries of how the KGB smuggles Nato's strategic secrets to Moscow. Filled with stories of murder, international smuggling and spies, *High-Tech Espionage* is well qualified to rival a John le Carré novel. Tuck explains how Western export controls have forced the Soviet Union and its allies to resort to covert methods of acquiring technology. He goes on to describe eight cases of embargo busting.

Tuck's concluding chapter once again returns to security concerns. He tells how the Pentagon employed a body of hackers to crack their security codes. Time and time again they found holes in what one official said was already a Swiss cheese.

High-Tech Espionage is another entertaining read. Like all the books included here, it makes you wonder at the far-reaching consequences of the humble microchip and its effects on politics as well as on technology. PC

BRAVE NEW WORLD

On the Record: Surveillance, Computers and Privacy — The Inside Story by Duncan Campbell and Steve Connor. Published by Michael Joseph, £7.95.
ISBN 0 7181 2576 2

Out of the Inner Circle — A Hacker's Guide to Computer Security by Bill Landreth. Published by Microsoft Press/Penguin, £8.95.
ISBN 0 14 087 139 X

Compulsive Technology: Computers as Culture edited by Tony Solomonides and Les Levidow. Published by Free Association Books, £4.95.
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Liberating Technology: Steps Towards a Benevolent Society by John Graves. Published by Peter Owen, £12.50.
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High-Tech Espionage by Jay Tuck. Published by Sidgwick and Jackson, £10.95.
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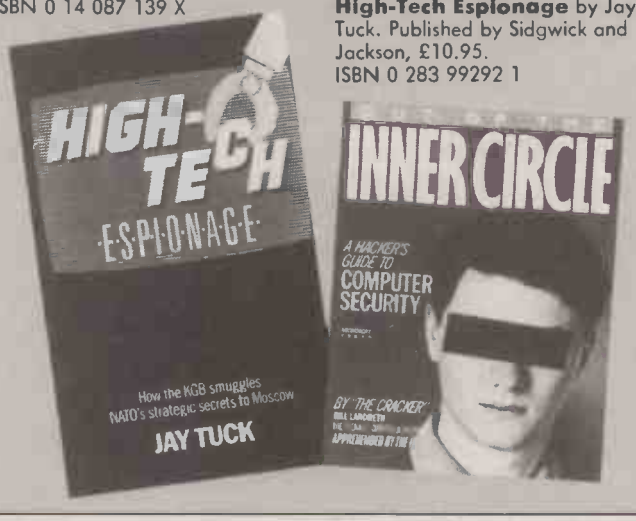

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On starting the computer users are asked for a password. They then see on their menus only those options for which they have authority. If no valid password is entered at the third attempt no more tries are allowed until the computer has been switched off and then on again.

CLAM works by locking subdirectories. Users can only access those subdirectories for which they have authority. Only the copy of CLAM that locked a subdirectory can unlock it. Access is not possible by loading an operating system from another disk.

MAIN FEATURES

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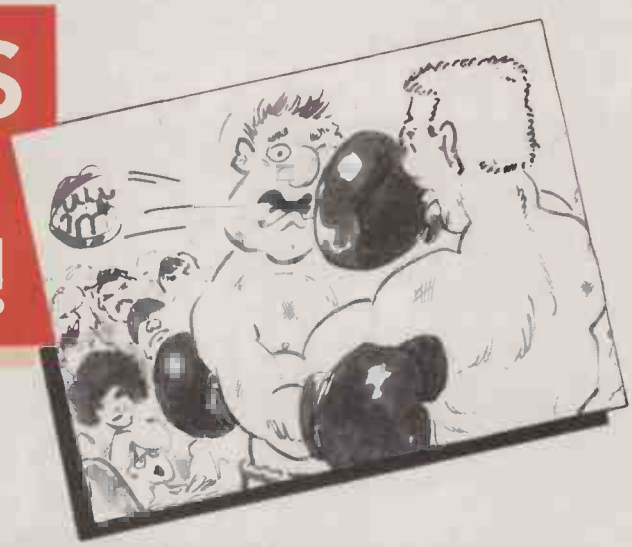

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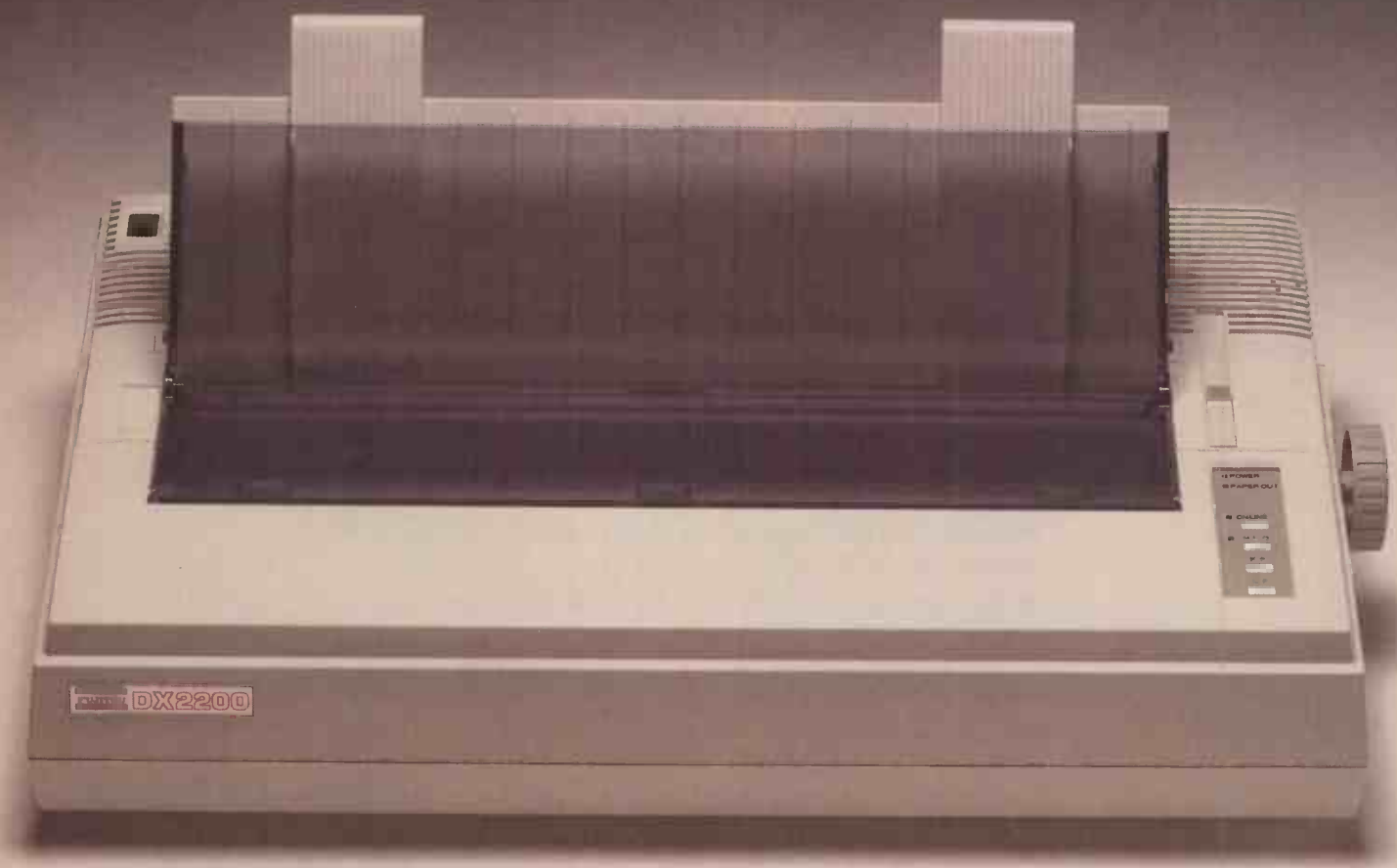

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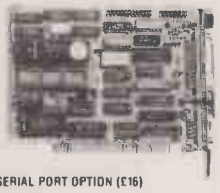

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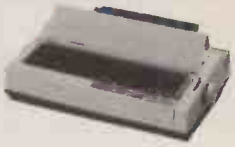

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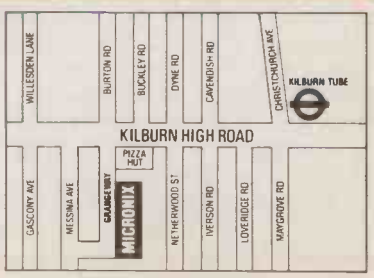

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APRICOT XEN-i
RALLYING TO THE STANDARD

By Steve Malone

At last Apricot has produced an IBM-compatible machine: a compact and powerful AT-emulator.

The launch of an IBM-compatible machine from Apricot marks a change in direction for Britain's leading business micro manufacturer. Although the Xen-i bears almost all the traditional hallmarks of an Apricot machine, it is able to join the mainstream of hardware and software add-ons available for the IBM family. It conforms to the IBM-standard architecture, and features a 20Mbyte hard disc, a 1.2Mbyte 5.25in. floppy, and is based around the 80286 processor.

The first thing that strikes you about the Xen-i is that it could hardly look less like an AT. To begin with, the dimensions of the new machine are the same as those of the earlier Xen, and the casing of our review machine was actually of the old Xen type. A few minor alterations to the casing will be made on machines being sent to paying customers. The footprint of the Xen-i is less than that of the average PC clone let alone an AT. The height of the CPU box is around half that of the PC, stepped to about two-thirds the PC's height at the rear.

Part of the reason why Apricot has managed to get away with such a small size is that the power supply remains separate from the main computer. The company has done the decent thing and provided enough cable to allow the rather large power-supply box to be tucked away out of sight. An advantage for Apricot is that versions for export are easier to produce.

DOUBLING UP

At first sight the Xen-i keyboard looks identical to that used on the earlier model. But closer examination reveals that a number of keys have been swapped around to conform more closely to the PC/AT layout. Thus the numeric keypad also doubles as a cursor-control pad, even though the previous Xen cursor controls have been retained. A Num Lock key is fitted at the top of the numeric pad alongside the repositioned Scroll Lock.

An interesting retention from previous Apricot models is the Microscreen. It was one of the company's better ideas, although the touch pads on the early machines made the thing almost unusable. The Microscreen now has six proper buttons to control it. Of course, AT software does not make use of the screen, but it would be a pity if this feature were allowed to wither through lack of support. The only Microscreen function implemented on the review machine was the calculator, which you access by pressing the Control and ÷ keys. You can program the Microscreen yourself via the Utilities sub-directory of Windows, which is bundled with the machine.

The Xen-i keyboard socket has eight pins, rather than the five used by the AT. However, an ordinary AT keyboard will work with the Xen, and third-party keyboards can also be used.

It is strange to see a 5.25in. floppy-disc drive on an Apricot machine in place of the usual 3.5in. unit. Although it obviously takes up more room than the 3.5in. drive there is still space for the power and disc LEDs on the right-hand side as well as the curiously labelled Voice LED, which has no function at present.

APRICOT XEN-i

PC VERDICT

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

☐ A classy machine which provides extra dimensions to the AT standard.

On the left-hand side of the CPU box there is a Reset button, while two expansion interfaces for the XP-i expansion box are hidden beneath plastic cowlings on the right-hand side. Mounted on the rear of the Xen-i there are the usual IBM parallel and serial ports, along with two nine-pin monochrome video sockets. One of them is reserved exclusively for use by Apricot monochrome monitors, while the other provides a monochrome output similar to that produced by a Hercules card.

Also fitted to the rear of the unit are the keyboard, the power-supply input and a d.c. power outlet for an optional external disc drive. The data interface to the external drive is also at the back of the machine.

As supplied, the Xen-i is configured to a monochrome signal, though you can reset it to use colour if you wish. The review machine was provided with an IBM-compatible Quad EGA + card which fits into one of the three expansion slots inside the machine. To use colour you have to move two jumper cables on the main board.

A look inside the Xen-i gives some idea of how Apricot has managed to squeeze the PC/AT architecture into such a small unit. In place of the profligate sprawl of chips that is usual in the IBM family, Apricot has produced a tightly engineered system that includes nine gate-array chips. The layout looks well considered, and the only sign of last-minute patching is a couple of resistors soldered across a chip on the far right-hand side of the board. The gate arrays carry out many of the functions that on the AT require an entire expansion board. Disc controllers, video/graphics display and the serial and parallel ports are all implemented in this way.

THREE SPEEDS

Naturally the Xen-i is based around the Intel 80286 processor and has an expansion slot available for the 80287 co-processor. Like most AT clones the Xen-i has variable clock speeds. Here Apricot has managed to go one better than most of the opposition, and provides a 10MHz speed as well as the more common 6MHz and 8MHz. Like the colour display, the speed is set by adjusting a jumper on the motherboard.

The main board extends over almost the entire base of the CPU box, with the floppy and hard discs mounted in a metal casing fitted above it. The 5.25in. floppy drive takes up around a quarter of the available space inside the computer. There is simply no room for a second floppy drive, hence the external disc interface.

The 20Mbyte hard disc is a much smaller and more discreet Miniscribe 3.5in. unit. Although it provided no problems during the course of the review, it did seem very noisy by today's standards. A 50Mbyte hard disc for the Xen-i is on the way, and Apricot says that this model is almost silent.

The most worrying thing about the inside of the Xen-i is the provision for expansion. Two of the three slots will take AT cards; the other is only for PC cards. All the cards are mounted horizontally on a removable back-plane behind the hard disc. You unscrew the backplane and take it out of the computer before sliding an expansion board into a free socket and replacing the backplane. The trouble is that there is only room within the computer for half-size cards.

(continued on page 51)

BASIC BENCHMARKS

Running the bundled GWBasic the Xen-i is faster than its predecessor, and thus stays well ahead of the rest of the AT-compatible opposition. The Basic Benchmark routines were published on page 102 of the January 1984 issue of *Practical Computing*. All timings are in seconds.

	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8	Av.
Apricot Xen-i	0.2	1.1	2.4	2.4	2.7	5.0	7.9	7.6	3.4
Apricot Xen	0.3	1.1	2.4	2.5	2.7	4.9	7.7	8.0	3.7
Compaq Deskpro 286	0.3	1.2	2.8	2.9	3.2	5.7	9.1	9.2	4.3
IBM PC/AT	0.5	1.9	4.6	4.7	5.2	9.1	14.6	13.5	6.8

SPECIFICATION

CPU: 80286 running at 6MHz, 8MHz or 10MHz
RAM: 1Mbyte with battery-backed system configuration; expandable to 11Mbyte with XP-i expansion box
ROM: 32K BIOS
Dimensions: 380mm. (15in.) × 370mm. (14.5in.) × 105mm. (4.2in.)
Display: 80 columns by 25 lines text and 720- by 348-pixel graphics on main board; EGA and CGA short cards available for colour options
Keyboard: QWERTY plus 10 function keys, numeric keypad, separate cursor-control pad; Microscreen with six keys
Mass storage: 1.2Mbyte 5.25in. floppy-disc drive, 20Mbyte hard disc; interface for optional external floppy drive
Interfaces: IBM-standard parallel and serial ports, Hercules-compatible monitor socket, Apricot monochrome monitor socket, nine-pin AT-compatible keyboard port, 32-way external drive and tape streamer interface, d.c. outlet
Software in price: MS-DOS 3.2, Windows, Gem, GWBasic
Expansion options: XP-i expansion box for IBM cards, PX card converter for Apricot cards, 80287 co-processor, mouse
Price: £3,499; XP-i expansion box £199; PX card converter £49
Manufacturer: Apricot Computers plc, Apricot House, 17 Westbourne Road, Edgbaston, Birmingham B15 3TR. Telephone: 021-454 9091
Available: now

Above: The floppy drive and Winchester, housed beneath a metal casing, take up half the inside of the Xen-i. A half-length EGA+ colour card is mounted horizontally above the motherboard.
Left: As well as the standard serial, parallel and monitor ports there is a connector for an external floppy disc.
Below: The keyboard attempts to reconcile Apricot and IBM standards. A colour monitor and colour circuitry are available as options.

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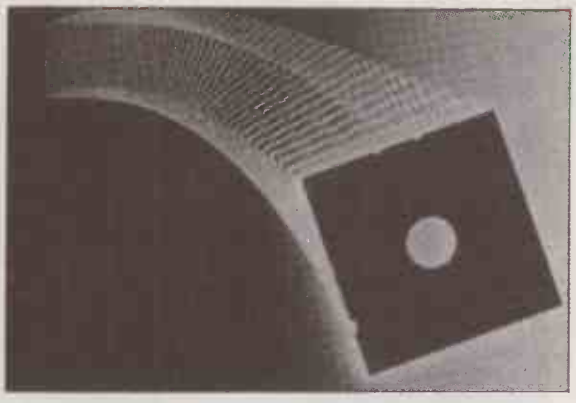

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(continued from page 49)

Admittedly most of the mainstream cards not available in a short-card format are multi-function cards which provide facilities fitted as standard on the Xen-i. But if you do find that you need to house full-length cards, or if you have already filled all three slots, you can turn to Apricot's £199 XP-i expansion box. This device allows up to three full-size PC or AT cards to be interfaced to the Xen-i.

One of the major card technologies which has yet to make its way on to the short format is memory expansion, as found on cards like the Above Board or Rampage. However, Apricot seems to have thought of this too, as the Xen-i has 1Mbyte of RAM internally, 512K being fitted to the motherboard and another 512K on a daughter board. This provides the 640K maximum allowed for under MS-DOS, plus a further 384K of extended memory. Apricot has fitted the Lotus/Intel/Microsoft (LIM) Expanded Memory Manager on to one of the gate-array chips, so the extended memory can be configured as a RAM disc by including the same device driver in the Config.Sys file used by the Above Board. Although the Xen-i cannot accommodate the 8Mbyte of expansion which the LIM standard allows, Apricot could add extra memory should it become necessary.

The all-important BIOS for the Xen-i is provided by the American firm Phoenix Software Associates. The Xen-i ran all the usual awkward programs like Sidekick and 1-2-3. It even ran the IBM PC/AT diagnostics without any difficulty. The only error occurred when the diagnostics attempted to test for the keyboard lock — which is not surprising as the Xen-i hasn't got one. The only other problem we encountered was with the Microsoft Flight Simulator, which we could not get to run even though Apricot says it should work normally.

Version 3.2 of MS-DOS is provided with the Xen-i. It is particularly ironic that Apricot has launched its first IBMulator with this release of MS-DOS, as it is the version IBM has chosen for the launch of the Convertible — which uses the 3.5in. discs that Apricot has been forced to abandon to become IBM compatible. To provide a friendly front end to DOS Windows is bundled with the Xen-i. Digital Research's Gem environment is also provided as an alternative, although no applications are supplied with the machine.

The hard disc on the review machine was more than half full with bundled software and various other files. It was therefore impossible to make a fair assessment of the machine's disc performance since the Bagshaw Disc Benchmarks run fastest when the discs are relatively empty. For the record, the Bagshaw Benchmarks were timed at a total of 89 seconds on the hard disc — pretty good considering it was so full — and 255 seconds for the floppy disc, which is just behind the Compaq 286's performance.

The emergence of the Xen-i signals the end of Apricot's independent stance in a world that has come to be dominated by the IBM standard. Viewed beside other AT-compatibles, the Xen-i is something of a hybrid. While providing software compatibility and the ability to accept IBM expansion cards, Apricot has not followed the full value-added route taken by Compaq or Olivetti. The company should have little trouble selling the machine in the U.K. and other countries where its reputation is assured, but it may experience greater difficulties in areas where it is thought of primarily as a non-compatible manufacturer. The deeply conservative corporate purchasers in America and elsewhere expect a machine that not only offers all the facilities of a PC/AT but looks like one as well.

CONCLUSIONS

■The Xen-i is a fully compatible PC/AT clone which marks the entry of Britain's major business micro manufacturer into a market it has previously spurned.

■The machine is much smaller than the average AT clone. This is achieved by some tight engineering, but also means that the power supply is separate and the expansion facilities are restricted.

■The Xen-i takes over pole position as the fastest AT emulator around. By fitting the LIM Expanded Memory Specification as standard Apricot shows that it has an eye to the future.

■This is the machine Apricot should have launched a year ago. Let's hope it is not too late for the Xen-i to become a success. PC

AMSTRAD COMMS
BAD CONNECTIONS

By Glyn Moody

Using the Amstrad PCW-8256 for comms could hold some nasty surprises for those who are used to the machine's WP functions.

One of the big attractions of the Amstrad PCW-8256 is that it is a complete system: you just plug it in and start typing. People who have become acquainted with word processing through using it may well be tempted to move on to using it for communications, and in particular electronic mail.

For anyone who is contemplating such a move, my advice is simple: Don't do it. Unlike the word-processing functions of the PCW-8256, which are easy to set up and straightforward to use once you have deciphered the manuals, progressing on to the world of communications on the machine is a nightmare.

In part these difficulties are a reflection of the immaturity of the comms area. While micros are an accepted part of the business scene, communications is still redolent of the hacker and enthusiast. And you really do have to be something of an enthusiast to cope with the U.K.'s leading electronic mail system, Telecom Gold. As well as an obscure set of prompts, Telecom Gold has an appalling editor which makes concoting messages on-line a real torture. Although there is a large amount of information on Telecom Gold, getting at it is such an effort.

Even before you start using comms software, getting the Amstrad into a fit state is not easy. One reason why the PCW-8256 costs so little is that its functionality has been pared to the bone. You get everything you need in a word processor but no more. As a result, the serial port, which is indispensable for comms, must be bought as an extra.

The Amstrad CPS-8256 provides the serial and parallel interfaces that are missing on the basic machine. It will set you back £59.95 including VAT. It plugs into the back of the PCW-8256 via the edge connector — the only means of expanding the machine — and is secured by two screws. The parallel port allows you to use printers with parallel connectors, though the Locoscript word processor bundled with the PCW-8256 will not work directly with any printer other than the one supplied.

As well as the serial interface add-on, you will also need a modem. The one used for this review was the Sage modem which comes with Chit-Chat. It is a fairly basic unit with no autodial.

MODEM SETUP

Although the Sage modem is a compact black box, even setting that up takes some effort. The lead from the serial port ends in a standard DIN plug. Unfortunately, the pins are arranged symmetrically so it is all too easy to plug it in upside down.

There is also a lead terminating in a telephone jack which plugs into the wall socket. You plug your telephone into a socket on the modem. When the modem is not in use, the telephone can be used in the normal way. The modem needs its own mains supply, so you lose the simplicity of the PCW-8256's one-plug arrangement.

Chit-Chat is an adaptation of the program reviewed in last December's *Practical Computing*. Although efforts have been made to make use of the Amstrad's idiosyncratic keyboard with its host of ancillary keys, the conversion is not consistent. For example, there are references to a non-existent Control key, which is in fact the Alt key. Chit-Chat comes on one disc with a manual which has been written for use with the Amstrad.

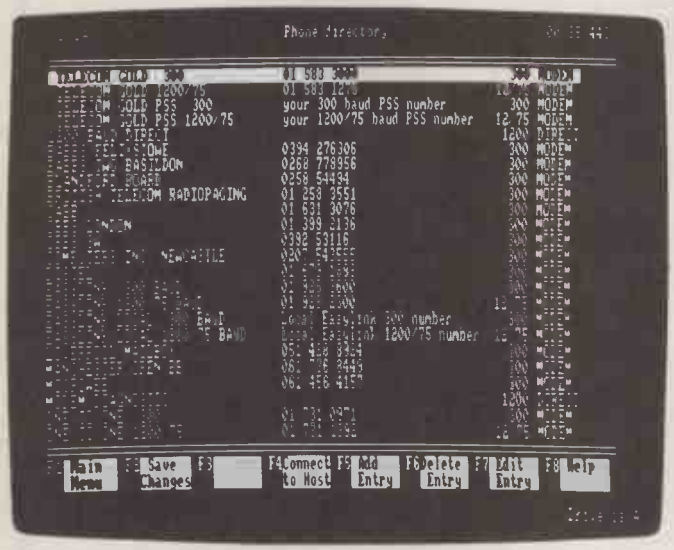
The manual advises you to make a bootable backup of the disc and tells you how to do so. This is sound advice, but if you

CHIT-CHAT

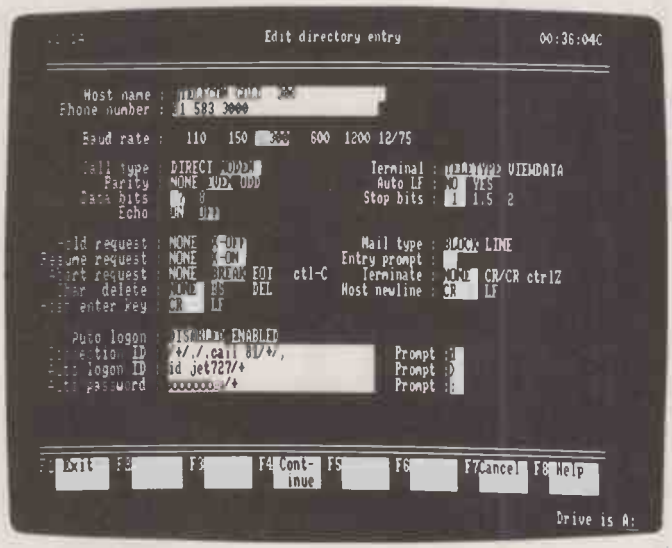
PC VERDICT

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

☐ Probably the best Amstrad package at the moment.



Chit-Chat's Phone Directory screen provides a list of phone numbers and preset baud rates for popular on-line services.



Pressing f7 from the Phone Directory brings up a complete set of parameter values, which you can edit if necessary.

have a single-drive machine it is no fun. Using CP/M's Pip command to transfer system files to a formatted disc is very confusing: it keeps referring to drive A: and drive B: even though they are the same physical drive. Transferring across the 15 files from the Chit-Chat disc requires 30 disc swaps on a single-drive machine. If you try to use the Copy command to copy whole discs at a time, the Chit-Chat disc brings up a cryptic message saying that the data is stored in an "old format"; in other words you cannot do it.

Assuming you survive all these perils, you are ready to log on. But even here there are pitfalls. The Sage modem has three push buttons at the front and one at the back. Whether they are in or out, and when you push them in, is critical. I found that the button at the back labelled Self-test must always be out. The two buttons labelled A and B at the front must either both be in or both out. Why they could not therefore have been replaced with a single button escapes me.

BAUD-RATE OPTIONS

Whether they are in or out depends on what service you wish to access. For example, if you want to use Telecom Gold they must both be out. This sets the baud rate of the modem at 300 for both transmit and receive. Most comms services use this speed for data, the main exception being Prestel and some bulletin boards. They use 1,200 baud for receive, and 75 baud for transmit.

The other button at the front is called Modem Connect. Contrary to what you might expect this is left out — and therefore disconnected — while you dial a number; it is only pushed in to connect later. The manual does explain this fairly clearly, but all in all there are so many buttons which have to be correctly set, not to mention DIN plugs which have to be the right way up, that you can soon become disenchanted with the idea of using a modem.

The program loads automatically from your bootable backup. The first time you use it you are asked to enter your name and address so that it can be entered irrevocably on the program disc. I found that it was allergic to my name: it beeped at me until I entered something longer. The same happened with the address: it seemed to need full details rather than a short form. Since I was unwilling to change my name just to use a comms program, I got round the problem by filling it up with gobbledegook. This kept it happy, but it illustrates how crass this kind of faint-hearted copy protection can be.

COMM+

PC VERDICT

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

☐ A do-it-yourself comms package for hackers only, but available in tamed versions.

Using the program is fairly straightfoward. The function keys appear as a menu of options along the bottom of the screen. The main screen allows you exit to CP/M, print out a file, create or edit a text, go on-line or set up a task. Help is normally available on f8.

Pressing f3 takes you to the list of phone numbers and baud rates. Entries can be added, deleted or edited. The Edit option takes you to the detailed directory entry. This screen contains all the gory minutiae which make comms such a nightmare for the uninitiated: things like Xon/Xoff, parity, word length, stop bits and so on. The list of services is pretty comprehensive, so with luck you will never need to descend to this level.

Using the phone directory is simple. You press f4 to connect to the host computer. If you have autodial facilities and the entry has been set up correctly, the whole process is automatic. For those without such luxuries, the instruction

DIAL 01-583 3000

appears for Telecom Gold. After you have dialled this number and received the characteristic carrier tone, you press the Modem Connect button on the modem, and replace the handset of your phone. The Chit-Chat software then takes over.

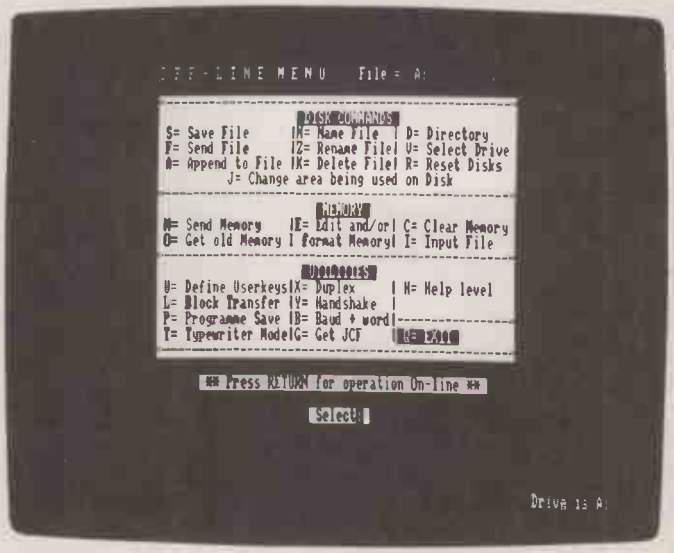
With Telecom Gold the whole process can be automated if you have fed in your ID and password. The on-screen appearance of the Telecom Gold service is standard, but there is also a record of time elapsed, which appears in the top-right hand corner, and the menu of function keys along the bottom. It is slightly confusing in that the function keys still refer to the telephone directory screen and you have to press f1 to exit to the subsequent screen.

From there you can capture text or send mail, which is useful given the appalling rate of transfer and weak editing facilities on Telecom Gold. The capture process is simple. Before you start reading some mail, you press f4, give a name to the file, then press Enter. This does not initiate the Telecom Gold function, which only responds to Return and is an instance of where it is easy to get confused by the different meanings of keys in different programs. To terminate capture you press f4 again.

SENDING MAIL

Sending mail involves a similar process. Once you are in the Send mode you press f7 to call up a pre-existing file. If the file contains the .Send command at the end, it will be sent automatically; if not, you simply enter the .Send command manually. The file can be produced either within Chit-Chat or using an external word processor. This allows you to produce pure ASCII files. The text editor provided by Chit-Chat is fairly crude; it does not have wordwrap for example.

Chit-Chat is capable of displaying full-screen Prestel graphics, along with the function-key options.



In Comm+ the main options are reached from the Off-line menu. Option G lets you compile and run a comms file.

(continued on next page)

(continued from previous page)

As well as electronic-mail and bulletin-board services, you can access viewdata systems like Prestel. The procedure for logging on is much the same, except that the push buttons on the modem must be in, not out. Chit-Chat does a good job of coping with the graphics characters used in Prestel. It also manages to use the whole of the screen, something its predecessor did not.

The other main feature of Chit-Chat is the ability to set up a range of operations to be carried out at set times, triggered by the internal clock. For example, you could set the Amstrad to access Telecom Gold when phone charges are cheapest. To do this, you set up a task file using a range of task commands. You also have to leave your micro on all the time, and an autodial modem is vital.

The manual is quite well written, though in places it shows evidence of an incomplete revision from its earlier incarnation. The program is generally better in this respect, in that you are not really aware that it is a conversion. Although it has its infelicities, Chit-Chat makes a valiant stab at taming a hostile area.

Unfortunately, the same cannot be said of Comm + from Margolis & Co. On booting up there is only the cryptic message

<RETURN> to go on-line or
<ESC> for off-line operation

This is particularly unhelpful, since there is no Esc key on the PCW-8256. Going on-line proved fruitless, while off-line operation provided an interesting menu but little else.

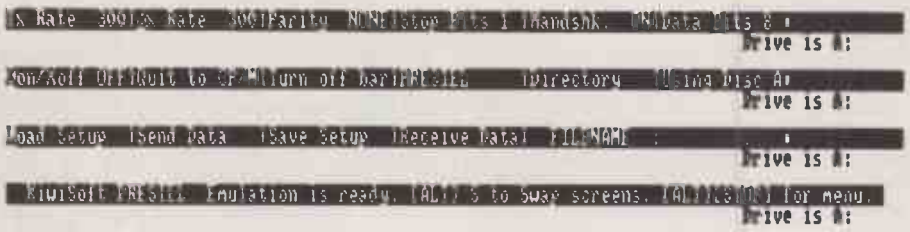
After much scrabbling through a full but poorly organised manual, I discovered that to realise the full potential of Comm + you have to write your own comms package in the Comm + language. This you do off-line, saving it with the file extension .SRC. Selecting option G on the off-line menu converts this into a file with the extension .JCF. Pressing G again causes this mini comms package to be run, and places you in on-line mode. By then, with luck, you will be connected to your chosen host. For example, the program

```
SET DELAY=5
DO 13
GET "PAD>"
IF DELAY=0 PART 0
SET DELAY=0
DO "CALL 81", 13
GET "PLEASE SIGN ON"
DO "ID ABC123 PASS", 13
```

will log you on to Telecom Gold. And it does work, but getting there proved an enormous effort. After every use of the off-line menu, the program insists on refreshing the screen. The single-letter commands on the menu are also very unhelpful.

Clearly Comm + is aimed at the real enthusiast, for whom it looks to be a powerful product. It is not suitable for the ordinary business user, nor is it really meant to be. For the business market someone else will have to do the programming and then sell a complete, working and documented system.

The final package, Datamail, comes from Newstar. The version I received looked like some kind of samizdat literature smuggled out of Moscow. Apart from the disc, there were just 12 pages of notes printed on green-lined computer paper. Newstar later sent me a more recent version of the manual which was a little fuller, though not much. The basic command menus are accessed by pressing Alt and Stop simultaneously. There are four menus, all displayed along the bottom line of the screen. They are quite difficult to read and not very informative.



The menu bars from Datamail's four screens. No other on-screen help is provided.

DATAMAIL

PC VERDICT

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

□ Has few virtues excepts its very low price.

The first menu lets you set up transmit and receive baud rates, parity, stop bits and so on. You toggle through the possibilities using the space bar. The next menu lets you return to CP/M, gives you a disc directory, or takes you to the Prestel menu bar. A final menu bar lets you load and save parameter setups, and load and send data.

But nowhere could I find anything to tell you explicitly how to send and receive electronic mail. All you are told is how to receive or transmit files separately, which is not much use for an interactive service. I also had problems with Prestel. It proved possible to receive data, but not to transmit. However, one nice feature of the Prestel emulation is the ability to display two screens side-by-side. On the whole, the main virtue of this package seems to be that it is very cheap. Perhaps later implementations will solve these problems.

It seems incredible that for a machine with such a vast user base, and in one of the fastest-growing areas of business computing, there should be no first-class comms package which addresses all the obvious problems and comes up with neat solutions. But although you may have to struggle to make comms work on the PCW-8256 at the moment there can be little doubt that this will change in due course. The Amstrad must eventually move beyond its word-processor origins to emerge as one of the cheapest and most convenient routes into the world of email and beyond.

SPECIFICATION

CHIT-CHAT

Description: communications package offering access to electronic mail, viewdata and bulletin-board services; optional modem extra
Copy protection: none
Price: £99.99 including VAT; £239.99 with 300/300, 1,200/75 baud modem
Publisher: Sagesoft plc, Regent Centre, Gosforth, Newcastle-upon-Tyne NE3 3DS. Telephone: 091-284 7077
Available: now

COMM+

Description: communications program generator
Copy protection: none
Price: £75
Publisher: Margolis & Co, 105 Foundling Court, Brunswick Centre, Marchmont Street, London WC1N 1AN. Telephone: 01-278 3032
Available: now

DATAMAIL

Description: simple communications program
Copy protection: none
Price: £39.95 including VAT
Publisher: Newstar, 200 North Service Road, Brentwood, Essex CM14 4SG. Telephone: (0277) 220573
Available: now

AMSTRAD CPS-8256

Description: serial and parallel interface for the PCW-8256 and PCW-8512
Price: £59.95 including VAT
Supplier: Amstrad Consumer Electronics plc, Brentwood House, 169 King's Road, Brentwood, Essex CM14 4EF. Telephone: (0277) 228888
Available: now

CONCLUSIONS

■With the setups now available, communications on the Amstrad is a nightmare. Unless you are really keen or desperate, it is best to wait until better products come through.

■Of the packages reviewed, Chit-Chat emerges as the clear favourite. It is relatively easy to use, and has the advantage that Sage will supply a modem with the package. Its main failing is that the manual shows signs of Chit-Chat's earlier heritage as an MS-DOS package, which could prove confusing.

■Comm+ is not a comms package in the same sense as Chit-Chat. In effect you have to write your own using the built-in language. This gives you great control, but again it is inappropriate for the ordinary user.

■Datamail is very limited and may even be unfinished, judging by the problems which arose. It is also very cheap. PC

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VIDEOLOGIC MIC-2000 INTERACTIVE VIDEO

By Simon Beesley

This add-on card includes software which allows you to add live video to computer-generated text and graphics on an IBM-compatible.

Both video discs and CD-ROMs are optical discs which use laser light to retrieve data, and both work in more or less the same way. But whereas one side of a 12in. video disc holds 54,000 frames, or 36 minutes of video with sound, the capacity of a CD-ROM disc is numbered in hundreds of frames.

The difference is that the video disc reproduces an analogue signal, while CD-ROMs store data in digital form. Converting a single PAL video picture into digital data requires around 2Mbyte, enough to store at least three medium-length novels. From this point of view, a picture is worth considerably more than a thousand words.

Given these figures, it is surprising that video discs have not found greater application as mass-storage devices. There are interactive video systems that allow computers to control video-disc players and superimpose computer graphics and text on video. But, by and large, interactive video has come to refer to the use of video discs for training, educational or point-of-sale applications. For this reason, most interactive-video systems are sold as a package comprising a video-disc player, computer, monitor and an authoring language.

DUAL-INPUT MONITOR

But Videologic's interactive-video system, MIC-2000, is rather different, as it is embodied in a single controller card which plugs into one of the expansion slots on an IBM PC, PC/AT or compatible. The MIC-2000 works with existing Enhanced Graphics Adaptor (EGA) cards, but you will need to replace colour-graphics adaptors with Videologic's equivalent card. You also need a high-resolution colour monitor capable of handling composite video and analogue RGB signals. With these in place, MIC and its accompanying software will allow you to use a PC to mix computer graphics and text with video from any video-disc player equipped with an RS-232 port.

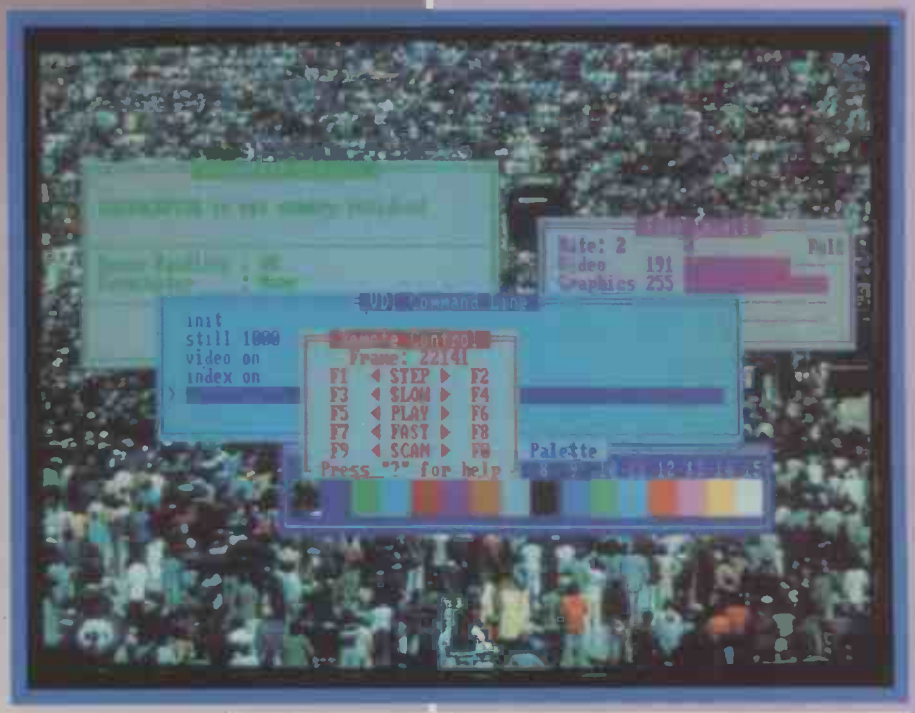
The way in which MIC combines graphics and text is somewhat unusual. Strictly speaking, the system does not superimpose computer graphics on video. Instead it sends both a composite-video signal from the video disc and an RGB signal from the computer to the monitor, switching between them at a rate of 25MHz. The system cuts a hole or template in the video picture to accommodate the computer-generated text or graphics. This technique, which is known as hard keying, has the advantage that the template can be made slightly larger than necessary in order to give computer output a very fine black outline. On the Videologic system this makes text and graphics look crisper than they normally do on an IBM display.

Another advantage is that the MIC card can read both PAL and NTSC video-disc players. The PAL TV standard used in Europe gives a picture with 625 lines at 25Hz, whereas the NTSC format used in America and Japan is 525 lines at 30Hz. The IBM PC outputs text and graphics in the NTSC format. If the MIC board detects a PAL signal coming from the player it converts the computer's output to match.

But it is MIC's software that really distinguishes it from its rivals. Unlike most interactive systems, the controlling program works through the computer's operating system rather than bypassing it. Under MS-DOS, MIC treats the video disc as another peripheral device. The software to control the player provides a number of commands which can be sent in the same way as commands to a printer or a disc drive. This makes it easy to control the video disc from a programming language such as Basic. You

SPECIFICATION

Description: interactive-video control system
Hardware required: IBM PC, PC/AT or compatible, any video-disc player with an RS-232 port, and a high-resolution RGB and video monitor
Price: £950
Manufacturer: Videologic Ltd, 12 Golden Square, London W1R 3AF. Telephone: 01-439 3343
Available: now



The memory-resident toolbox utilities (above and right) permit control over MIC's commands, fade control, the colour palette and the background colour. They are displayed here against a video background.

do not need to run an authoring language tailored to a specific video-disc interface.

Some of the MIC commands duplicate the facilities available using the manual controls on the video-disc player. Thus you can play through any sequence of frames on the disc, wind forward or reverse, branch to a new sequence or bring up any single frame. Other commands set the way video will combine with computer output and provide a limited editing facility.

KEY COLOURS

The system displays the video image by making one of the computer-generated colours transparent. By default black is the transparent colour, so images from the video appears as the background to computer generated text or graphics. With the Transparency command you can reassign the key colour so that video material peeps through a given patch or patches on the screen.

A limited but useful editing facility is provided by the Fade command. Depending on how far the disc head has to move across the disc, video-disc players can take up to five seconds to access a new frame or sequence. By fading out the current image while the player is accessing a new frame, the Fade command creates an effect of seamless continuity. With it you can program a fast or slow fade to one of 255 levels of intensity; you have control over the brightness of the video, the computer text and graphics, and the level of the sound tracks.

Videologic also supplies two memory-resident programs, called Toolbox and Interceptor. Toolbox is a Sidekick-like utility that pops up to offer such features as a command-line interface for the MIC operating commands, a fade control panel, and a colour palette which can be used to make different colours transparent. Interceptor lets you execute MIC commands from within an application program, so if you really wanted to you could have live video and sound in the background while you run WordStar or Lotus 1-2-3.

Even without Interceptor, the MIC operating software offers a high degree of compatibility with much of the existing base of MS-DOS software. For example, it will run concurrently with Windows while Windows itself is running other programs.

To give an idea of possible MIC applications Videologic has linked the system up with Microsoft's Rbase database. The database shows a list of British birds. After you select a species you are shown a still or moving picture of the bird in question, accompanied by bird song or a commentary from David Attenborough. But impressive though it is, the Rbase demonstration is no more than a gesture towards future possibilities.

TAILOR-MADE DISCS

The bulk of Videologic's sales are to large companies using interactive video for training purposes. As far as small companies or individual users are concerned, the major obstacle preventing video discs being used for database applications is the high cost of recording video on disc. There are very few discs available off the shelf, ready-made for interactive video, and most of them are for training purposes. So if you want a video disc for use as a database of still pictures you will probably have to produce your own. Philips charges £3,000 to press a master disc from 1in. broadcast-standard tape, and recording the tape could raise the total cost by the same amount again.

Perhaps the most promising development for analogue video databases is the sort of hybrid optical-disc unit designed by Philips for the BBC's Domesday Project. The Philips VP-415 takes 12in. video discs and combines them with CD-ROM technology. By using one of the audio tracks for digital storage it provides 324Mbyte per side. The combination offers the best potential yet for mass storage: a disc which will give you 324Mbyte together with 54,000 stills or 36 minutes of video and sound.

CONCLUSIONS

- The MIC-2000 controller card and its accompanying software offer a cheap and unusually flexible basis for interactive video.
- MIC's major asset is its software, which is highly compatible with IBM PC systems and includes a useful editing facility.
- The MIC system offers scope for using video in novel ways, in particular to support an image database. It is also well suited to mainstream interactive-video applications such as education, training and point-of-sale.
- In principle MIC brings video within the reach of small companies and even individual users, but for the time being the high cost of producing a video disc tailored to a specific application makes it unlikely that many people will take advantage of it. PC

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Q&A
PLAIN-SPEAKING DATABASE

By Mike Lewis

With this package you use natural English sentences to set up and interrogate your database.

One of the most difficult things about using a database is the peculiar language which is so often needed to carry out a search or a query. Imagine, for example, that you run an agency for holiday homes and you want to find a property that meets a particular customer's requirements. You turn to your database, and after much thought and several failed attempts you type something along the lines of:

```
LIST ALL FOR TYPE="COTTAGE" .AND.
    NO:SLEEPS>=6 .AND. GARDEN="Y"
    .AND. ("LAKE"$AMENITY .OR.
    "MOUNTAINS"$AMENITY)
```

With a package like dBase II this syntax would work, but it is hardly intuitive.

How much nicer it would be if you could type instead:

I want a holiday cottage which sleeps 6 or more, has a large garden, and is either by a lake or in the mountains.

With Symantec's Q&A you could type this sentence and get the correct answer — assuming, of course, that the relevant information is already in the database. You could then follow it up by typing

Who owns it?

or

What is his phone number?

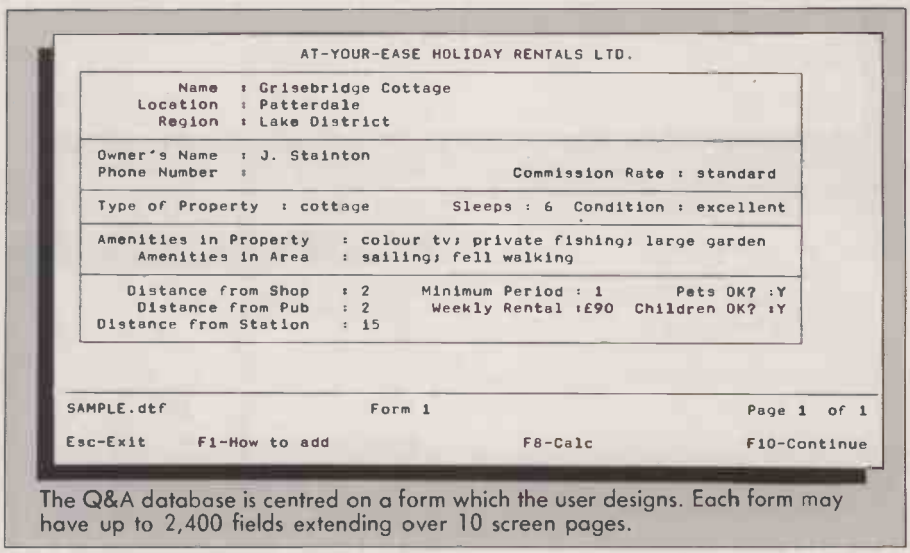
or

What is its weekly rental?

Q&A is the most successful attempt I have seen to bolt a natural-language interface on to a database. You can use ordinary English not just for queries and searches, but also for creating new records, doing global updates and requesting reports. Symantec calls this part of the package the Intelligent Assistant.

Even without the Intelligent Assistant, Q&A would still be a very serviceable filing system. It is not a true relational database along the lines of dBase II, as you can only have one file in use at a time. It is really intended for applications involving a large volume of data without too rigid a structure and with lots of ad hoc enquiries.

Like many similar products, Q&A is orientated towards forms. To design the database you design a form using a conventional screen editor. It took me less than half an hour to create a form for the fictitious database of holiday homes which I invented for this review. This included defining the field types and some range checks, and also attaching so-called programming statements to some of the fields.



The Q&A database is centred on a form which the user designs. Each form may have up to 2,400 fields extending over 10 screen pages.

These programming statements will appeal to the power user who wants to make form filling less of a chore. They have lots of uses: performing calculations, setting default values, rerouteing the cursor according to the data entered and quite a lot more. I used one to establish a look-up table for my region field. This would allow an operator to type EA for East Anglia, for example.

There is a remarkable amount of freedom in what goes into a form, with virtually no restrictions on field names or numbers of fields. In theory, a single record can contain half a megabyte of data. You can also draw boxes in forms, select alternative colours, and even set up your own help screens.

But the really impressive part of Q&A is the Intelligent Assistant. As delivered, it understands around 400 common words and phrases, though they do not allow you to do very much by themselves. Before you can use the Assistant for the first time you have to teach it the terminology of your particular application.

As a first step, the Assistant goes through the database, extracting field values and presumably making them into some sort of index. It needs to know the actual contents of fields, not just field names, so that if you later ask:

Show me the houses and flats on the South Coast

it will know that houses and flats are types of property and that South Coast is a region.

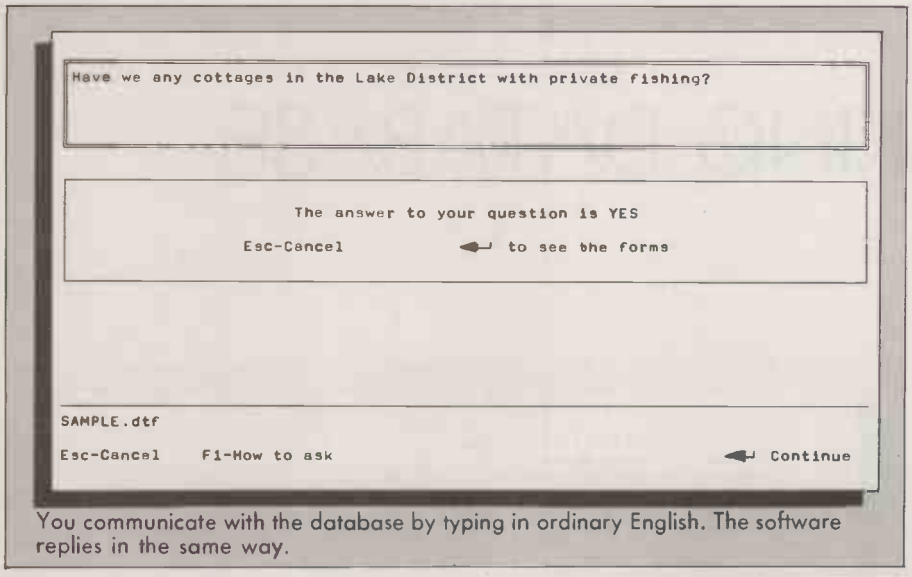
Once you have gone through the teaching process, any new forms will have to update these indexes along with the main file. This can be quite time consuming, so Symantec advises you to enter the bulk of your data before using the Assistant for the first time.

Next you may teach the Assistant some of the vocabulary that you will use when asking it questions. This process is organised into eight lessons and is very easy to follow. You can also do the teaching as you go along if you prefer, though putting some initial

(continued on next page)

SPECIFICATION

Description: database package with integrated word processor, report generator and natural-language interface
Hardware required: IBM PC, PC/AT or compatible with 512K RAM; hard disc is advisable
Copy protection: none
Price: £250
Publisher: Symantec Corporation of Cupertino, California
U.K. distributor: Softsel, Softsel House, Syon Gate Way, Great West Road, Brentford, Middlesex TW8 9DD. Telephone: 01-568 8866
Available: now



You communicate with the database by typing in ordinary English. The software replies in the same way.

(continued from previous page)

effort into the teaching process makes it easier to ask questions in a natural way.

The sort of thing that the Assistant wants to know includes alternative ways of describing the main subject of the database and the various types of data in it. For example, I told it that my sample file was basically about properties, but that I might also refer to properties as places or accommodation. Up to 11 synonyms can be nominated.

Similarly, I told it that rent per week, cost and weekly terms all mean the same as weekly rental, and that a TV is a television. Other fields can be tagged as locations or people, and you can link adjectives and verbs to specific items of data.

After an initial training session lasting about 20 minutes I entered my first query. The mechanics of doing this are simple. You type your question or command in a box at the top of the screen. Q&A then spends a little time thinking about it, during which it highlights the word that it is currently working on. Most of my queries were analysed in five to 10 seconds with the program running on an Olivetti M-24. The software then displays its interpretation of what you want, for you to either confirm or reject.

I started by typing:

Which is the most isolated cottage in Scotland?

After some five seconds the Assistant replied:

Shall I do the following? Create a report showing Name and Distance from Shop from the forms on which the Type of Property is Cottage and the Region is Scotland and the Distance from Shop is greatest?

This is exactly what I wanted, so I pressed Y to confirm. After another short delay, up came the correct answer. I had, of course, already taught the Assistant that the word "isolated" means a high value in the Distance from Shop field.

With the name of the cottage on the screen, I was then able to follow up with:

Who owns it?

The Assistant takes pronouns like "it" to refer to the last record that it found, and it knew that the verb "to own" was linked to my Owner field, so this question also produced the correct reply.

There are dozens of other ways of asking questions. The overriding aim of Q&A is to let you enter queries and commands without any thought to the wording, just by using natural English. Most of the time it is successful. You can ask Yes/No questions like:

Is there a property in Keswick called Fell View?

and ones involving counting or arithmetic, such as:

What is the average rental for places in Wales?

In the vast majority of cases the Intelligent Assistant will grasp exactly what you want and will produce a faultless response.

When the program does have difficulties, it will ask you to clarify your request, learning as it does so. For example, when I typed:

I want a cottage that has a garden and is not in the back of beyond.

the Assistant replied:

I don't know the word highlighted above. What would you like me to do?

The word in question was "back", and the options suggested were to alter the query, to teach the Assistant or to ignore the word. I decided to type:

Define back of beyond as distance from shops more than 2 miles, distance from pub more than 5 miles, and distance from station more than 5 miles.

This was accepted without further complaint, as I had already told the Assistant that "miles" was a unit of measurement for distances. It also knows about plurals: shops and shop are treated identically, as are properties and property.

When I went back to the query, the cottages selected turned out to be less than two miles from shops, which was what I wanted. But they were all more than five miles from pubs or stations, which was the opposite of what I had intended. It seemed that the software only applied the "not" to the first part of the condition. Putting "back of beyond" in brackets made no difference.

In several hours of experimenting with the Intelligent Assistant, this was the only time that it came up with a wrong answer. On the rare occasions when it does let you down you can always go back to using old-fashioned program-like syntax. Q&A's main filing module includes a very respectable report generator and a powerful retrieval option that uses traditional things like < and > symbols, and wild-card characters. Both are available whether or not you decide to use the Intelligent Assistant.

Q&A includes a word-processing module, which is adequate if unexciting. Its strongest point is a mail-merge feature linked with fields in the database. The Q&A utilities module mainly covers import and export. You can import from PFS, Filing Assistant, 1-2-3, DIF and ASCII, and also from dBaseII and III files that have first been converted to ASCII. You can export to DIF and ASCII formats. This module also covers various file-handling options and printer installation. Lastly, there is a quick macro facility, which can be called up from anywhere in the package.

On the negative side, the biggest difficulty with Q&A is processing time. Although it rarely took more than 10 seconds to handle my queries, this was with a sample of just 16 records. The time needed to scan the database is probably comparable with other packages, but there is also a delay while your input is analysed. Since this involves looking at actual field values it must increase with the amount of data, so speed could be a problem with a large file.

Furthermore, my 16 records, amounting to less than 4K of data, required a staggering 56K of file space. This is presumably accounted for by the various indexes, the Intelligent Assistant's vocabulary, and my look-up table and custom help screens. Clearly, a hard disc would be vital for any serious applications.

CONCLUSIONS

- Apart from its natural-language feature, Q&A is a useful though unexceptional flat-file system with added modules for word processing and reports.
- If your application involves lots of ad hoc enquiries to a single file the Q&A approach is very attractive.
- The software is remarkably skilful at working out what you mean.
- Not everyone will want to talk to their database in plain English; for many jobs a more concise, unambiguous language is needed. PC

Q&A

PC VERDICT

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

☐ It is hard not to be impressed by the Intelligent Assistant. It's fun too.

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+ Database Browser
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The excellent 350-page tutorial and reference manual will teach you step-by-step how to use the source code editor and expand your programs to support multiple files and screens including the "fancy stuff" such as pull-down menus and TAS-windows (we're the ONLY database that can do this). TAS-Plus has 128 colour combinations available and can display all IBM graphic characters. You can even get at or set the system time and date. TAS-Plus allows you to produce programs that are more professionally looking and with more "polish" than even the very expensive so-called "professional" software packages.

Finally, when it comes down to the speed of writing and more importantly running your programs (because that's what you do every day) you will find that the compiled code makes it load, read and write data quicker than any other database we know of. And don't feel sorry for yourself if you already have dBase, TAS-Plus can read and write those files as well. Now, you must agree that's respectable at any price, at £69.00 its awesome. And if you still need convincing that this is the bargain of a lifetime we offer a 60-day money back guarantee*.

AT £69 TAS-PLUS IS COMPLETE

It consists of the Relational Database, 4th Generation Language, Source Code Editor, Runtime Compiler, Screen Painter, Program Generator, Database Browser, Report Writer and 350 Page Tutorial and Reference Manual. TAS-Plus has over 86 commands and over 200 options available in its source code editor. TAS-Plus supports 16 simultaneous open files, each with up to 16 indices and a total of 65,000 records per file with up to 10,000 characters per record.

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TAS-PLUS DEVELOPER'S VERSION £199

For those who need even more power. Open 32 files, each with up to 32 keys per file. Save up to 17 million records. Includes programmers toolkit (includes the source code of the editor which is written in TAS).

TAS-PLUS MULTI-USER VERSION £299

Includes TAS-Plus developer and supports DOS 3.1 NETBIOS file and record locking.

SYSTEM REQUIREMENTS

TAS-Plus runs on IBM PC, XT, AT and all true compatibles. It requires at least two floppy discs and a minimum of 384KB RAM. The current TAS Level-1 product is available for CP/M and non-IBM compatible MS-DOS systems (including Apricot) for £199.

TAS-PLUS FOR THE TECHNICALLY MINDED

Because TAS compiles down to intermediate machine code your programs will execute fast, TAS itself is written in Assembler. TAS uses B-Tree multi-key file access and is the fastest database we know of. It provides an incredible, but easy to learn, 85+ commands including IF, DO, WHILE, FOR/NEXT, GOTO, GOSUB, ON statement etc. Excellent array handling and string manipulation.

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(Apologies, there are at present no brochures available for TAS-Plus).
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"We want you to show how much our new £505 printer can produce in 60 seconds," said Epson. **"Oh good," we thought, "a short-copy ad."** Then they told us their EX800 could print 30 characters a second - and we were as happy as two ducks in a duvet factory. "Half a minute," I said, tapping out SOS messages on a calculator, "if you think we're writing all that, I'm a monkey's uncle." "Have a banana," they said. Hmph. Such sympathy. We were moved to tears. Anyway, here we are, faced with writing War and Peace Part One and completely on our own into the bargain. Well, not completely alone - after all, you're still reading, aren't you? Of course you are. You're not the sort of namby-pamby who's put off by a bit of eyestrain when there's half a chance of some decent writing, I can tell. You don't need any of those dreadful 'hi-tech' shots with lasers, grids and dry ice wafting all over the shop to grab your attention. The riff-raff might have cleared off already in search of those ads where big, busty women suggestively stroke some product or other under the headline 'Look at the big features on our new model', but have you? No, of course not. Nor are you impressed by any of those corny gimmicks that are just second-rate substitutes for the genuine interest that only the printed word can generate. After all, does 'Animal Farm' need a scratch sniff card to make it live? Would 'Lady Chatterley's Lover' be any more interesting as a pop book? (Well, come to think of it ...) No, you read to improve yourself, to learn about the world around you - and even if you don't manage either here, at least there's a chance that you'll learn a thing or two about computer printers. This is Epson's ad, after all, so I really should tell you about the big features on their new mod ... oops. What I mean is, the EX800 has a far greater specifications than any other printer in its price range (which is just as well for us, given amount that we've got to write). As we said earlier, the EX800 costs only £505 (RRP exc. which just so happens to remind me of an extremely amusing and interesting fact about Now you really are going to learn something about the world! This could even be your big to improve yourself. All you have to do is casually drop this into conversation at parties, pow, instant success! It's far easier than learning how to play the piano, after all. (You remember the ad I mean - 'They laughed when I sat down at the piano - someone had ni stool.' Yes, that one. What a load of old rubbish.) Anyway, where was I? Oh yes, this e amusing and interesting fact. Did you know - and not a lot of people do - that the unit of in Vietnam is the dong? It's true, it really is! Look it up if you don't believe me. And just for a quirk of geography, it could have been the unit of currency here. Then even our inno nursery rhymes would have turned out completely different, e.g.: 'Said Simple Sim pieman, "Let me taste your wares!" / Said the pieman unto Simon, "Show me first you you get the idea. We'd better get back to the printer before the Advertising Standards cottons on. The most important feature of the EX800 has to be its speed. It whizzes c.p.s. in letter-quality mode, but can manage an astonishing 300 c.p.s. in Elite draft. To idea of how quick that is, we'll count up what we've written and then let you know h EX800 would have taken to get this far. Meanwhile, name that tune. Rumpty tumpty rumpty tumpty tara, rumpty tumpty tumpty tum, piddley piddley pom. No idea? He Rumpty tiddley, tumpty tiddley, rumpty tiddley tum. Rumpty tumpty tumpty tum, rum pom. Yep, it's the Archers. And at the third stroke, the EX800 would have been printi seven seconds ... beep ... beep ... beep. Here, hold on a minute. That means we reached the bottom of the first page. Gordon Bennett, we're going to be here writi this rate. Still, that's all the more reason to get on with it, I suppose. The new Ep remarkably easy to use. The new Epson EX800 is remarkably easy to use. (Yes, that repetition, as this is an important feature - and OK, it does use up a few more c thing is, when you want to change typestyles on an ordinary printer, you have to whole rigmarole of making software commands. (Dragsville, Arizona.) The Epson other hand, has a 'Selectype' panel on the front. (Freaky City, Florida.) All you have

n the wide - or to use a longer word, extensive - range of print options (N.B. there are fonts) is push one or two of the eight backlit switches. Now that's what I call simple. It's ar simpler than, say, balancing a packet of frozen faggots on your head, hopping up and one leg, flapping your arms and shouting, "Yib hoy, snig floy, I am an inter-continental ssole," - and that's a dead cinch. In fact, I just did it right here in the office. There, I did it s wild! Come on, you have a go. It'll give you a bit of a break - and if you're reading this on t certainly ought to break the ice in your carriage. "But no, enough of all this frivolity," I say. "Does this new EX800 have an integral push-feed tractor and short tear-off bar as d, with the option of a cut sheet feeder also available?" Wow! What a question. Are you u're not in the computer printer business yourself? Hmm. You sound pretty clued-up to me. , the answer's yes. And before you start asking any more smarty-bottom questions, yes s an optional colour unit available. For only an extra £55 (RRP exc. VAT), you, yes you, can n seven, yes seven, glorious colours. Get your reports red! Give your accounts a purple ! Send blue suggestions to your business associates!!! Well, maybe not. Still, it's about time ad another character-count to see how far we've got. Any requests for music this time? thing grand and inspirational, perhaps, to lift our hearts and bear us on in triumph to the ssful completion of our epic labour? Something that expresses fundamental optimism in the ndless potential of the human spirit? You've got it. Here we go, here we go. Here we go-o, here we go, here we go-o. Here we go, here we go, here we go. Here we go-o, here we go. All ther now, verse two - here we go, here we ... oh all right, we'll spare you the rest. The news is, Epson EX800 would have got here in forty-five seconds. Just fifteen seconds to go! (I was ays red-hot at maths.) I'd better stick in a couple more product benefits before I finally run out space. The Epson EX800 has a very large .. err .. umm .. thingy. I mean whatsit. That is to say, a odah. Oh very well, a large memory - an 8K buffer to be exact, with the option of an additional K also available. (The point of this is to free your computer for other tasks more quickly - but of urse I'm forgetting again, you probably know that already.) The EX800 is IBM-compatible ... ough why you aren't using an Epson computer I don't know. I mean, what's the point of us going n about how good Epsons are if people don't take a blind bit of notice?? Oh look, I'm sorry. Perhaps I wouldn't get so angry at having to mention a rival outfit if they had a name that took up a reasonable amount of space, but one that uses an abbreviation? That Is Truly Sickening. The final point to make is that the EX800 boasts the proverbial reliability of all Epson printers. Not that the word 'proverbial' means an awful lot, of course. Have you noticed how many proverbs actually contradict each other? There's 'Look before you leap' and 'He who hesitates is lost'. There's 'Many hands make light work' and 'Too many cooks spoil the broth'. Weird. It really is time some of these were brought up to date. How about 'Where there's a will, there's a lawyer'? Or 'A friend in need is a pest'? Yes, that's it. He who laughs last has no sense of humour, people who live in glass houses shouldn't take baths, a bird in the hand is better than one overhead, see a pin, pick it up - all day long you'll have a pin ... but I'm wandering again. What I should have said in the first place was that you can count the mistakes the EX800 makes on the fingers of one foot. But look, we're almost there. The coupon is looming up at last! And the great thing is, we've made it together. We've had our ups and downs, it's true, but you've stuck with us to the bitter end. Terrific. Can't you just feel that bond of comradeship, that deep empathy between us now? Of course you can. And now we've shared so much, we'd do anything for each other, I'm sure. For instance, if we asked you to fill in the coupon and send it to Epson, you'd do it for us, wouldn't you? What do you mean, no?

To: Epson (U.K.) Limited, Dorland House, 388 High Road, Wembley, Middlesex HA9 6UH. (Telephone 01-902 8892) Please send me less information on your EX800 printer - quick.

Name _____ Company/Address _____

HPC 2 Telephone: _____

EPSON

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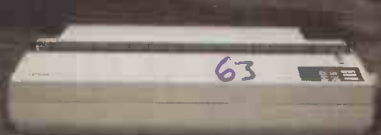
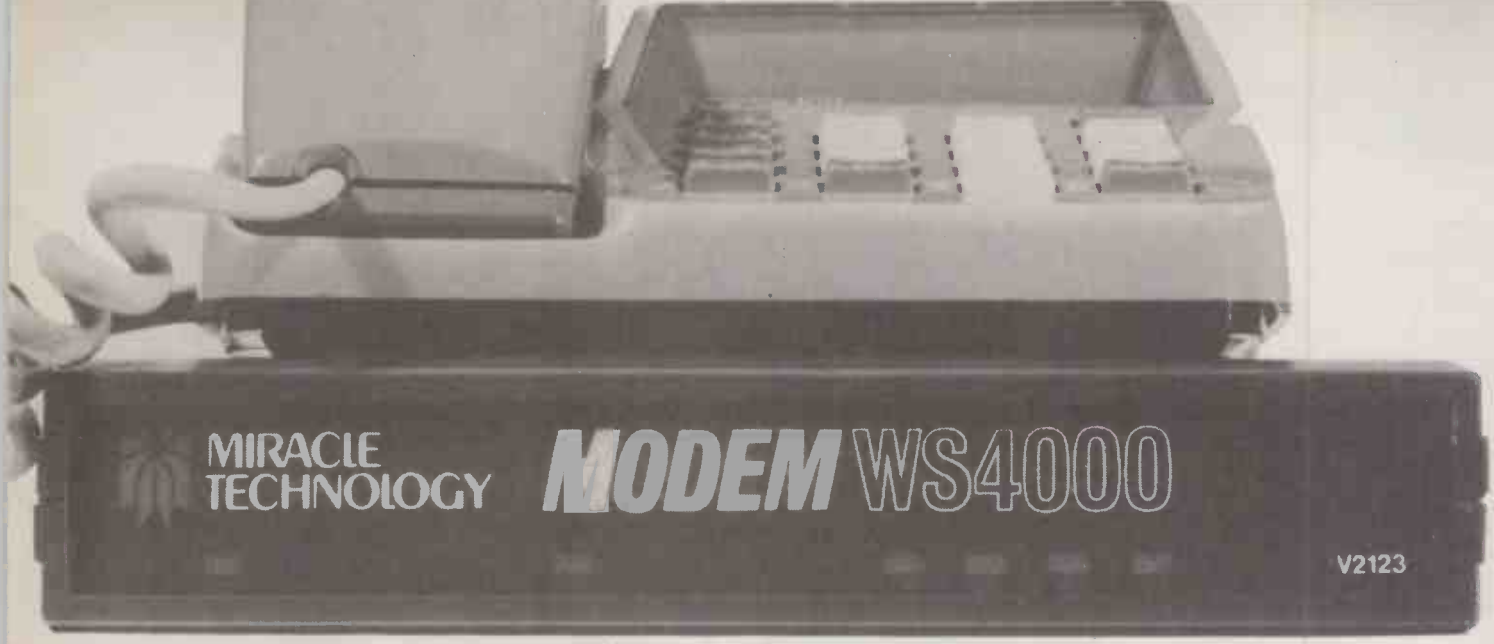


Remember us telling you about the Epson EX800, the printer that makes others in its price range look like snails on valium? Well, now they've brought out the EX1000, a printer that does everything the EX800 can, but which has a wider carriage to take paper for spreadsheets. You can get one for only £665 (RRP exc. VAT) — and you can get more information on both EX printers by cutting the coupon above.



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64

PRODUCTIVITY PLUS

GD FR QK TYPG

By Glyn Moody

If you find yourself repeatedly typing the same words and phrases this memory-resident program could save you a lot of time.

Everybody uses abbreviations, whether generally accepted ones like "asap" or purely personal versions. Building on this habit, Productivity Plus from Productivity Software International allows you to use any abbreviation — standard or made up — as you type text into your word processor, database or spreadsheet. Provided that the abbreviation has been entered in one of Productivity Plus's pre-defined word lists the program will automatically expand it into its full, comprehensive form.

As with so many recent programs based around neat and simple ideas, Productivity Plus is memory resident. Indeed, this is almost inevitable since it works by intercepting output from the keyboard before the main application program can get to it, putting the expanded version in place of the keystrokes that were actually typed. The program takes up 64K of RAM and runs on the IBM PC family.

Although the idea behind Productivity Plus is beautifully simple, loading and running the program is a bit of a palaver. First it must be set up for the particular application you intend using it with. Everything is controlled from the main menu, which is called up by typing

PPLUS

if you are loading the program for the first time in a session, or

PMENU

if not.

The menu which comes up offers you the facility to change the configuration of the system. The current list of 25 or so options includes about 15 word processors along with everything else obvious like Lotus 1-2-3 and dBase. If your application is not present there is a Customise option, though the manufacturer does not guarantee that it will always work.

After loading Productivity Plus you have to load a word list containing the abbreviations and their expansions. If you are already in an application program you must exit to DOS and then call up the main Productivity Plus menu before changing your word list or loading a new one. Having chosen your word list, you exit to DOS, load the application and then run it.

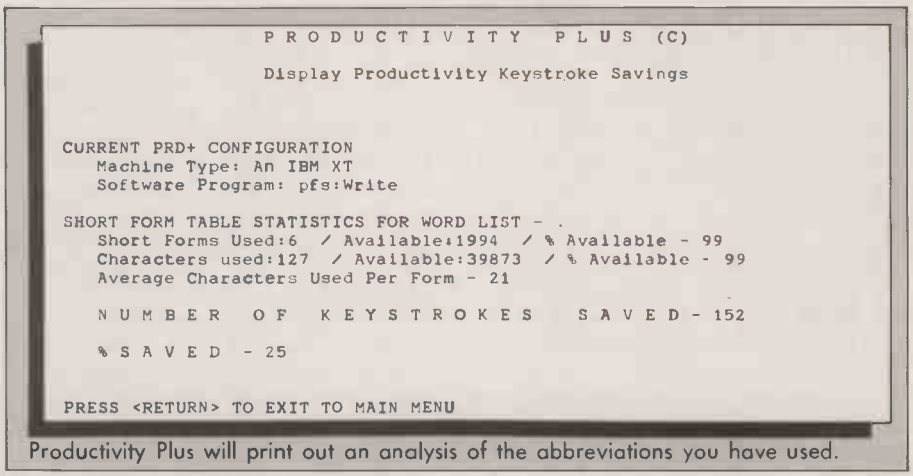
To set Productivity Plus running you press Alt and Esc simultaneously. Thereafter whenever you type a pre-defined abbreviation, Productivity Plus will simply overwrite it with the expansion assigned to it in the word list. The program can distinguish an abbreviation from the same sequence of characters when they form part of a longer word. It does so by recognising delimiters that define the beginning and end of an abbreviation, such as a space, comma, full stop, brackets and so on. Expansion of abbreviations to the full form takes place smoothly and very fast, so your normal typing rhythm is not interrupted.

In addition to using pre-defined word lists you can add extra abbreviations as and when they arise. To do this you press the Alt and the Backspace Delete keys simultaneously to put Productivity Plus into Add mode. You then type the abbreviation you wish to use, followed by a colon and the expanded form. If you wish you can add any new abbreviations to your permanent word list by saving them at the end of a session.

Abbreviations can be up to eight characters long and you can have 2,000 in a word list. The expanded version can have up to 240 characters, and can include words, phrases and even macros for programs like 1-2-3.

I must confess that I found the whole business of creating, loading and saving word lists slightly confusing. The manual is nicely produced in a fold-over pad format, but it could be better organised.

The other big problem is price. Productivity Plus is currently only available in the U.S. where it weighs in at a steep $195 — say £150. This, and the rough edges still apparent in its implementation, rather spoil what is in principle a splendid idea.



Productivity Plus will print out an analysis of the abbreviations you have used.

PRODUCTIVITY PLUS

PC VERDICT

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

☐ A neat idea, marred by some awkward aspects and a high price.

SPECIFICATION

Description: a memory-resident program which expands abbreviations as they are entered; also has macro capabilities
Hardware required: IBM PC, PC/AT or compatible; occupies 64K of RAM
Copy protection: none
Price: $195
Publisher: Productivity Software International, 1220 Broadway, New York, NY 10001. Telephone: (U.S. area code 212) 967-8666
Available: now, from U.S.A. only

CONCLUSIONS

- Productivity Plus is a memory-resident program that lets you use abbreviations which it then automatically expands.
- It is trivially easy to use, though less easy to set up.
- It is rather expensive for what it does, but with improvements and a hefty price cut it could become an indispensable aid. PC

STELLA
A MODEL OF ITS KIND

By John Lewis

Modelling and simulation beyond the wildest dreams of spreadsheet users becomes possible with this graphics-orientated package for the Macintosh.

Modelling is a familiar concept to most microcomputer users. Spreadsheets owe much of their success to the ability to simulate the way a business works, allowing predictions to be made about the consequences of a particular course of action. Stella is intended for modelling of a more general kind, and is designed for tracing out the dynamics implied by any series of interrelationships.

Stella is based on the assumptions that all living things — and some non-living ones — are goal seeking, and that in order to be goal seeking a feedback structure is required. This leads to an emphasis on the dynamics of a system, rather than on its equilibrium or steady-state position.

Stella allows you to build a feedback loop into a model and will continue to cycle through it until you tell the program to stop. For this review I set up a model of an oscillating spring. I could have added to it by introducing the damping effects of air resistance and friction.

With some difficulty a similar model could be built up on a spreadsheet. But a spreadsheet model can only give a snapshot of the system as it exists at one particular moment. To find out what the system is like at a different time you would have to rerun the spreadsheet with a different set of starting values. By contrast, Stella allows you to get a picture of how the system changes over time. Using the package's graphing facilities you see an animated display of changes in the system's parameters. You can also print out a permanent record of the dynamics of the model in either graphical or tabular form.

COPY PROTECTED

The Stella system disc is copy protected, and you can only boot from the master disc supplied. To run Stella from a hard disc you need a separate installation program which is available free of charge from Logotron, the program's U.K. distributor. Logotron says that Stella should run satisfactorily in conjunction with the Switcher utility program.

The first stage of using Stella is to build up a structural diagram which defines the problem under investigation. To do so you assemble a set of basic elements or tools which are displayed on the package's opening screen. Among these tools is the Stock element, looking rather like a bathtub, in which the net inflow and outflow is registered. The Flow and Flow Regulator tools take the form of a pipe with an intelligent regulator to control flows. The Converter converts mathematical inputs into output control signals. A link or pipe joins the other elements together so that information can pass between them.

In the bottom left-hand corner of the screen there are two Zoom boxes on which you can click to get a better view of your diagram. As each of the main tools is used, additional dialogue boxes can be called up to enter constants or the mathematical relationships between the various inputs. These relationships can be expressed in standard mathematical fashion or as a graphical function between any two variables over the whole of the operating range.

The expected Edit menu allowing you to cut, copy and paste is not present. So you cannot transfer any Stella information via the clipboard to another Macintosh application, though you can File, Print, etc. A Specs menu lets you select the duration of the simulation you will be running, together with the step time and whether you want any of the major tools to be animated. For example, if you choose to animate Stocks the bathtub element in your diagram will fill or empty in response to the inflows and outflows. For your computation method you can choose Euler, Runge-Kutta 2 or Runge-Kutta 4. You can also set the upper and lower limits for any variables so that the calculations are kept within defined bounds.

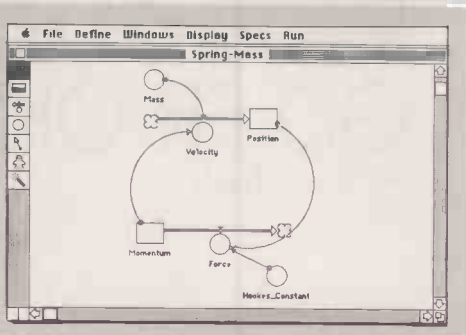
Once everything is set up you start to

STELLA

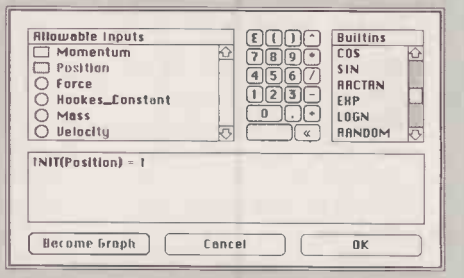
PC VERDICT

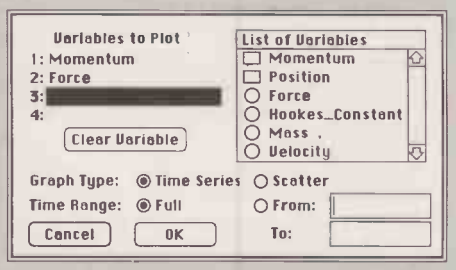
	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	■	☐
Ease of use	☐	☐	☐	■
Documentation	☐	☐	■	☐
Value for money	☐	☐	☐	■

☐ Fun to play with, and a powerful tool for those with a thorough knowledge of modelling and simulation.

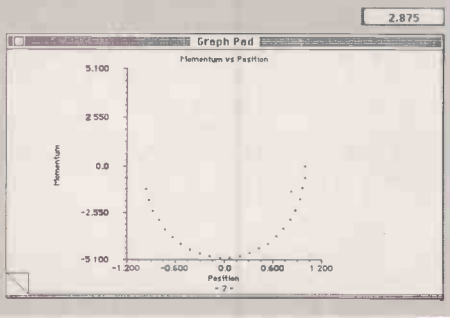


You build up your model from Stella's basic elements. The model above represents a mass suspended on a spring. The dialogue box below sets up the controls for a converter.



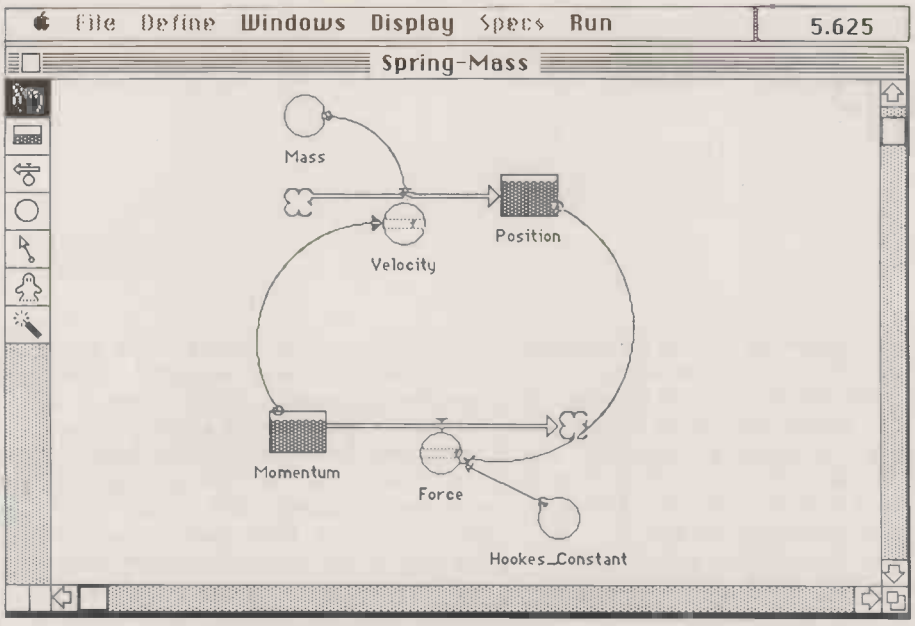


Above: Dialogue boxes are used to select the plotting mode. Below: A plot of momentum against position for the oscillating spring. Elapsed time is displayed at the top.

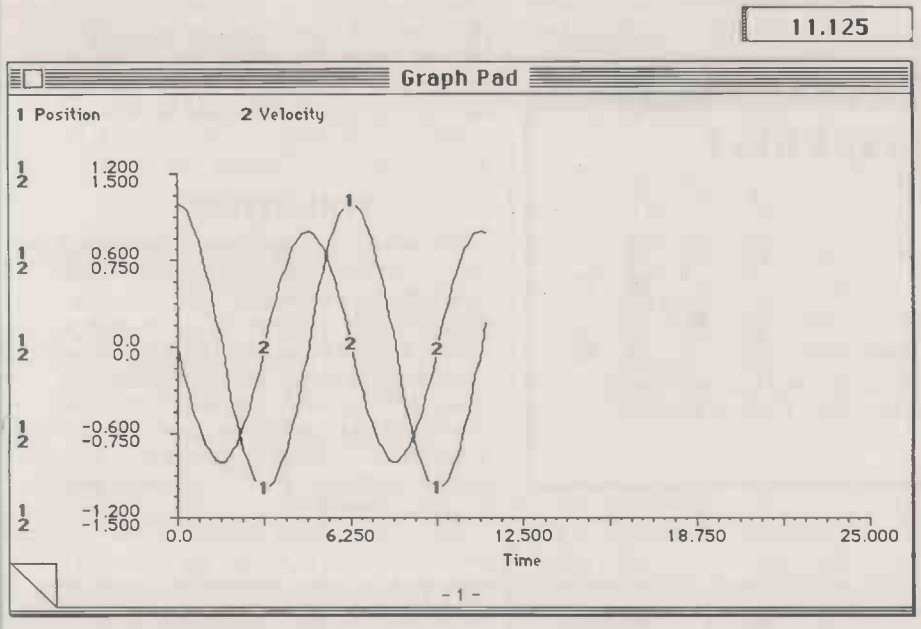


SPECIFICATION

Description: modelling and simulation program, using structural diagrams to construct the model
Hardware required: Macintosh with at least 512K RAM
Copy protection: master system disc must be present to boot the program
Price: £249
Publisher: High Performance Systems Inc. of Lyme, New Hampshire
U.K. supplier: Logotron, Dales Brewery, Gwydir Street, Cambridge CB1 2LJ. Telephone: (0223) 323656
Available: now



The model can be animated to show how the values of the elements change with time.



A double plot, showing how both position and velocity vary with time.

simulate your model by selecting Start from the Run menu. A clock in the top right corner of the menu bar shows the passage of time within the model. You can pause at any point to investigate a particular property, or even break off the simulation altogether if it is obvious that something has gone drastically wrong.

The animated diagram displayed at this stage is amusing to watch, but for hard information you need to flip to the Graphs window. Here you can plot up to three different graphs. Any pair of variables can be plotted against each other, or you can plot any variable against time. The program automatically scales the axes and labels and individual curves. If the Graph Pad window is selected while a simulation is being run you can watch the graphs being drawn as the simulation develops.

The Table window allows you to follow the progress of up to five variables in numeric mode and to obtain a printout, if required, as the simulation proceeds. Any of the equations used in the model can be reviewed if you open the Equation window. A Search facility allows any individual name or variable and its associated tool to be located. If you have a large simulation you can use Search to identify the effect on a particular variable of any change you might make.

The documentation for Stella expects you to learn by doing, and in this respect it is more a tutorial than a reference manual. The population-dynamics example it uses exhibits overshoot and collapse: at first the population thrives, but then it collapses quickly. The model is built up using the concepts of birth fraction, death fraction, death rate, natural lifetime, etc. Changes are made to the model to try and show the overshoot and collapse pattern, though by the end of the introductory chapter this has not actually been achieved. You are left with the author urging you to take some time to modify the model to generate the anticipated pattern.

The next chapter gives an insight into the philosophy behind Stella, together with some tips on how to produce good models. The point is emphasised that data is more than a collection of numbers; it can also include structural relationships, which Stella is designed to cope with. You are urged to state what your hypothesis is before trying to test it; to change only one thing at a time; and to find out what the limitations of your model are by destructive testing.

MODELLING WORKSHOPS

A brief description of the various menus is followed by six modelling workshops. The first is an extension of the population-dynamics model, with extra variables. Another simulation investigates the interaction between a predator and its prey to show the oscillatory changes in their individual populations. Inadvertent Evolution in a High Tech Firm and a look at Adam Smith's Law of the market comprise workshops 3 and 4, while the final two look at diet and exercise, and macroeconomic money flow.

As it stands, the manul provides a good introduction to a difficult subject. But to get the most out of Stella you will need to know more about modelling than the manual tells you. The program was written by Barry Richmond, a professor at Dartmouth College, and I got the impression that the documentation started life as an adjunct to a full course on modelling and simulation. Certainly this would explain its tutorial style, the sketchy index, and the lack of any suggestions for background reading. It could also be the reason why you are not even told what the maximum size of a model can be. This could prove disastrous if you had spent many hours constructing a simulation, only to find that it is too big.

CONCLUSIONS

- Stella is a modelling and simulation package powerful enough to meet the needs of most serious users.
- The Macintosh's graphics interface is used to generate an animated display of the simulation that is fun to watch and provides a useful practical introduction to the subject.
- The documentation deals well with a difficult subject, but does not give a full explanation of modelling techniques. PC

FARSIGHT
1-2-3 PLUS WP

By Glyn Moody

This Lotus 1-2-3 clone offers spreadsheet facilities plus word processing in a windowing enviornment.

Programs which aim to clone the top-selling Lotus 1-2-3 spreadsheet never do so exactly; unlike IBM clones they always add features. For example, VP-Planner adds a very powerful multi-dimensional database to 1-2-3 and Twin extends the graphics. Similarly, the latest addition to the clone collection, Farsight, not only offers a useful word processor as standard, it also combines its elements in a highly effective windowing environment. The program is written in the Modula-2 language; it runs on the IBM family and costs £99.

Installing the system is relatively straightforward. As well as making backup copies or copying across to a new directory, you also have to run a short installation program to initialise the ports for printers and communications. You access it from a menu bar which appears after the program has been loaded and run.

Pull-down menus are a feature of Farsight. To use them you press f3 to move to the menu bar, and then cursor across and down to select the one you want. Alternatively you can select a menu or an option within it by keying its initial letter. The Installation option is found on the Desk menu; you can choose from a generous range of alternatives to configure the ports.

In addition to standard pull-down menus, Farsight makes considerable use of windows. The windows are akin to Framework's frames in so far as they appear with a double-line border and can be overlapped, resized and moved around using the cursor keys. You can also zoom into any one window so that it fills the entire screen.

CURRENT MODULES

The Initial screen displays what modules are available — presumably against the day when others such as a database, graphics and comms are added. The main screen shows the drive windows, along with information about disc drives and the files held on them. The pull-down menus allow you to create directories and sub-directories, and to edit their contents. They also allow you to perform sorts on files, so enabling you to pull out sets of files according to certain criteria.

Perhaps the most useful feature of this window environment as far as file handling is concerned is the ease with which files can be copied from one sub-directory to another. All you have to do is employ a standard cut-and-paste technique: you mark the file to be moved, cut it, move to the new location and paste it. You can do all this using the function keys.

Farsight is also clever when it comes to creating files. When you begin to type a new file name, the program inspects the keystrokes as they are captured. As soon as a file name is recognised as unique, Farsight beeps. Pressing Enter then calls up a small subsidiary menu which asks whether you want a spreadsheet or word-processing file, and appends the appropriate file extension.

As befits a self-styled clone, the spreadsheet is very closely modelled on 1-2-3. The on-screen appearance is the same, except that whatever is at the cursor position will flash, and the menu bar remains along the top. Unlike 1-2-3, which uses horizontal menus, Farsight has menus which drop down.

FARSIGHT

PC VERDICT

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

☐ A usable Lotus look-alike with the added bonus of word processing.

When you pass from the windows environment into the spreadsheet a number of additional options appear along the menu bar. The maximum size of spreadsheet which can be set up is 256 columns by 2,048 rows. Farsight offers the same 50 or so functions preceded by @.

Spreadsheets set up under 1-2-3 load without difficulty, and generally Farsight and 1-2-3 seem to be closely compatible. One area where Farsight falls down is graphics. Unlike 1-2-3 or the other Lotus look-alikes, it has no graphing facilities. This may be a drawback if you regularly use such features but later releases in the Farsight series will doubtless cover them. As with the file duplication, the cut and paste within the spreadsheet is very easy to use.

The word processor contained within Farsight is interesting, if only because it is not an outright clone of anything. Once again, some new options appear along the top of the screen when you pass from the windows environment. One of them is the Chapter heading, from which you control the basic layout. Under this heading there are a number of options, once of which is, confusingly, also called Chapter and handles page length, and top and bottom margin; the Ruler option deals with justification, indents, hyphenation and so on.

Details such as which Chapter and Ruler settings are operational, what the tabs are and where you are on the page are shown on the screen just above where the text begins. An area to the left of the text is used to indicate hard and soft page breaks, headers and footers, and suchlike. The headers and footers are confusing to set up, and let down the program's general ease of use.

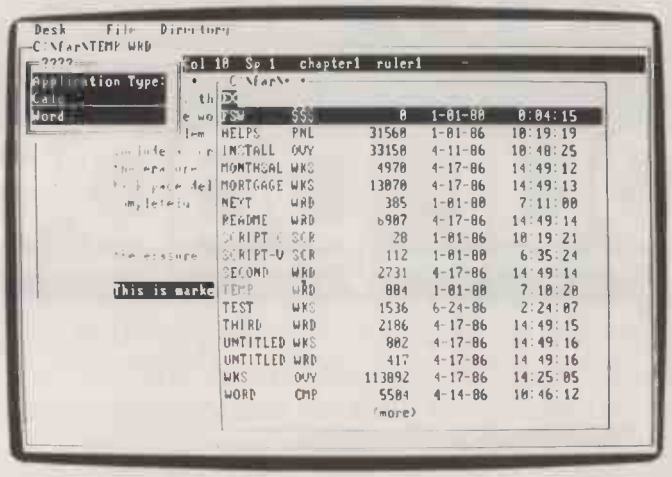
TYPE STYLES

The various type styles are also indicated here. Options available include bold, subscript and superscript, italic and strike-through. Each of them is shown with a symbol in the left-hand margin which illustrates a characteristic of the typeface, for example ß for bold. You select the type style using the pull-down menu headed Typestyle, or by pressing the assigned keys on the keyboard. Bold is invoked with Alt-2, for example.

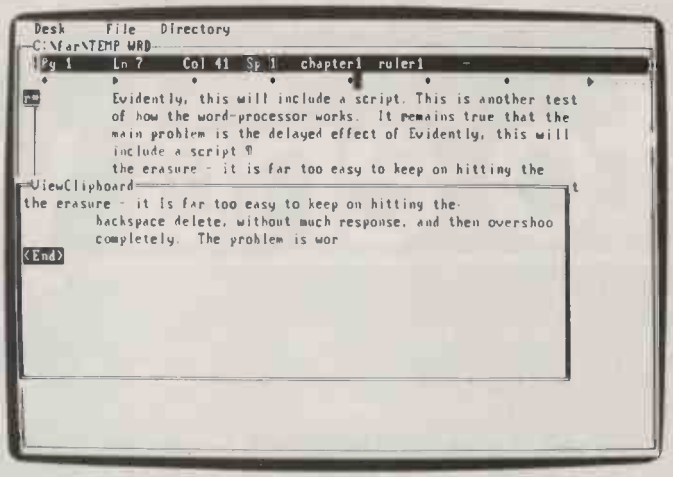
When you print a document, you are given the choice as to what kind of pagination you want, and whether you want a page eject at the end. There is a useful Print Spool option which allows you to continue working as the file is printed. However, it seemed to take a long time to save the file to the spooler, thus losing much of the benefit which this facility should confer.

In fact, speed is perhaps the biggest failing throughout Farsight's word processor. Entering text is no problem, but Backspace Delete is slow and there is a very severe time lag before it takes effect. In consequence I found myself holding down the Backspace Delete key too long, only to watch it gobble up more than I bargained for.

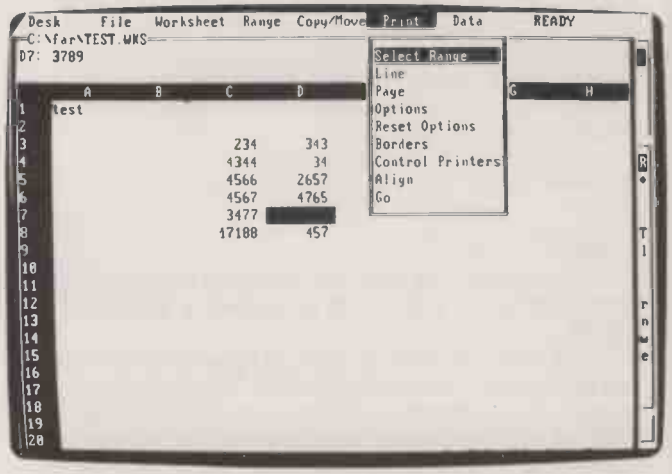
There is a rudimentary mail-merge option which alows you to create form letters and pull in names and addresses held in a simple sequential file. On the form letter field names are identified by being



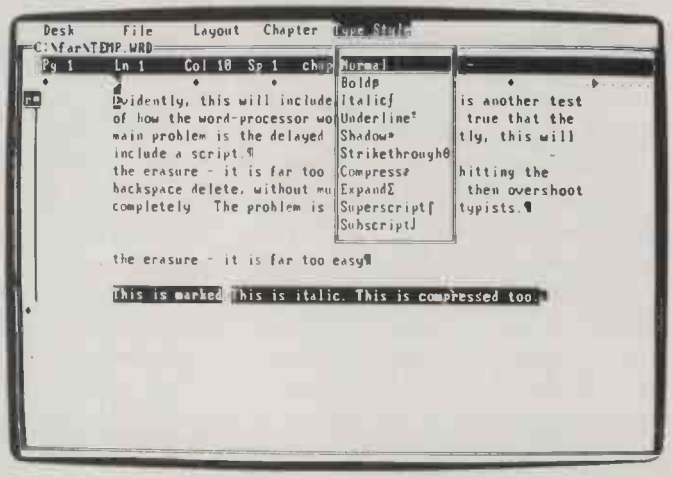
Creating a new file, called Ex, while another file is open and the disc directory is displayed in the top-level window.



The clipboard is used for cut-and-paste operations within an application, or for transfers between applications.



Farsight's spreadsheet looks a lot like 1-2-3, except for the pull-down menus and flashing data under the cursor.



Not all type styles are represented on-screen, but appropriate symbols appear in the style bar on the left.

SPECIFICATION

Description: a Lotus 1-2-3 clone with extensive word-processing facilities unified in a windowing environment
Hardware requirements: IBM PC, PC/AT or compatible with at least 256K RAM
Copy protection: none
Price: £99
Publisher: Interface Technologies Corporation of Houston, Texas
U.K. supplier: SK Micro Systems, St. Michaels House, Norton Way South, Letchworth, Hertfordshire SG6 1PB. Telephone: (0462) 679331
Available: now

preceded by &. Other features include the ability to write a script — the name given to a sequence of operations that can be assigned to a single keystroke. This feature is really a sophisticated version of the macro facility found on 1-2-3, which is also available on Farsight and is claimed to be fully compatible.

Normally you would work with the word-processing window filling the whole screen. But it is very easy to set up multiple and simultaneous word-processing windows, or even to mix spreadsheets and documents. You can then cut and paste between them to your heart's content. You can review the clipboard via another window at any time.

To set up new windows you move to the main drive window, and create another file just as before. You move between windows by pressing f6 if they are ordinary file windows, and Shift-f6 if they are drive windows. This cuts down on the confused sequence of blinking outlines that occur as you switch around from one to the other.

USEFUL EXTRAS

All in all, the windows environment which lies at the heart of Farsight is most impressive, especially for a package costing less than £100. Even if you could manage without sophisticated options like cutting and pasting between documents, the option of being able to use them greatly simplifies operations like moving files around directories.

The spreadsheet may lack the new features of the latest release of Lotus 1-2-3 — and it is certainly more limited in terms of graphing — but for the average user it could well prove sufficient. Farsight's word processor is hardly a rival to Microsoft Word, but it too is a competent effort. And its multi-window feature means you can use it as a notepad while you are working on the spreadsheet or another word-processing document.

Farsight comes with one fat ring-bound manual. It is strictly utilitarian, rather like the original Lotus 1-2-3 manual, but it covers the basics of the windowing system and installation quite well. Unlike other 1-2-3 clones it does not assume that you already know how to use Lotus 1-2-3. The word-processor section is thin, though like the others it does have a very full reference chapter. There are a number of appendices and a good index in the back.

Each of the Lotus 1-2-3 clones now on the market has a particular appeal. For spreadsheet users who need powerful database facilities, VP-Planner is well out in front, while Twin is best for those with particular graphing needs. Others who need a useful word processor with their spreadsheet can now turn to Farsight.

CONCLUSIONS

- Farsight is a very cheap Lotus 1-2-3 clone which offers a useful word processor in addition to the spreadsheet.
- The windowing environment in which the spreadsheet and word processor function means that you can have several files open at once.
- Farsight's biggest drawbacks are its slow word-processing speed and its lack of graphics in the spreadsheet.
- Farsight could become even more attractive if other modules in the same series are launched as promised. PC

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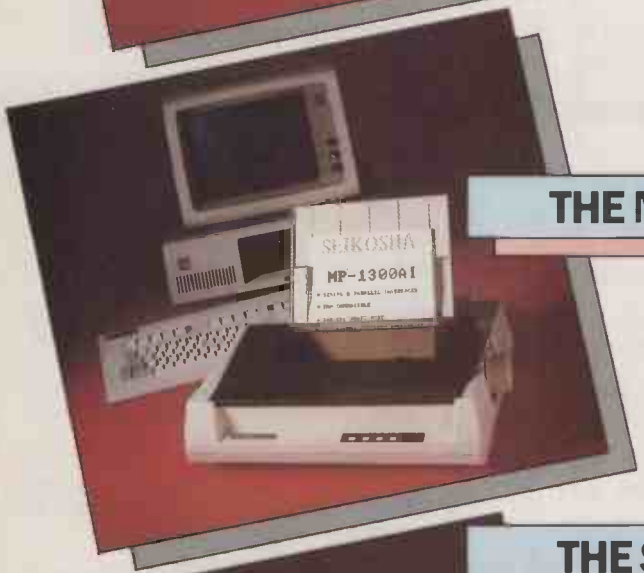

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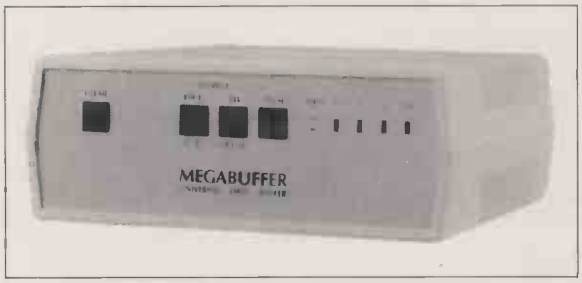

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S&S UTILITIES
57 VARIETIES

By Steve Malone

These short programs, available individually at a standard price, set out to rectify shortcomings of your existing software.

There is a growing demand for utilities which perform those useful functions that the large software houses overlook when they release their packages. One of the best-known producers of these utilities is S&S Enterprises and in the past 18 months this small British operation has developed a set of invaluable programs.

We have been looking at utilities for the IBM PC; the S&S programs are also available for the Apricot range. The applications range from DOS utilities to specialised add-ons for popular software packages, and from the essential to the whimsical. They are designed to improve the performance of the PC or make life easier for the user. A total of 57 modules are available, though there was only time to examine a few of them for this review.

The Pocket command is a 10K program which creates a disc cache and stores programs and data accessed from disc. S&S claims that it has achieved fivefold speed increases using special Pocket test data supplied with the program. When we tested Pocket we achieved a speed increase of around four times — still pretty impressive. Of course, to be able use a program like Pocket you have to have enough memory to set aside for a substantial cache to make the program worthwhile.

Two programs called Undelete and Unformat are designed as fire-brigade utilities for use when you have accidentally deleted a file or formatted a disc that contains valuable information. Although success is not guaranteed, these programs can usually recover some of the information wiped from a file.

SLOPPY MS-DOS

Undelete works because MS-DOS is sloppy in the way it deletes files. Instead of erasing a file entirely from a disc it simply removes the first letter of the file name from the directory. The Undelete utility bypasses the operating system and shows the file names on the directory track which have been deleted. You choose the one you want to restore, and the utility then attempts to retrace the required data. Undelete's success rate depends on whether anything has been written to the disc since the deletion was made, as any new file will overwrite sectors occupied by deleted data.

The real magic is performed by Unformat. In theory, when a disc is formatted the read/write head goes over the entire disc, setting logical zeros and ones and overwriting anything that is already there. The operation of Unformat depends on the process not being as thorough as it might be. The program goes over the disc, retrieving any recoverable information and dumping it on to another floppy. This process might well take many hours and a number of floppies, and even then may well result in only partial success. As S&S says, prevention is better than cure, and it is preferable simply to keep backups.

No set of utilities is complete nowadays unless it includes several memory-resident programs. The pop-up utilities in the S&S collection range from the slightly silly to the quite useful. An example from the silly end of the spectrum is the program which displays a clock/alarm in the top right-hand corner of the screen when you press Alt-C. The trouble is that MS-DOS already provides similar facilities, and many modern applications programs have an on-screen time display already installed. The alarm feature may be slightly more useful. Any competent programmer could probably write the clock utility in an afternoon, and it is just the kind of example given in many Teach Yourself 8088 Assembler tutorials.

DIY HELP

Slightly more advanced and more useful is the Fasthelp facility. This pop-up program allows you to write your own help pages, which can then be loaded and popped up on a screen when required. The sample help file provides DOS assistance, though it is too limited to be really useful. But Fasthelp could come into its own to provide help for some of the more arcane command structures of programs like Framework of dBase III.

The only problem with this approach is that someone has to go through the manual and type in all the potentially useful help before the program is any use. Perhaps S&S could provide this kind of customised help for specific programs. It would certainly give the package a wider appeal.

The most valuable utilities available from

S&S UTILITIES

PC VERDICT

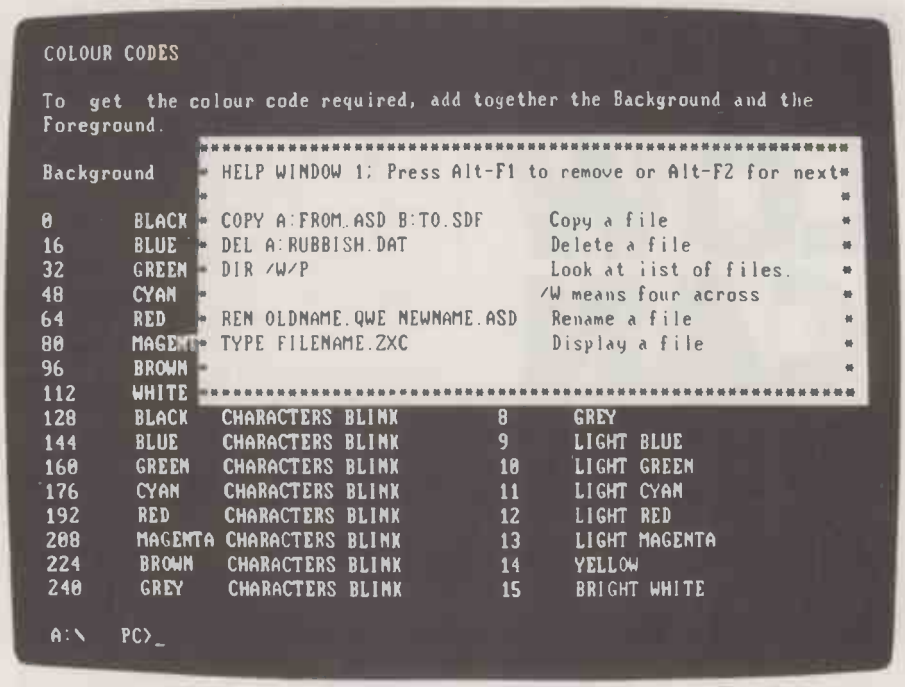
	POOR	AVERAGE	GOOD	EXCELLENT
Performance	☐	☐	■	☐
Ease of use	☐	☐	■	☐
Documentation	☐	■	☐	☐
Value for money	☐	☐	☐	■

[ ] The scores above are for the best packages: careful selection will provide you with a bargain.

Fix Lotus allows you to boot early versions of Lotus 1-2-3 and Symphony from a hard disc without using the system disc.

```
C:\   PC>makefix
Do you want to run Lotus 123, Symphony or both ?
Please enter 1 for 123, S for Symphony or B for both.
b
Please enter the number that can be found on the
Symphony introduction screen
1234567
Thank you.  Your FIXLOTUS is now ready to use.
It will work for both 123 and Symphony
Follow the instructions in the file FIXLOTUS.DOC
You may only use FIXLOTUS with that copy of Symphony
If you need to re-install FIXLOTUS on your hard disk,
you must re-run this program from the S & S disk.
You may only do this up to THREE (3) times.

C:\   PC>_
```



Fasthelp provides a pop-up utility which allows you to put your own help facilities inside windows.

S&S are undoubtedly those designed to augment specific packages, and there are a number of modules written with Lotus 1-2-3 and Symphony in mind. One of them allows Symphony.WKS files to be translated into 1-2-3.WRK format — a utility scandalously omitted by the Lotus programmers.

Other S&S utilities allow the £ sign to appear in a worksheet, and transpose rows and columns. There is also a utility which allows you to print text down the side of a spreadsheet. S&S says that Lotus is pleased that the company is supporting Lotus packages in this way.

Lotus is somewhat less enthusiastic about the Fix programs, which allow you to boot 1-2-3 and Symphony from a hard disc without having the system disc in the floppy drive. They do this by intercepting the relevant interrupts and redirecting them elsewhere. The result is that as long as there is a formatted floppy disc in the drive, the program will not care whether it is a Lotus system disc or not. Lotus cannot be best pleased with a company that circumvents its copy protection in this way, but it has not taken any action over the programs in the year or so that they have been available.

To be fair to S&S, it has gone to some lengths to ensure that the Fix programs are not misused. In order to run them you first have to enter the serial number of your copy of Symphony or 1-2-3, or of your computer. From then on you can only make copies with that machine or package, and then only three times. This is probably sufficient to prevent the Fix utilities from being abused, and although there is bound to be some leakage it is unlikely to be on a large enough scale to worry Lotus.

Some other business packages demonstrate the hit-and-miss nature of the S&S utilities. Among the word-processing programs there are utilities to convert WordStar files to ASCII format, along with word-count and label-printing utilities, and a program to allow Epson printers to print WordStar documents in condensed, italic or superscript type. To users of the WordStar/Epson combination — of which there must be many thousands — the extension of these utilities can be invaluable. On the other hand, it is plain daft to have a program which simply puts an I or a u in the corner of the screen to tell you whether or not Caps Lock is on.

One problem with these utilities is that S&S's pricing policy makes no distinction between the sublime and the ridiculous. Each of the programs costs £10, with discounts if you buy several at once. This means that many programs are available at bargain prices — for example, another company is offering a similar package to the Lotus sideways-print program at five times the price — while some others are more the kind of thing you would expect to pick up as freeware. This is not to say that S&S is offering a pig in a poke. Its advertisements give a brief description of what each program does, and the company offers full support and a money-back guarantee.

Dosmenu is a menu-driven friendly front end to DOS which enables you to load applications programs from the main menu.

SPECIFICATION

Description: short utilities for the IBM PC to add new facilities to the operating system, certain applications or particular hardware configurations; Apricot version also available
Hardware required: variable
Price: £10 each, any five for £40 or any eight for £65
Publisher: S&S Enterprises (Amersham) Ltd, Utilities Division, 31 Holloway Lane, Amersham, Buckinghamshire HP6 6DJ. Telephone: (02403) 4201
Available: now

CONCLUSIONS

- The best programs in the series are great value for money and show up certain competing products as the overpriced underpowered programs they are.
- Some of the utilities in the series are all but worthless, so be careful not to buy a lemon.
- The series as a whole is reminiscent of the bygone years of micracomputing, when you took pot luck from programs advertised in the classified columns of the computing press.
- A company like S&S which produces bug-free software at a reasonable price, with full support and a guarantee, is worthy of your patronage. PC

HOW LOW CAN YOU GET?

While most manufactured products climb steadily in cost, price cutting has become the norm in the PC market. **Glyn Moody** investigates how this happy state of affairs has arisen, and how long it will last.

The annual inflation rate of the Retail Price Index has recently dropped almost to zero. For a generation which has been brought up to expect prices to rise inexorably every year — sometimes by as much as 25 percent — this seems like a divine dispensation from an otherwise unswerving law. Yet steady inflation on this scale is largely a phenomenon of the last 25 years.

Similarly, manufacturers' lemming-like rush to cut PC prices may appear to be an integral feature of the business micro world but, like inflation, it is merely something we have all become used to. It is also comparatively new.

In fact, the consistent reduction of prices in the micro market is almost without precedent in any industry. In the past, savings brought about by mass production or advances in technology have been absorbed by the provision of extra features for the same price. Car manufacturers, for example, use the addition of non-optional extras as a ploy to justify price increases, even when manufacturing advances could otherwise force reductions.

Initially it seemed that the computer industry would follow in this hallowed tradition. But micros changed all that. When IBM introduced its PC into the U.K. in January 1983, it was offering a premium product in what was a seller's market. As a result, it was able to maintain a high price with a healthy profit margin.

Two months later it introduced the PC/XT with a further £2,000 mark-up, and still people bought it like there was no tomorrow. As IBM's manufacturing capability struggled to keep up with the almost insatiable demand, micros looked like a new licence to print money.

Then in February 1984 IBM shocked the computer world, and possibly even itself. For no obvious reason other than a desire to discomfort the opposition, it cut the prices of its micro products by up to 25 percent.

As often happens, once the genie of price cutting had escaped from the bottle it was reluctant to go back, and the growing band of IBMulators soon joined in a general lowering of the basic system price. Olivetti introduced its M-24 compatible at prices which at the time *Practical Computing* called "very aggressive". Many lesser names followed suit, and it was clear that pricing had become more fluid than in the past.

Perhaps in retaliation for this weakening of its position in the PC market, IBM then launched the PC/AT in the autumn of 1984. Its price was about the same as that of the XT when it was first introduced. To make room for the AT, the price of the XT itself was reduced by nearly £1,000.

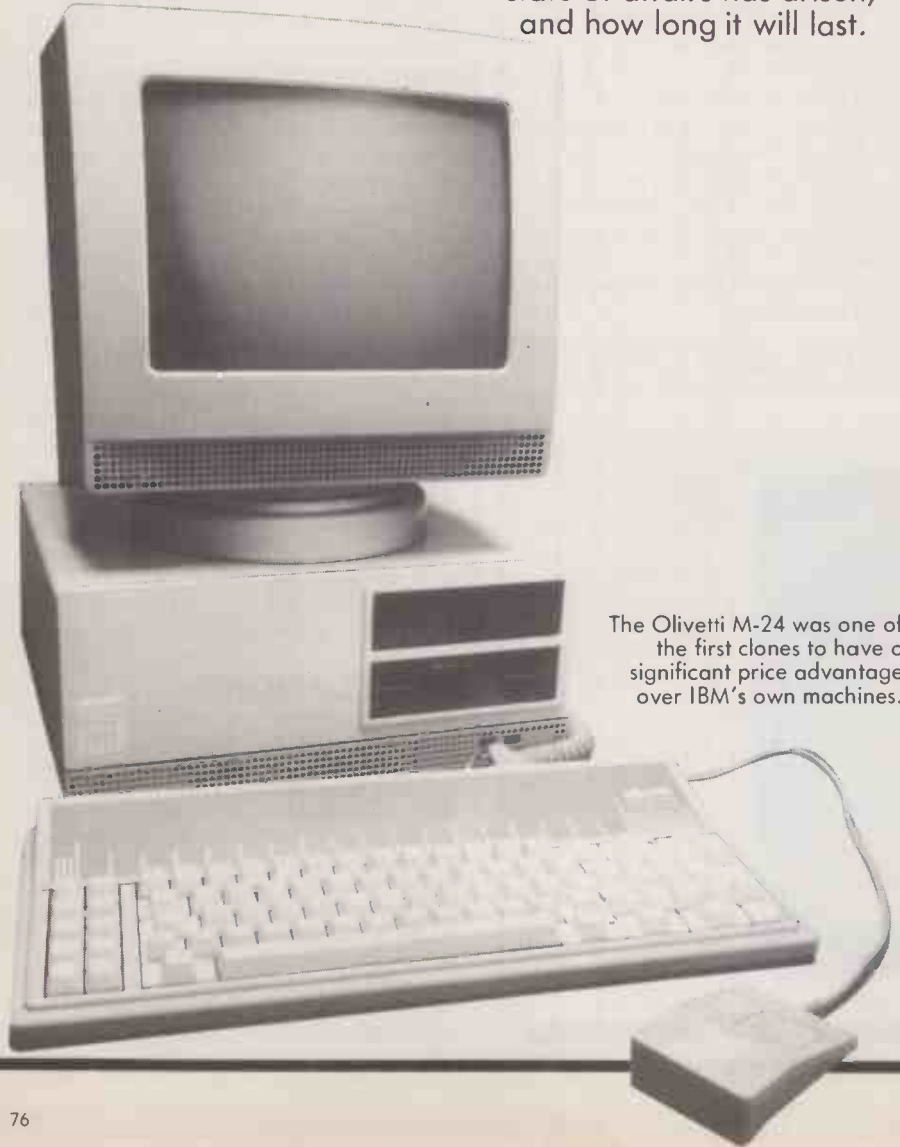
Another factor came into play at the beginning of 1984 in the form of the weakening of the pound against the dollar. As sterling continued to plummet towards parity with the U.S. currency, IBM announced that it would be increasing U.K. prices on the XT and AT to compensate. These were purely local changes brought about by the weakness of sterling, and were not matched by similar rises in the U.S.

THE ROT SETS IN

These higher prices remained while the pound hovered near the $1 level, but ultimately stronger forces prevailed. Just as prices were beginning to come down, a significant shift in the PC universe occurred. Cheap clones had hitherto been made mainly by smaller, often unknown manufacturers, which seemed to pose less of a threat to the established order or things. But in November 1985 two big names, Tandon and Epson, announced PC and XT compatibles at substantially lower prices than had previously seemed possible. Tandon, along with Tandy, also offered an AT-alike for around two-thirds of IBM's price. What had been a small crack in the monolith of PC pricing began to threaten its foundations.

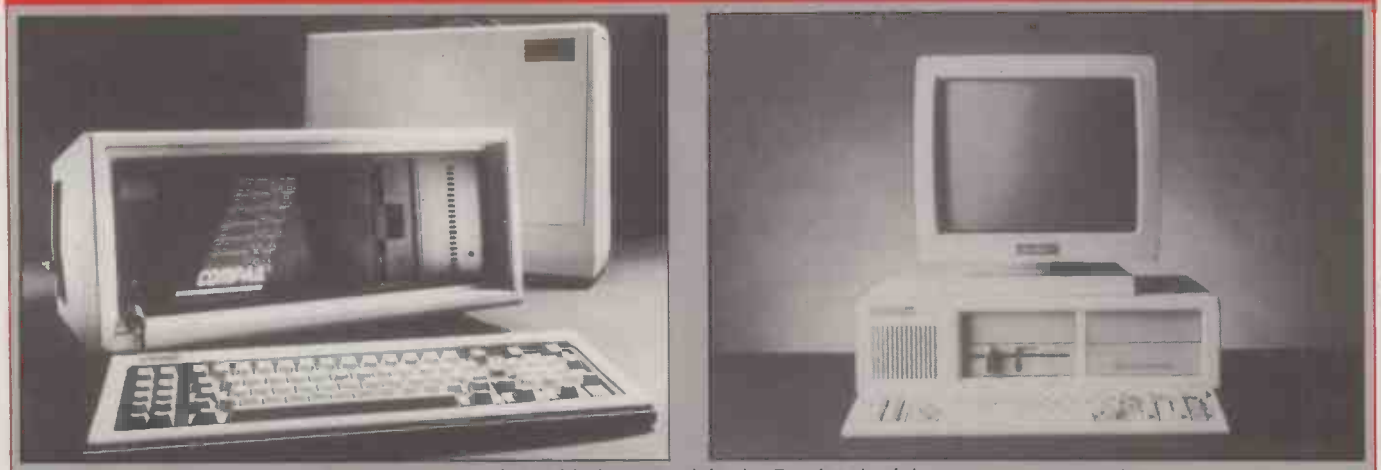
Since then we have seen a continual drop in prices across the board. At the beginning of 1986 companies such as Computopro offered PC clones for around £1,000 and XTs for £1,400. As we reported in our June feature on clone makers, there are now over a dozen manufacturers with machines in this price range. Below even these figures is the Osborne PC, which we reviewed last month: a complete system with two floppies costs less than £600.

Practically every major manufacturer of

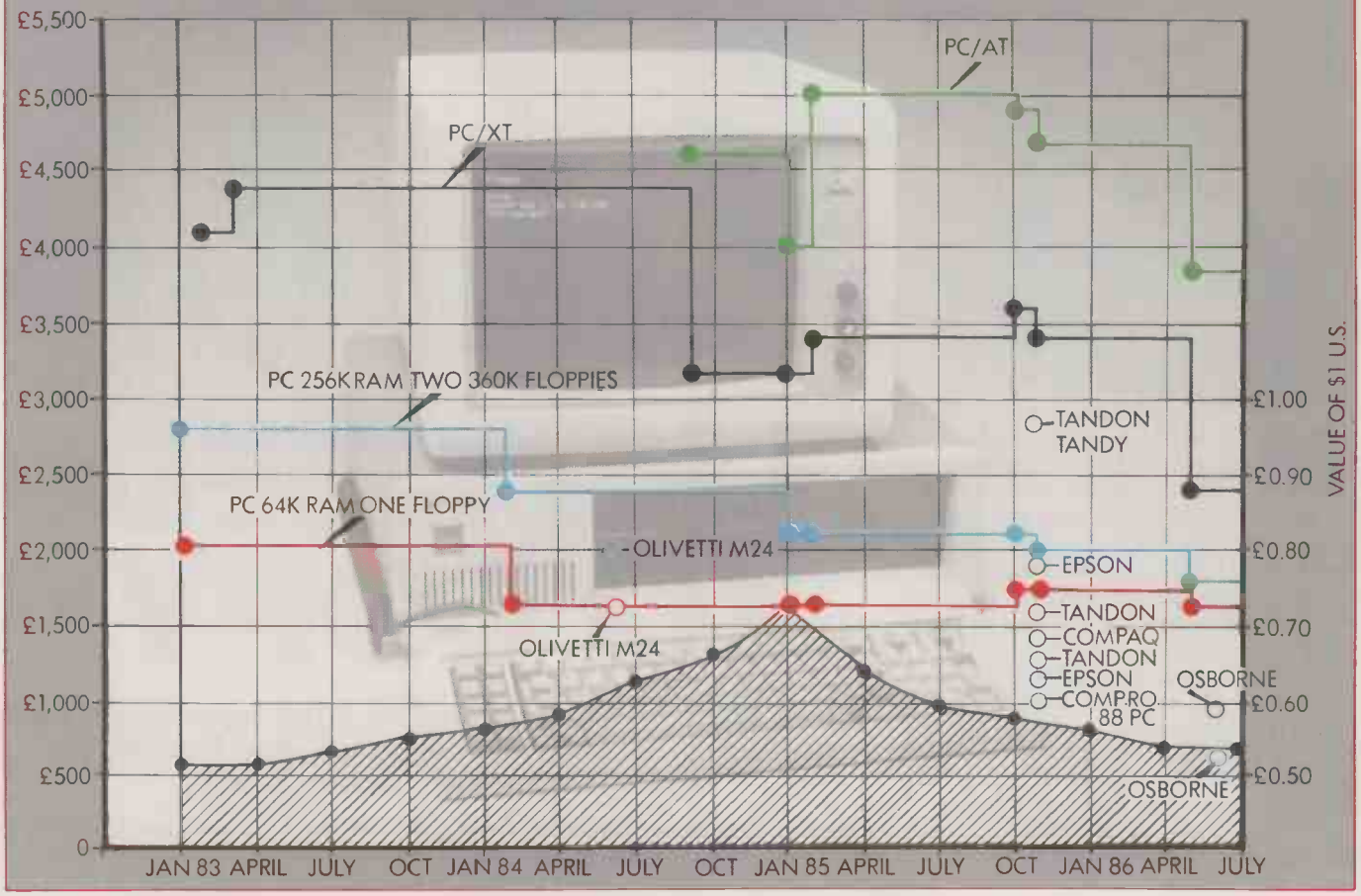


The Olivetti M-24 was one of the first clones to have o significant price advantage over IBM's own machines.

PRICES OF IBM PC FAMILY AND CLONES



Compaq (left) took the value-added route while the Tandon (right) concentrates on price.



IBMulators has followed this downward spiral of pricing, but IBM has responded by announcing more up-market machines. Clearly its strategy is to preserve its position and margins by offering performance rather than price cuts. It has also thrown a spanner in the works by launching the Convertible, with its 3.5in. disc drives, and announcing that similar drives will also be available as options for the XT and AT. The implication is that even if IBM cannot stop the fall in prices of conventional PCs with 5.25in. drives, it can at least try to hold on to its position by making that technology obsolete.

This change in format may cause the price-cutting trend to break step but not to stop, and IBM knows this. Its chairman, John Akers, has even gone so far as to indicate that IBM has no wish to participate in a pell-mell rush towards miniscule profit margins, and that it will abandon the commodity sector of PCs in favour of the more profitable upper end of the market. Apricot's recent experiences also show that this general price plunge is not something you can fight against. You either have to get in there and slash prices with the rest of them or, like Apricot, you get out.

For the user, the question is how long can this go on? Pundits are predicting basic IBM PCs for around £300 by the end of the year. That will mean a complete, workable system will cost less than an Amstrad PCW-8256. Alan Sugar's plan for an Amstrad PC is now one of the industry's worst-kept secrets, at least in outline. The unknown factor is price. Profit shaving has become so extreme that it is hard to see how even a consummate operator like Sugar will be able to concoct a product which undercuts the competition. It may well be that the determining factor will not be price but specification, particularly in terms of bundled software.

Whether or not the Amstrad PC proves to be the great non-event of 1986, it remains a fact of life that after the past six months PC pricing will never be the same again. After all, the 1983 machine is now available for one-fifth of its original price. Since that drop ignores the effect of inflation, there is every hope in these apparently inflation-free times that price cuts will be even more dramatic in the future. PC

GARY WING

LICENSED TO COPY

Steve Malone examines one way large organisations can obtain multiple copies of a program without incurring the wrath of the company that produced it.

Most micro software is still sold on a one-off basis, the assumption being that it will be used by a single user working in isolation on a stand-alone micro. But life is not quite like that any more. In many large organisations the same program will be used by tens or hundreds of individuals, and may be running on multi-user or networked systems.

As a result, many large users are starting to demand the ability to copy programs without getting on the wrong side of the software publishers and the law. A new type of agreement known as site licensing has been devised to meet this need. Customers who are party to an agreement of this kind are permitted to make copies of their program discs in return for a flat fee paid to the software supplier.

The move towards site licensing has been led by large corporations and government purchasing agencies which have aimed to use their enormous spending power to try to force down the cost of bulk purchases. Although initially the idea was dismissed by a number of large software houses, it seems to have caught on with end-users, so now even the biggest companies are giving it serious consideration.

The dilemma for the big software houses is that the epidemic of illegal copying has only recently been brought under control by the introduction of copy protection and copyright laws prohibiting unlicensed copying. Now the software houses feel they are being asked to take the lid off the same problem once more.

The initial response of the publishers has been to see the desire for site licensing simply in terms of customers wanting cheaper products. This has led companies like Micropro to arrange for discounts of over 50 percent for large orders. The discounts offered are on a sliding scale: for example, orders of around 15 copies of WordStar 2000 get a reduction of 45 percent, which rises to 57 percent for purchases of over 500 copies. Cumulative purchases are taken into account, so the customer does not have to splash out on 500 copies at once to gain the maximum benefit from the scheme.

THE REAL NEED

Although this arrangement goes some way towards satisfying the demands of end-users, it fails to address the real problem. The reason most users want unprotected programs is for security, not to enable them to make copies and hand them around. Because magnetic discs are a notoriously unstable method of storage, users of a protected program are justifiably nervous in case the master disc becomes damaged in some way. It is peace of mind that they are primarily interested in rather than software distribution.

So if unprotected software is popular among users, why are a larger number of software houses not adopting it? When we asked a number of software publishers we got a variety of answers ranging from the cautious to the paranoid. Some of those with a commanding position in particular markets see no reason why they should offer further incentives to buy their programs when customers have already decided to standardise around it.

But many objections by software houses are the result of there being no clear definition of what site licensing involves. For instance, Lotus told us that it considers the

ability to install 1-2-3 and Symphony on hard disc to be a form of site licensing.

Apart from the problem of defining what site licensing is, there is also the difficulty of deciding what constitutes a single site. Is it an office, building, region, country, corporation or subsidiary? Furthermore, how does a software house judge what a site licence is worth and how long it should remain in force. It is also difficult for manufacturers to ensure that all the copies are going to authorised users and not just being "copied and sold by some of our dealers", as one major software house with bitter experience complained.

It is this kind of imponderable which led a Micropro spokesman to condemn site licensing as "unworkable, inequitable and unfair". Yet Micropro has introduced a Corporate Licence Agreement that stops just short of full site licensing.

INSPECTORS

The Micropro plan is to provide programs that are not copy protected. The user will be able to purchase a number of serial labels which are placed on each new copy as it is made, effectively licensing the copy. A corrupted disc can have its serial label transferred to a new copy. To ensure fair play, Micropro reserves the right to send independent inspectors to the licensee's premises.

One company that is offering full-blooded site licensing in the U.K. is Computer Associates' Micro Products Group, which manufactures the Supercalc series. For a single fee starting at £60,000, companies can obtain a corporate licence that allows unlimited copying. The actual price of the agreement is set by Computer Associates after examining the site, with the final price depending on how many personal computers and people are likely to use the product, the projected growth and the company's turnover.

Most users want unprotected programs for security, not for them to make copies to hand around. It is mainly peace of mind they are interested in.

Once the terms are agreed, Computer Associates hands over a master copy which has the licensee's logo on the title. This allows Computer Associates to trace any copies which might go astray from the licensee's site. The software house is also able to offer user support and training for an additional sum.

Computer Associates says that it has had an enormous amount of interest in the scheme because it allows standardisation throughout a company, as well as providing security. With an estimated 20,000 micros GEC is one company that has taken advantage of the scheme, and Computer Associates is talking to a number of other firms.

At present licensing agreements are mostly geared towards the stand-alone micro, but the recent rise in demand for multi-user and network systems has introduced a further complication. A single copy of the program on a file server can be used simultaneously by a number of people.

Most companies have separate licensing deals for networked software. For example, Ashton-Tate sells the stand-alone versions of dBase III and Multimate for £599. For an additional £799 you can buy a LAN pack which allows a further three accesses to the packages. Although this might be suitable for small LANs, in the future there will be networks which allow 200 to 300 users to be served from a single package. When that happens the current piecemeal arrangements will no longer suffice.

The problem is compounded by large corporations which want to keep a single package on a mainframe for security and easier maintenance, with the program being distributed to terminals networked to it. Lotus has tackled this problem already. It is currently running a pilot scheme with the oil company Exxon and is looking to continue the experiment with other interested companies.

The development of site licensing is likely to draw manufacturers and end-users closer together. A corporation that holds a site licence is likely to make greater demands in terms of support and training on the software house and its dealers, which in turn will want to keep tabs on the way its product is being used. PC

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ISDN

The Integrated Services Digital Network transforms existing phone lines into fully fledged data links. **Jack Schofield** looks at what the system will mean for communicating micros.

The idea behind the Integrated Services Digital Network (ISDN) is to extend the benefits of the digital telephone network right into the home or office, adding data communications to voice. It depends on having two things: a digital telephone exchange, and a black box at the user's end of the line to multiplex the channels. The key point is that you do not have to replace the existing twisted-pair wiring that already provides the voice telephone service. ISDN does not await large-scale recabling or a satellite dish in every front garden, both of which would require a massive investment and take decades to complete. ISDN is relatively cheap, and should be in widespread use by the end of this decade.

An ISDN line should be able to provide speech, data, high-speed facsimile, telex, photo videotex and slow-scan television. The data channel could be used for anything from accessing distant databases to remote meter reading and burglar alarms. ISDN will provide users with access to their local packet service, which in the U.K. is British Telecom's Packet Switch Stream (PSS).

INEFFICIENT

All this is possible because the analogue telephone is an extremely inefficient way of carrying information, and in practice it only works one way at once. By working digitally much more data can be put through the same line. In fact the International Telegraph and Telephone Consultative Committee (CCITT) has decided that one line can carry 144kbit of information per second. A good-quality voice call requires only 64kbit/s, which leaves another 64kbit/s channel free for data or voice, with a 16kbit/s D channel for signalling information. This arrangement is known as 2B + D.

One 64kbit/s data line is enough, at least theoretically, for over 50 simultaneous, 1,200-baud modem links to databases like Prestel, or 1,280 telex lines at the standard 50 baud. Using facsimile, an A4 page could be sent in about eight seconds — though the creaking old telex network will decline, and fax itself is unlikely to survive when high-resolution graphics can be sent at high speed from one micro to another. The possibilities for new services such as picture-phones are exciting.

But so far all of this is pretty much pie in the sky. The standard is not complete, the equipment is not being manufactured, and no one really knows what consumers will want to do with the extra capacity anyway. And even if these problems were solved, there are not enough digital telephone exchanges installed in the U.K. yet.

Nevertheless there are some pilot projects under way. BT is running trials in Milton Keynes and elsewhere. Both the U.K. and France should be going national in 1991 to 1992. Switzerland and Italy are expected to follow in 1992 to 1993, and then Germany in 1995. In the U.S., AT&T's Bell Laboratories is backing ISDN heavily, and seven of the 22 Bell operating companies have ISDN projects.

Most of these projects are business orientated, since the facility to replace a messy mixture of telex, data and voice lines with ISDN's integrated access is particularly attractive to corporations. Equally, the chance to charge corporations huge sums of money is attractive to telecoms vendors. There is one trial of domestic use, called Project Victoria, which is being run by Pacific Bell in the U.S.

British Telecom calls its ISDN project IDA, which stands for Integrated Digital Access. So far there is only a pilot service available via four large digital telephone exchanges: London Baynard, London Maida Vale, Birmingham Midland and Manchester Blackfriars. Extension lines have been run as a short-term expedient to carry IDA to about 60 business centres, though so far British Telecom's charges for this are not really economic.

IDA does not actually follow the full projected ISDN specification, which is compatible with the seven-layer Open Systems Interconnect (OSI) model being defined by the International Standards Organisation (ISO). British Telecom is buying multiplexers from STC to convert IDA to CCITT. But the general view is that it is important to get started using what is available and worry about the details later.

An ISDN line should provide speech, data, high-speed facsimile, telex, photo videotex and slow-scan TV — anything from accessing databases to burglar alarms.

Indeed, it seems likely that BT will never try to install a complete ISDN system: it has too much invested in current digital exchanges to replace them. Instead, BT will deliver IDA to the customer, to whom it will look like ISDN. The actual network design will be solely BT's problem, because it will not be visible to the user.

For now both IDA and Project Victoria offer integrated digital access at a maximum data rate of 80kbit/s. In IDA, the main band of 64kbit/s can be used for voice or data. A second band of 8kbit/s is used for data, being changed to 64kbit/s at the local exchange for transmission through the main network. The D signalling channel is also 8kbit/s.

Getting a single line on IDA costs £890, which includes the NTE1 or Network Terminating Equipment. The NTE1 is designed for desk use and includes a telephone handset, a keypad and an LCD display. The annual rental is £710. Unless you live in London, Birmingham or Manchester you might have to pay several hundred pounds more for the connection. Running cost are extra too.

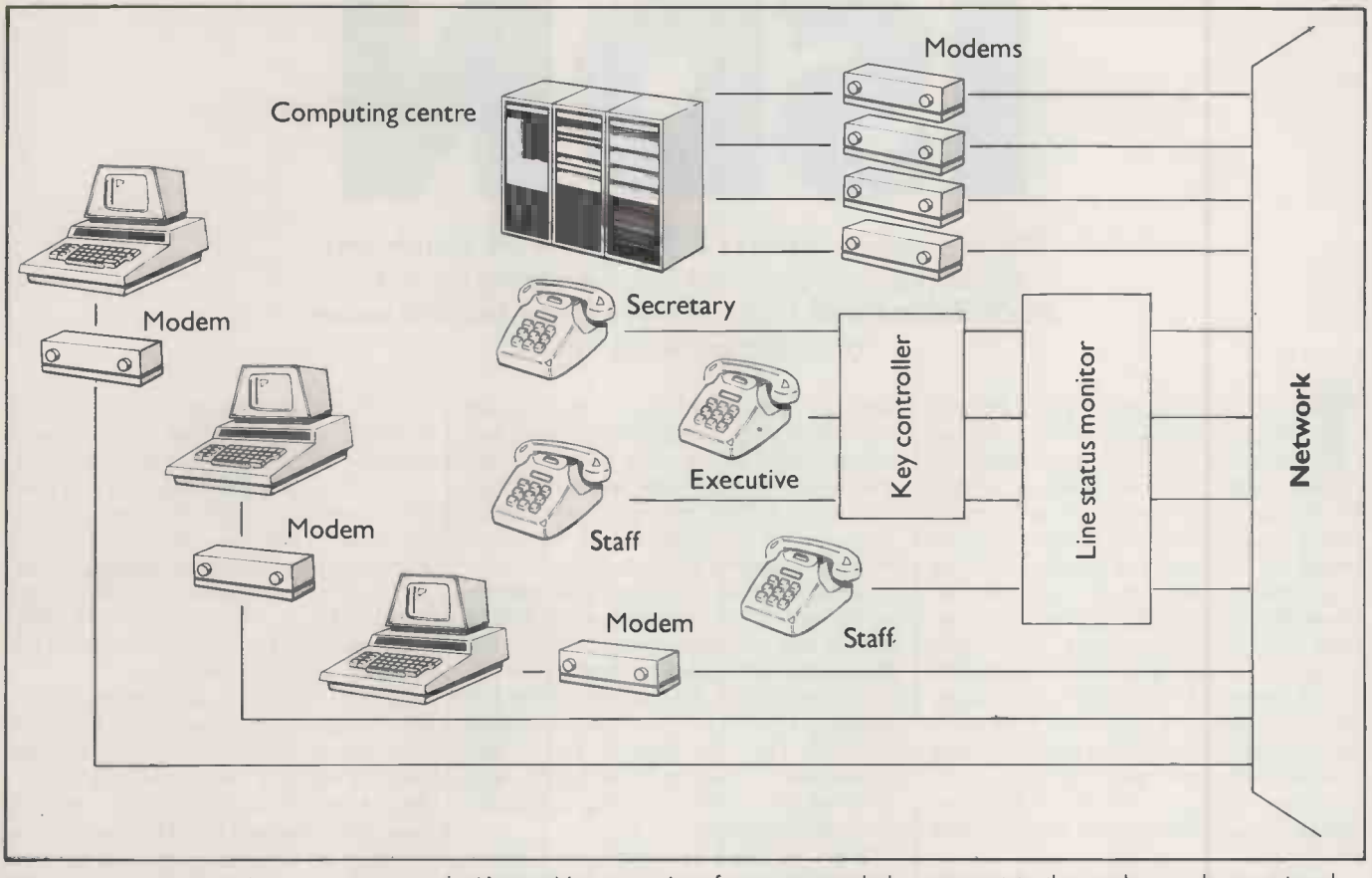
MULTI-LINE CONNECTION

For heavy users, BT offers the multi-line NTE3 with up to 30 channels. This provides what is known as a primary access. The total data rate can be up to 2Mbit/s in Europe, or 1.5Mbit/s in the U.S. International links to other ISDN networks are planned for autumn 1987.

Project Victoria is interesting because it aims to allow people to use existing equipment as far as possible. Pacific Bell claims it will work with virtually any telecommunications equipment, information service, transmission carrier or computer terminal. Pacific Bell is definitely aiming at residential and small-business users, which in California includes the large overlap of self-employed consultants and other professionals working from home. It sees this market as having enormous potential.

The company has 200 people using its equipment on trial in the small town of Danville, California. They were chosen by mailing 1,400 residents, of whom 900 volunteered for the project. The final

(continued on next page)



(continued from previous page)

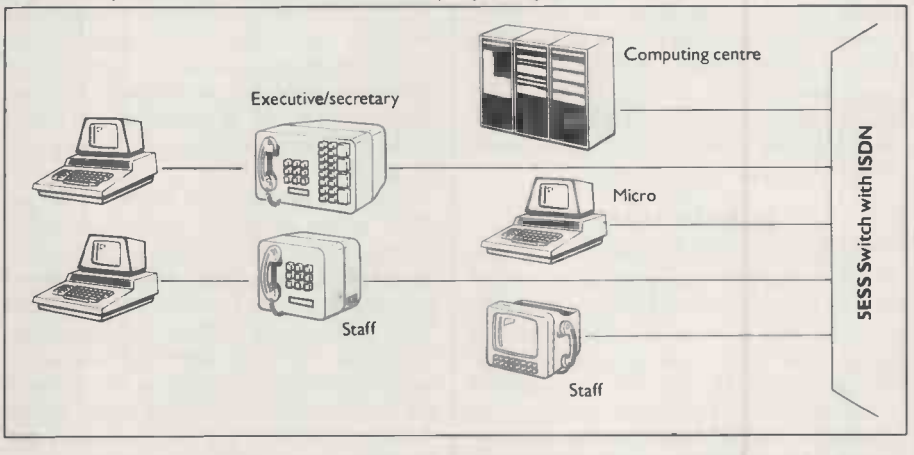
selection was made to get a balance of one-third computer illiterates, one-third people who had computers, and one-third who already had a computer and a modem. Half those selected were Pacific Bell employees.

Each person was loaned a hand-built black-box multiplexer which Pacific Bell calls an adaptive differential pulse code modulator (ADPCM). It is about the size of a stereo amplifier, and has seven phone-type sockets which provide the phone line with two voice channels at 32kbit/s — half the ISDN standard — plus five simultaneous data communications channels. One of these works at speeds from 300 baud to 9,600 baud, and the other four at speeds from 50 baud to 1,200 baud. A redundant minicomputer handles the routeing of input to different gateways on the exchange.

The ADPCM can be connected to any micro which has an RS-232C serial port, but Pacific Bell provided each person with an Apple Macintosh computer as well. This was to provide ease of use through mouse-driven software, plus a few fancy extras. For example, people using the Project Victoria bulletin-board system, with its 100-channel on-line chat facility, can send little faces showing different expressions, and also have comments spoken in a digitised voice by the micro.

People familiar with CB Simulator on the Compuserve database in the U.S. would find the Danville board very similar. Indeed, many people are using the same Virtual Space Software downloaded from Compuserve because it allows you access at 9,600 baud via the ADPCM and X-25 packet switched network. People who are not taking part in Project Victoria can also log on to the board at normal speeds of 300 or 1,200 baud using a modem and the ordinary phone system.

Above: Numerous interfaces are needed to connect to the analogue phone network. Below: Any CCITT-standard device should plug straight in to ISDN.



The other services available to those with equipment on trial are MCI Mail, Dow Jones News, Teleguide, Home Banking with the Bank of America, and an energy-audit system from Pacific Gas and Electric. Teleguide is a Prestel-type information service which uses the North American NAPLPS protocols — much prettier than Prestel — and contains large amounts of local information. Many Teleguide terminals are installed in the smarter shopping centres and hotel lobbies for free use by the public. Burglar alarm and energy-management facilities are to form part of the next trial.

If it goes public an ISDN system would at least provide most households with practical justification for owning a proper home micro. For businesses users the system promises the total transformation of the telephone system. In theory ISDN should be able to connect all terminals to all networks, which would be quite a challenge. But the combination of voice, electronic mail and a few videotext databases coming down the same line to the same terminal would be a dream come true for most of those struggling with the morass of incompatible systems currently available in the U.K.

Further information on ISDN is available in various publications from British Telecom. PH3489 gives details on IDA, PH3490 on availability, PH3496 on tariffs and PH3702 on ISDN. You can also call British Telecom on Freefone Linkline (0800) 222444. PC

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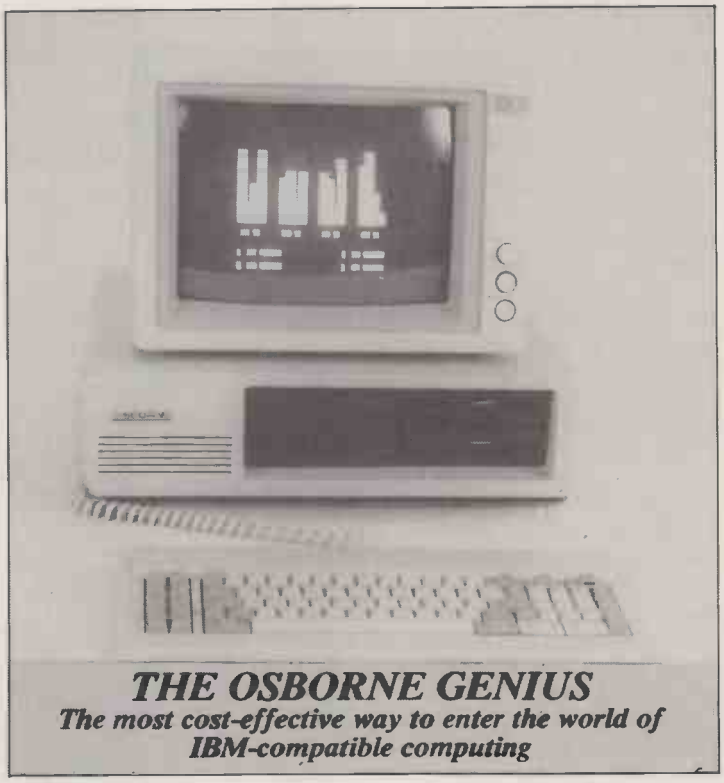

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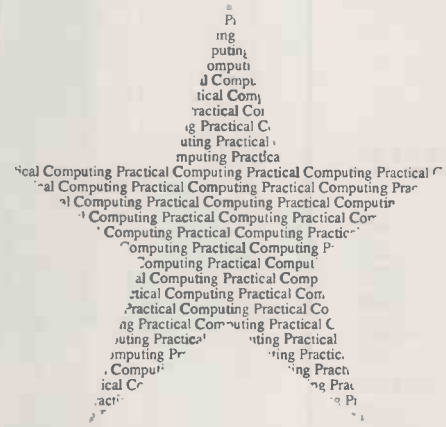
83

THE INVISIBLE LINK

Ian Stobie investigates the printer-control languages that have spurred on the development of personal publishing and laser-printing applications.



The Postscript page-description language allows you to specify arbitrary clipping boundaries for text and graphics. You can use this feature of Postscript to crop any text, graphic or scanned image to a specified clipping region. You can also run text to fill irregularly shaped areas.

Page-description languages (PDLs) form the vital link between the most powerful modern printers and applications programs such as word processors or page make-up packages. The best known is Postscript, which runs on the Apple Laserwriter and some Linotype typesetting machines. But other PDLs such as Ripress, Interpress and DDL are emerging to compete with it on other manufacturers' equipment.

PDLs are rarely seen by users. Most of the time the code is generated automatically by the application program or operating system which they are using. But PDLs are important because they form a device-independent layer between the user's software and hardware. Which PDL a printer uses ultimately determines which software will run on it.

Any printer needs to be told exactly where to mark the paper. So languages of some kind have always existed to control printers. The Diablo 630 protocol originally developed for Diablo daisywheel printers and the Esc/P command language designed for Epson's dot-matrix printers both do the job of PDLs and are now widely used standards.

But as printers have increased in power so control languages have had to increase in complexity to match them. With a simple printer like a daisywheel much can be left implicit. You send a sequence of character data to the printer in ASCII. You change things like the vertical and horizontal spacing or page length by sending simple one- or two-byte codes. ASCII itself has fossilised within it a few control codes for line-orientated printers, such as Tab, Backspace, Linefeed and Formfeed.

MATRIX PRINTERS

Dot-matrix printers have more flexibility and so they require more extensive command languages, but the principle is still the same. The Epson Esc/P command language employs a host of two-, three-, four- or even five-byte codes to define, say, condensed, emphasised or double-strike characters. You can also use codes to select different character sets as the dot patterns are pre-defined in the printer's ROM or downloaded into a local memory buffer.

Many matrix printers can handle bit-mapped graphics, which can be regarded as an extension to the command language. Here you first send a control code to select graphics mode, Esc-K for example. The printer then interprets subsequent characters as patterns to control the positioning of individual dots on the printer. Nine-pin matrix printers typically use eight pins for printing graphics; a vertical row of eight dots at a specific at point on the paper can then be represented by one byte of data.

This combination of control codes and bit-mapped graphics provides a flexible and complete way of describing a page to a printer. The problem comes as the output quality of printers improves. Laser printers work at very high resolution, typically 300 dots per inch. So to send a page or a substantial part of a page to a laser printer as a bit map would mean sending over half a megabyte of data, which would take a long time and tie up a large amount of memory on the user's system.

The problem is made worse because a laser printer needs an image of a complete page to work from. Most other sorts of printer can print part of a page and then wait while the application software figures out what it wants to do next. But once a laser printer starts on a page it has to finish it.

This is because in one sense its xerographic technique is more like photography than printing. The photo-sensitive coating of the drum and the power of the laser have to be carefully matched to the rotational speed of the drum to get the right exposure. The drum cannot stop to wait for data to arrive, so when it starts to move, all the data necessary to complete the page has to be ready.

For these reasons it makes sense to give the printer a processor and large memory buffer of its own. The user's computer can then define the page in a compact and easily transmitted way and the printer will reassemble the description into a bit image in its own large memory buffer.

Not all laser printers use this approach but as soon as the amount of graphics or the complexity of a page reaches a certain level it is probably the most effective. Where several users share the same printer on a network it is particularly desirable to reduce the amount of time print jobs take crossing the network.

The PDL is obviously a key part of this process. The page description takes the form of a program written in the syntax of the particular PDL, which takes up far less space than the equivalent bit map. The PDL program is transferred across to the printer, where in the case of Postscript it is executed by a built-in interpreter running on the printer's own processor. The output from the program is a printed page, which is produced from a full-page image assembled by the interpreter in the printer's memory buffer.

The Apple Laserwriter is the cheapest laser printer with a full PDL. It contains a 68000 processor, 1.5Mbyte of RAM and 500K of ROM. The ROM contains some fount definitions written in Postscript and a full interpreter for the language.

Postscript is similar in power and complexity to an ordinary programming language like Basic. Its syntax resembles Forth more than Basic: it is stack orientated and uses a postfix notation in which operators are preceded by their operands — hence the name Postscript.

A Postscript program usually consists of a header called a prologue and a data-dependent part called a script. The prologue will probably be written by a member of a team developing some application package; an appropriate script is then generated automatically by an application program each time the user wants to print a new page.

Postscript itself does not make any formal distinction between program elements and data, which can make a machine-written Postscript program very hard to read. A script will normally contain a great deal of data in the form of Postscript's literal constants, which are enclosed between parentheses, interspersed with the occasional procedure call.

HUMAN-WRITTEN

The human-written prologue will probably be easier to read, not least because it should contain a few comments, identifiable by the % sign that precedes them. The prologue normally contains little data but a large number of procedure definitions for the application to use when generating the script. This structural convention of script and prologue is useful for large programs, but Postscript itself is indifferent to whether programs conform to it. Small programs can be written more simply.

With Postscript printing is likened to painting. You build up an image by placing paint in selected areas. The paint can be in the form of letter shapes, lines, filled geometric shapes or even half-tone representions of photographs. The paint can be in black, white or any shade of grey, but the last colour applied is the one that shows. Only when the painting process is complete

Practical

This smeared print of the word "Practical" is achieved with a loop. The word is represented in the laser printer's memory buffer 19 times, each time in a slightly different shade of grey at a slightly offset position. It is then entered one last time in white, and the page is actually output to paper. The Postscript program to do this (right) was run on an Apple Laserwriter and is based on a listing given in *Postscript Language Tutorial and Cookbook*, one of several books on the subject recently published by Addison-Wesley. The image below was produced from Postscript code generated with the Just Text package.

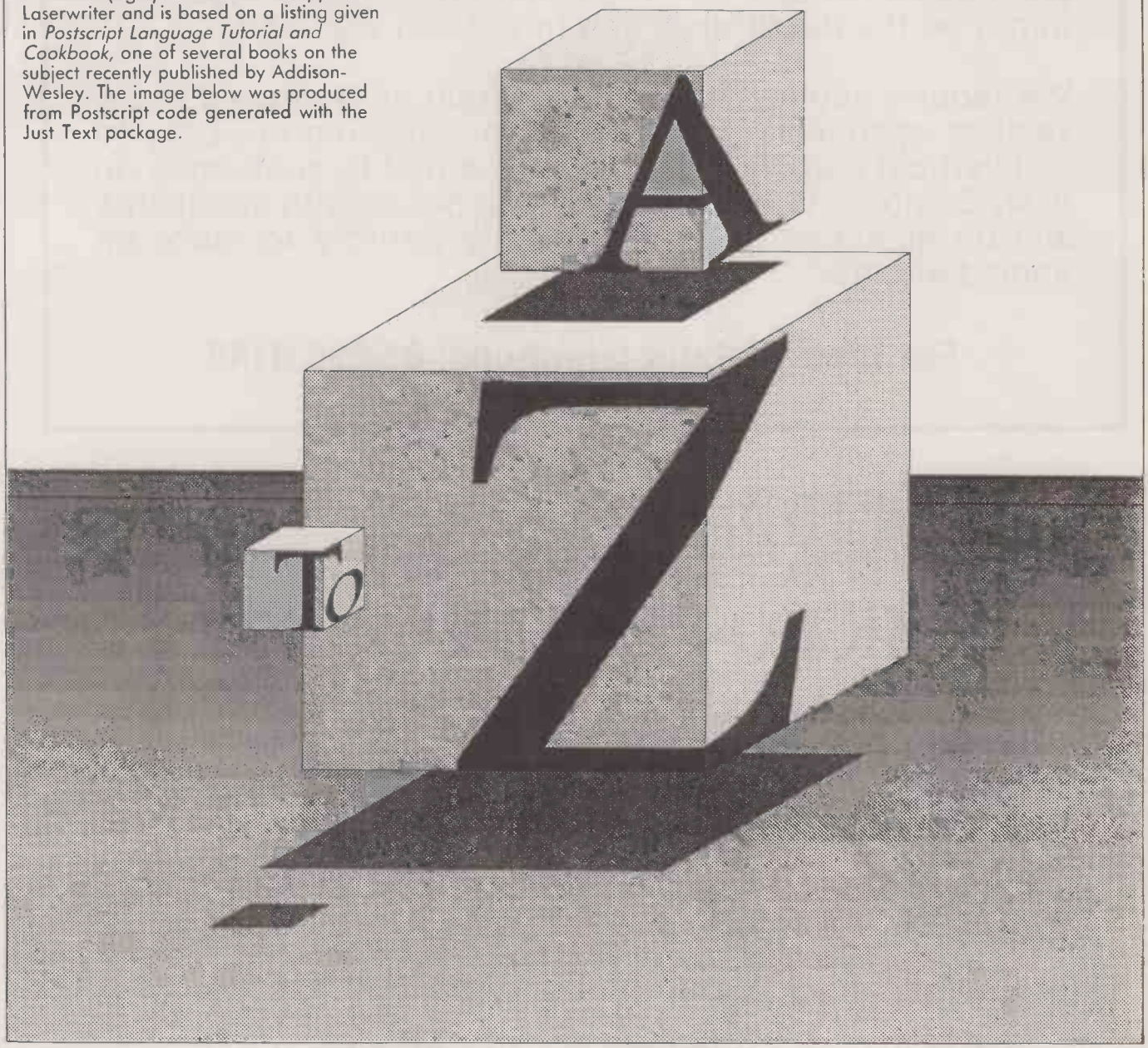
```
% Example PostScript program

/Times-Italic findfont 40 scalefont setfont     % select font
/printName{ 0 0 moveto (Practical) show} def    % define print procedure
320 400 translate                                % locate in mid page

.95 -.05 0                                       % set loop conditions
{setgray printName -1 .5 translate } for         % start incr end
                                                 % do procedure n times

1 setgray printName                              % do one more time in white

showpage                                         % print current page
```



is the page actually printed by the Postscript output device.

Our example programs were run on an Apple Laserwriter. Since the Laserwriter contains a full interpreter you can program it simply by connecting a suitable terminal to its RS-232 port. A Macintosh running Macterminal or Vicom is the obvious choice, but any other computer with an RS-232 and terminal-emulation software should work. If you do it this way a PS> prompt appears on-screen once communication is established, and you type in the program line by line.

Since the Laserwriter does not contain a proper editor it is more convenient to prepare the program separately with a suitable piece of software and then download it. We used an editor and downloader provided to dealers by Adobe Systems, which will work with the Laserwriter attached to an Appletalk network. On the Mac you could also use Just Text, a page make-up package which allows you to use Postscript directly.

The control that PDLs allow over the finished page has helped bring ambitious new applications to the personal computer. Some IBM programs support Postscript and work with the Apple Laserwriter. For example, Microsoft Word is probably at its best attached to this printer, as it can make full use of the Laserwriter's range of built-in founts.

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INTERVIEW

SIR CLIVE SINCLAIR

INTERVIEWED BY CAROL HAMMOND

After a period as a technical journalist, Clive Sinclair set up Sinclair Radionics in 1962. The company produced consumer electronic products, including radio and amplifier kits, hi-fi sets and, in 1972, the world's first pocket calculator. In 1978 Sinclair severed his connection with Sinclair Radionics and went on to form Sinclair Research, the company that produced the ZX-80, ZX-81, Spectrum and QL home micros. He was knighted in 1983. The computer side of the business was sold to Amstrad earlier this year. The residue of the company, now known as Sinclair Research Labs, concentrates mainly on research and development.

Are you still interested in computers?
ABSOLUTELY. To be honest, when I started in computers — which have always been a passion of mine — I wasn't that interested in the games side. I'm interested in the more serious users, which is one of the reasons why I was very happy with the deal with Alan Sugar because it got me out of the games business. I like to see computers as tools. When I started in the biz I thought my first job was to get people interested in using computers, and that's what we did with the ZX-80/ZX-81/Spectrum. Now is the time to start getting people affordable computers that function satisfactorily.

There has been talk that you are launching a new business computer, perhaps later in the year.
WE haven't got absolutely permanent plans yet. The idea is to go into the portable computer field, but that wouldn't be until next year. I believe that really the future of computing lies in portables, but at the moment few people use portables because they are an unsatisfactory compromise.

Will you be using flat-screen technology?
THAT'S not decided yet. But of course another of the problems with the current portable computers is the displays. Frankly, they are not as good as they need to be.

Will it be IBM compatible?
I THINK that a degree of IBM compatibility is necessary. You need to be able to switch files with IBM machines, but that doesn't mean to say it has to be an IBM clone. In fact, if it was I think it would suffer from deficiencies because that would imply some limitations that we wouldn't like to see.

Do you think the business micro market is getting boring?
UTTERLY — because we're not in it yet. It needs us.

What about the prototype of the silicon wafer chip?
THAT'S a firm called Anamartic and we've floated it off as a separate company now. We're in the process of raising the funds necessary for that: so far Sinclair Research has put £2 million into the project, Barclays Bank has put in £850,000 and now we're looking for another £6 million.

Will there be any funds from Amstrad?
NO, it has nothing to do with Amstrad. I think it's very important for people to begin to realise that all we ever did was one deal with Amstrad and that's that.

What effect do you think the chip will have on the semiconductor industry?
I THINK it will change the world, I really do. Wafer scale is absolutely the way to go, and it is the most amazingly pioneering thing we're doing at the moment. If you come back in a few years time then that's the way one will be making memories and computers. Wafer scale will just take over totally.

When you had the problems in April a lot of people made criticisms that it was down to distribution problems or a lack of marketing skills. How far do you think these are fair comments?
WHAT people fail to realise is that every company in the business got into trouble at the same time in the same way. It was universal. So you can't say it was this, that or the other, because it was the same for everybody. The whole industry was completely screwed up because retailers worldwide over-ordered and got it completely wrong. That screwed the manufacturers: it screwed us, Atari, Commodore, Acorn. It screwed the lot of us, and we can't all be that incompetent. We all had faults and could have done things better, but the problem was an industry-wide one.

With hindsight would you have done anything different?
YES. We were too ambitious with the QL. We should have stuck with the Spectrum base. The difficulty about that is that I am a person that wants to innovate. That's my job as I see it, so the temptation is always to try and map out new territory. Had the QL not had the teething troubles it had it would have done very well. We certainly did sell a lot of them.

Will you play safe in the future?
NO, I'm not going to play safe in the sense that I won't cease to risk my money on ventures; and some of those are bound to fail. But I'll try and keep them in separate compartments. We've got separate companies now, and we're looking to a different structure in the future. I've learnt a lot about the nature of business, how to organise things. I don't think I'll be playing safe, but I think I'll be more successful because of experience. Certainly any products I get involved with in future will have quality as the priority, but I'm not really interested in products that aren't innovative.

Where do you think you'll be in two years time?
A FRIEND of mine in Cambridge said that long-term planning in the computer industry is "What's for lunch?". Looking two years ahead is decidedly difficult at the moment. I couldn't make a prediction. PC

TOP 10

WP packages for the IBM PC range from the cheap and easy to the costly and comprehensive. **David Barlow** makes his selection.

One look at our top 10 shows just how stagnant the market for word-processing software has become. Only Executive Writer is relatively new. The remaining nine are little more than updated versions of old faithfuls. In most cases the specifications have been improved, but there has yet to be any worthwhile reduction in prices.

With packages costing up to £500, there is ample scope for wasting money on features you are unlikely ever to need. It is therefore not surprising that budget packages are becoming increasingly popular. Not only do they offer dramatic savings in the purchase price; they are also quicker to learn and far easier to use.

The publishers of word-processing heavyweights still appear to be thriving, but their future sales are likely to be more with the networking versions of their products. Microsoft Word, Multimate Advantage and Word Perfect all jumped on to the multi-user bandwagon quite early, and will no doubt reap the benefit of their foresight.

Printer support is important at all levels, and is crucial as far as the latest laser units are concerned. Lasers are well matched to the multi-fount capabilities of some of the more expensive word-processing packages. But even prosaic dot-matrix printers with additional letter-quality fount modules benefit from the sophisticated printer drivers that are now appearing. Word Perfect, for instance, has no fewer than 140 printers on its configuration list, and Volkswriter 3 boasts an impressive 71.

Improved display hardware is also beginning to make itself felt. If you have an IBM Enhanced Graphics Adaptor display-driver card and a high-resolution monitor it is now possible to squeeze 43 lines on to one screen instead of the conventional 25.

Spelling checkers are also improving all the time. Gone are the days when using one took so long that nobody ever bothered. Many will now pick up incorrect capitalisation and misplaced punctuation in addition to those ever-present typing errors, and most now give a list of suggested alternatives on request. It must be said that the appropriateness of the suggestions varies a great deal, and it is obvious in some cases that not enough attention has been given to the completeness of the dictionaries or the algorithms used for the search procedures. Anglicising still seems rather a hit and miss affair, and despite software houses' claims to the contrary some packages insist on placing a z where many people would prefer to see an s.

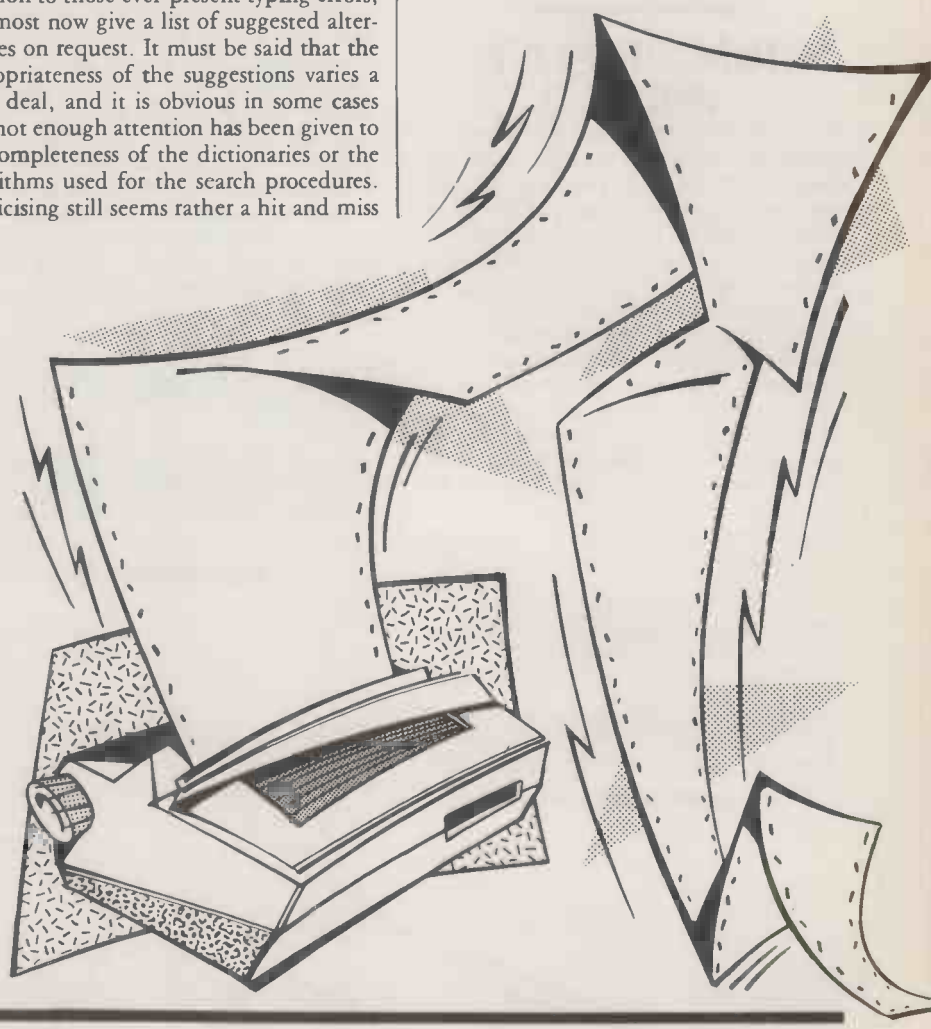
Convenience is now a key aspect of spelling checkers. They can check a word, a sentence, a paragraph or an entire document at the press of a single key. On the most compact checkers it is not necessary to swap discs on dual-floppy systems. For example, the entire program and dictionary used on PFS Write or IBM's Writing Assistant will fit on a single floppy disc when used with a 512K IBM compatible. This compactness helps to speed up the program too: it can check through a document's spelling at a speed of more than 60 words per second.

Finding alternative words is the job of a thesaurus, something that is starting to appear as part of the larger programs. Because of the file sizes involved, you really need a hard disc for a thesaurus to be a practical proposition. With a floppy it is much too slow.

There is no sign of an impending transformation in the market for WP software. But cheap packages will almost certainly continue to pack in more features for less money, simply to satisfy the demand from everyday users. In contrast, the established heavyweight programs will continue to command correspondingly hefty prices, relying for new custom on the ever-increasing numbers of corporate users installing PC-based network systems.

SUPPLIERS

Executive Writer: Computer Frontier (U.K.), Business & Technology Centre, Bessemer Drive, Stevenage, Hertfordshire SG1 2DX. Telephone: (0438) 310163
IBM: PO Box 32, Alencon Link, Basingstoke, Hampshire RG21 1EJ. Telephone: 01-578 4399
Multimate Advantage: Ashton-Tate U.K., 1 Bath Road, Maidenhead, Berkshire SL6 1UH. Telephone: (0628) 33123
PFS Write: Software Publishing Europe, 85-87 Jermyn Street, London SW1Y 6JD. Telephone: 01-839 3864
Smart: Innovative Software, Southampton House, 192-206 York Road, London SW11 3SA. Telephone: 01-223 3876
Volkswriter 3: Lifetree Software Europe, Lowndes House, The Bury, Church Street, Chesham, Buckinghamshire HP5 1HH. Telephone: (0494) 772422
Vuwriter: Vuman Computer Systems, Enterprise House, Manchester Science Park, Lloyd Street North, Manchester M14 4EN. Telephone: 061-226 8311
Word: Microsoft, Excel House, 49 De Montfort Road, Reading, Berkshire RG1 8LP. Telephone: (0734) 500741
Word Perfect: Sentinel Software, Wellington House, New Zealand Avenue, Walton-on-Thames, Surrey KT12 1PY. Telephone: (0932) 231164
WordStar: Micropro International, Haygarth House, 28-31 High Street, London SW19 5BY. Telephone: 01-879 1122



TOP 10

EXECUTIVE WRITER

SIMILAR in concept to PFS Write, though not as powerful, Executive Writer is a competent package at a bargain price. It forms part of Adam Osborne's Paperback Software series, and if you want to do mailshots you will also have to budget for Executive Filer. It does, however, boast an indexing facility and it supports macros up to 100 keystrokes long, both features not normally found on inexpensive packages. A spelling checker add-on module is available.

Price: £60

FOR

Good value. Simple to use. Macro support.

AGAINST

Rudimentary. Extra modules required for mail-merge and spelling checker.

IBM DISPLAY WRITE 3

A PROFESSIONAL package aimed at corporate users who might want to transfer WP files between their PCs and mainframes running Display Write 36 or Display Write 370. It includes all the usual WP functions plus a 100,000-word American spelling checker. Its mail-merge facility can accept dBase VisiCalc, Lotus, Multiplan or ASCII files. Display Write can manipulate numerical data; its capabilities include totalling and averaging. Macros of up to 500 keystrokes can be created. One unusual feature is the way it allows you to produce simple line diagrams to be incorporated into documents. Like Multimate, Display Write supports background printing and foreground print queues.

Price: £451

FOR

IBM name. Mainframe file-interchange facility.

AGAINST

Expensive. Spelling checker not anglicised.

MULTIMATE ADVANTAGE

THE fact that Multimate is now under Ashton-Tate's wing should ensure a healthy future for this professional word processor. Multimate is probably the most robust package currently available, and it is therefore ideal for the word-processing office where operators have little or no knowledge of micros. Boilerplating facilities are excellent, and the program can be extensively customised by the use of key macros. A powerful mail-merge facility is included as standard and it can accept data from other mainstream packages. The spelling checker has a large dictionary but is rather cumbersome to use. The Advantage version includes a simple card-index system, and will run on local area networks.

Price: £495

FOR

Robust. Established. LAN version available.

AGAINST

Cumbersome. Expensive.

PFS WRITE

PART of the PFS series of cheap and easy-to-use software, Write has now established itself at the lower end of the market. It is menu-driven and includes an anglicised spelling checker. Its facilities are quite basic, but they are sufficient for simple applications and are all exceptionally easy to use. Headers, footers and automatic page numbering are all supported. Mail-merging is possible in conjunction with PFS File. Charts produced by PFS Graph or the new Harvard Presentation Graphics can be incorporated into Write documents. IBM's Writing Assistant is based on PFS Write but has a more intelligent spelling checker.

Price: £125

FOR

Exceptionally easy to use. Fast, compact spelling checker. Good value.

AGAINST

Needs PFS File for mail-merge. Basic facilities.

SMART

THE word-processing module of the widely acclaimed Smart integrated-software package has some unusual and advanced features. There are no less than 12 founts, including Greek, Gothic and two custom founts. Smart lets you produce especially large documents, and you can store several files in memory at once, switching between them at will. The package is well integrated with the other Smart modules. It is easy to learn, thanks to the provision of confidence levels which bar inexperienced operators from the more difficult commands. Smart WP is supplied with a built-in 80,000-word spelling checker and it includes a mail-merge facility.

Price: £295

FOR

Integration with other Smart modules. Multiple founts. Easy to learn, thanks to confidence levels.

AGAINST

Needs other Smart modules to make the most of it.

VOLKSWRITER 3/ SCIENTIFIC

A COMPETENT package that has been developing and improving considerably over the past few years. Volkswriter 3 tends to overdo the use of the PC's functions keys: there are no fewer than four modes for most of them, making commands difficult to memorise. But it is a powerful package, and includes some useful features. The massive 170,000-word spelling checker can be run from RAM disc to make it even faster, and there is an auto-hyphenation facility. The Textmerge feature automatically inserts names and addresses into standard documents. Volkswriter 3 includes a multi-lingual facility that allows common characters and accents from major European languages to be used from the standard English keyboard. A new scientific/technical version is expected this year.

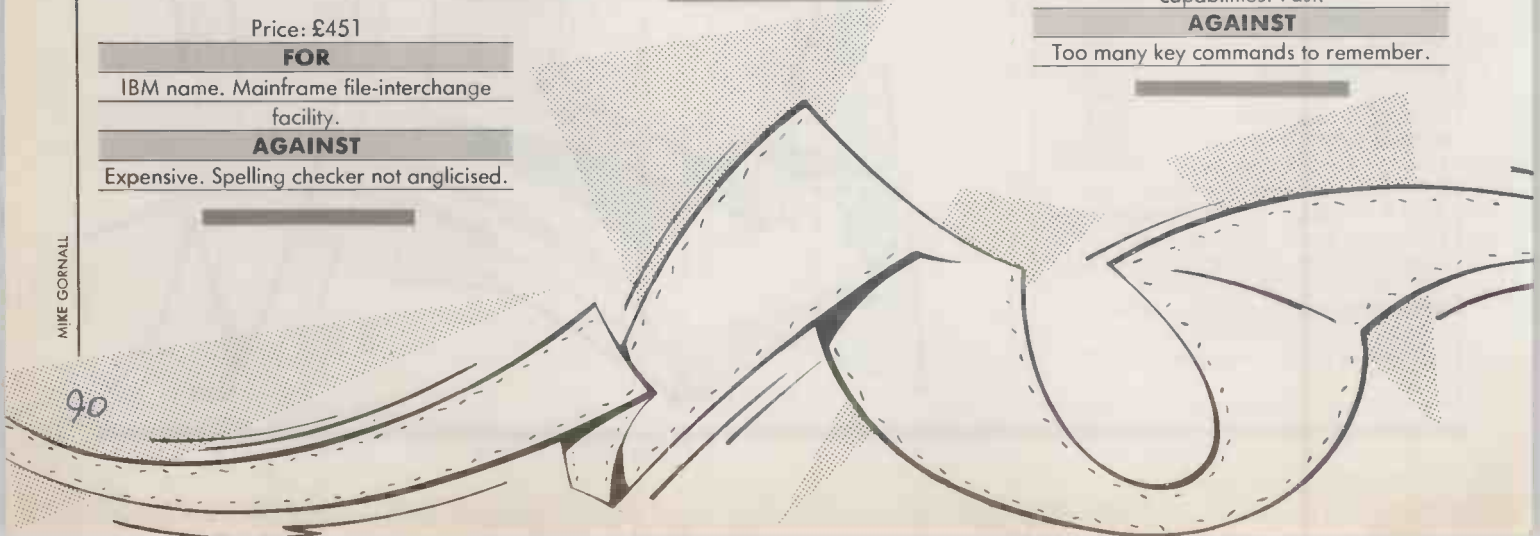
Price: £325

FOR

Massive U.K. dictionary. Multi-lingual capabilities. Fast.

AGAINST

Too many key commands to remember.



MIKE GORNALL

VUWRITER

THERE are two variants of Vuwriter. The Scientific version is for technical work with mathematical symbols and Greek characters. Vuwriter Arts includes German, Greek, Gothic, French, Danish, Spanish and Old English character sets. Complex mathematical formulae can be built up over three or four lines if necessary, and though this is a rather slow, painstaking process you can save basic formula elements into a glossary for reuse. Vuwriter can display several character sets and type styles on-screen at the same time. Keyboard translation tables are displayed on-screen when working in Foreign mode to signal which key will produce the required character. Vuwriter supports a wide range of printers, including lasers.

Price: from £295

FOR
Established. Flexible scientific and language facilities. Multiple-fount display.
AGAINST
Printer selection needs care. Disc-based tutorial required.

WORD 3

MICROSOFT'S powerful WP package adopts a radical approach that makes extensive use of graphics. It displays multiple founts and uses the same command structure as Microsoft's Multiplan spreadsheet. Word makes most sense when used with a mouse, although it is not essential. Word 3 includes an outlining facility which allows headings and sub-headings to be expanded into a full document. You can designate up to four Windows on the Word screen and transfer data freely between them. Sections of text can be assigned to a glossary and filed away on disc for later use. Word 3 includes a spelling checker and mail-merge facility. It can also be used on LANs, and a version to run under Xenix is thought to be under development.

Price: £425

FOR
Multiple-fount display. Spelling checker. Makes good use of mouse.
AGAINST
Expensive. Unusual user interface takes time to learn.

WORD PERFECT 4.1

ONE OF the most comprehensive WP packages currently available, though probably geared more to those who do their own writing than to secretarial use. Version 4.1 features a thesaurus, split screen, an Undo feature that restores the last three deletions, line drawing, sorting and improved proportional spacing. The spelling checker has a 110,000-word dictionary which will check anything from just one word to the whole document. The recently announced Word Perfect Library, which also works with the Mathplan spreadsheet, includes six extra desk-accessory programs, all contained within a menu-driven shell.

Price: £425

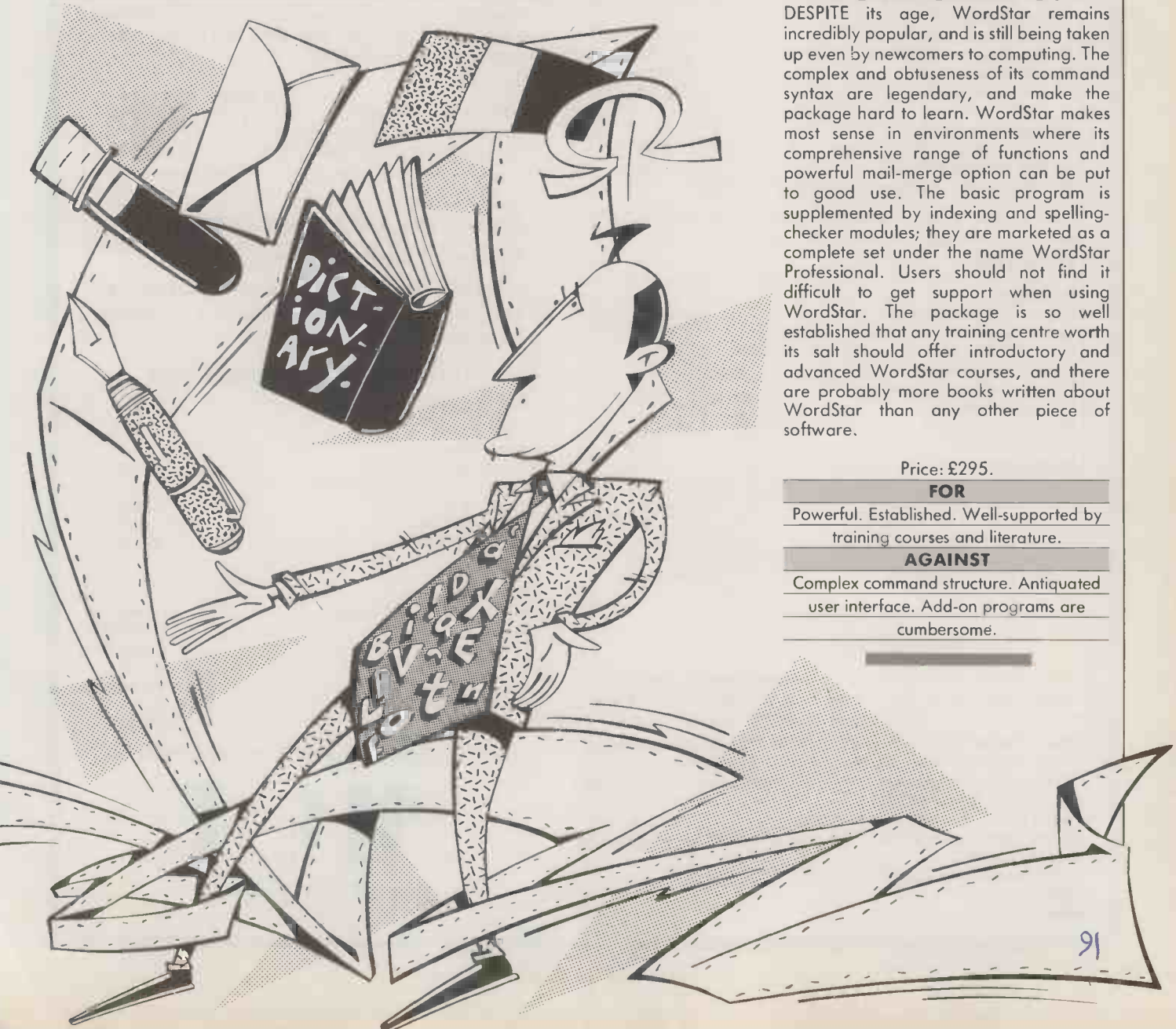
FOR
Full-featured. Thesaurus. Spelling checker.
AGAINST
Expensive.

WORDSTAR 3.4

DESPITE its age, WordStar remains incredibly popular, and is still being taken up even by newcomers to computing. The complex and obtuseness of its command syntax are legendary, and make the package hard to learn. WordStar makes most sense in environments where its comprehensive range of functions and powerful mail-merge option can be put to good use. The basic program is supplemented by indexing and spelling-checker modules; they are marketed as a complete set under the name WordStar Professional. Users should not find it difficult to get support when using WordStar. The package is so well established that any training centre worth its salt should offer introductory and advanced WordStar courses, and there are probably more books written about WordStar than any other piece of software.

Price: £295.

FOR
Powerful. Established. Well-supported by training courses and literature.
AGAINST
Complex command structure. Antiquated user interface. Add-on programs are cumbersome.



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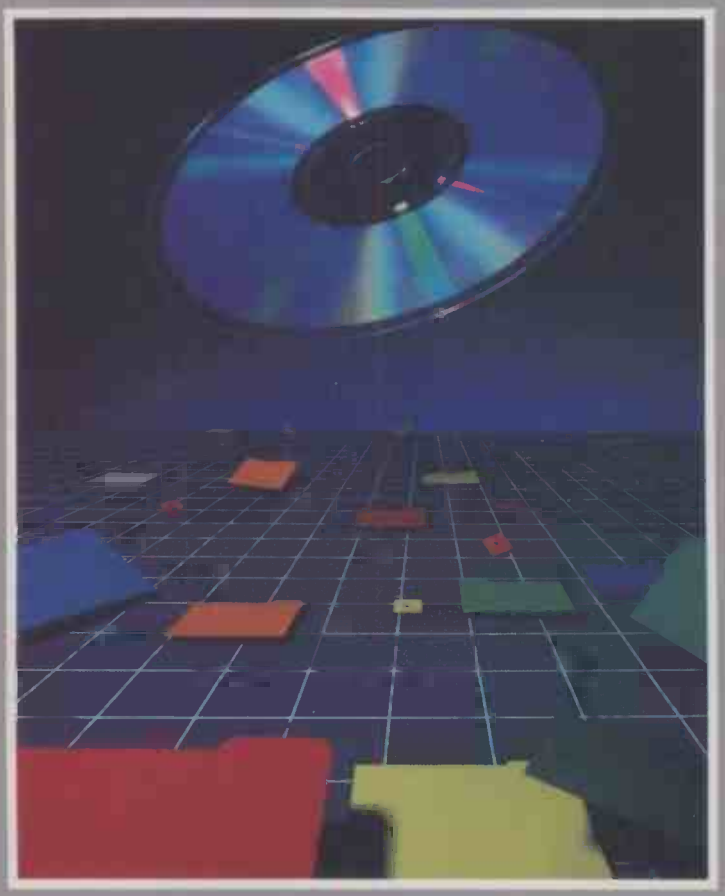
MASS STORAGE

Memories of the future

To match the processing power of modern micros you need somewhere to hold your data where it can be reached quickly and easily. **Glyn Moody** compares how the up-and-coming technologies tackle the task.



Mass storage is about holding information for periods longer than the duration of a work session; during a session it is usually held in a volatile form in RAM. Historically, mass-storage technology has always lagged behind advances in chip design. There are two main reasons for this.

One is that each order-of-magnitude increase in processor technology typically brings in its wake the ability to cope with a two-order-of-magnitude increase in mass storage. For example, the first rudimentary microprocessors like the Intel 4004 worked with around 1K of RAM. This meant that mass-storage devices were unlikely to have to store no more than a few tens of kilobytes; the chip could not cope with more.

The eight-bit chips, such as the Z-80 which lies at the heart of the CP/M systems, could address a maximum of 64K RAM initially. Associated storage devices rarely exceeded a few hundred kilobytes. Today the 16-bit chips like the 80286 and the 68000 can usefully work with around 100Mbyte of storage. In effect, each development in the silicon world leapfrogs forward and requires a number of years of steady progress in storage technology to match and exploit it.

The other main reason for this disparity is that whereas advances in chips are effectively quantised — there is no halfway house between the eight-bit Z-80 and 16-bit 8086 — mass storage proceeds by a process of continuous improvement and refinement. This has been most apparent in recent months with the appearance of ever smaller Winchester disc drives that can store increasingly large quantities of data. Not long ago a 5.25in. hard disc held a few megabytes; today the same drive may well top the the 100Mbyte mark.

In addition, storage units can nearly always be daisy-chained to give a capacity far greater than that of one unit on its own. This means that practically any mass-storage requirement can be met if you are prepared to pay for it. Advances in mass-storage devices have been largely a matter of reducing the cost of a given technology. This contrasts with the pattern of change in silicon technology, where there have been real advances which would be almost impossible to reproduce by linking together less powerful units. It is only recently, with the widespread use of optical techniques, that mass-storage methods have made a significant divergence from the last 20 years' progress in magnetic media.

It is noticeable that old storage technologies are rarely superseded entirely — again, in stark contrast with successive models of processors, which seldom suffer previous generations to co-exist with them. Instead, older storage methods begin to migrate to particular tasks or to specialist niche markets. As time progresses, a hierarchy of storage devices evolves, the place of each type of device being determined by its respective advantages and disadvantages in terms of speed, cost, ruggedness and so on.

For example, magnetic tape was once the dominant computer-storage medium. Now it is relegated to two specialised areas: among home-computer users, where its chief virtue is cheapness; and as a backup medium for hard discs. Its main limitation is the slow rate of data transfer, but in these areas speed is less important than economy.

The Winchester disc is currently undergoing an interesting transition from its previously exalted position as a special, extra-large archival storage device. It is beginning to take over the role previously played by the floppy disc, and is becoming the norm on most personal computers. Many people now find the floppy's data-transfer rate too slow and its capacity too limited. But if the floppy has been pushed down the hierarchy somewhat, it still has its uses. In particular, it is a convenient form for transferring information physically between systems. It is also cheap enough to act as a backup — though admittedly an inconvenient one — for hard discs.

At the same time we are seeing a rise in the importance of new technologies to fill the gap left by Winchesters further up-market. The role remains the same: they are relatively expensive high-capacity units, used mainly for archival storing. The write-once read-many-times (Worm) laser disc is the technology which currently seems to offer the best solution. Already there are units costing only a few thousand pounds — roughly the same as the first sizable Winchester drives — with storage capacities of a few hundred megabytes. Future developments will be directed towards increasing capacity still further, and to

(continued on next page)

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producing erasable discs. The CD-ROM represents another avenue presently being explored.

In the October 1985 issue of *Practical Computing* we surveyed the entire range of mass-storage technology. In this feature we concentrate on some of the products which fit into the current hierarchy of storage devices at key points.

PRICE-PERFORMANCE

The hard discs on expansion cards, considered on page 101, represent the last stage of the widespread implementation of Winchester technology. They offer the chance for everyone with an IBM or clone to update to what is now almost standard on all machines. Their lifetime is likely to be limited as the number of PCs not fitted with a hard disc will soon start to shrink. But until then these devices provide a neat instance of how successive products — they have advanced from 10Mbyte to 20Mbyte and now 30Mbyte — represent an advance in value for money rather than a radical change in technology.

One disadvantage of hard discs is that they are not generally removable. This can be an inconvenient constraint, and a number of companies have come up with solutions. Among them are Bernoulli discs, low-capacity Worm drives and fully removable hard discs, all of which are examined on page 97.

We also look at some of the new memory expansion cards like Above Board and Rampage. While they are not strictly mass-storage devices, their large capacities mean that their function will inevitably blur into the hitherto distinct realm of hard and floppy discs. The use of spare memory as a high-speed RAM disc is one example of how this will happen.

One of the most exciting developments in mass-storage technology has been the CD-ROM, which we discuss opposite. It is essentially no more than a read-only version of the Worm drives, but interestingly a common standard seems to be emerging — something that is rare enough in the bickering world of micros. The CD-ROM is noteworthy for the staggering quantities of data it can cope with. The move from floppy to hard disc was essentially one of degree, but the massive capacity of the CD-ROM could bring with it developments which cannot even be guessed at.

In fact the CD-ROM could represent a counter-example to the until now smooth evolution of mass-storage devices. It is a truism that as micros develop, the biggest threat to their usefulness is the data deluge: it may be that there will be just too much data available, and too little information. If the CD-ROM takes off as its promoters hope, it could prove to be the most significant storage technology since magnetic tape — or possibly even paper itself.

Compact data

The CD-ROM, like the related audio compact disc, is both durable and cheap to make. **Carol Hammond** explains the principles and prospects of this important new storage medium.

It seems that the CD-ROM is about to come of age as a mass-storage medium for computers. This is partly because of the recent agreement on a CD-ROM standard by the hardware and software manufacturers. It is also because there is the promise that more players may soon be available. A group of 11 Japanese hardware manufacturers have announced that they intend to join the ranks of Sony, Philips and Hitachi and produce CD-ROM players; Atari may be offering a CD-ROM for the 520ST. At the same time a slow trickle of software is beginning to appear, and more applications are being found for CD-ROM.

The name CD-ROM stands for compact disc read-only memory. The discs and their players are direct descendants of the audio compact disc. CD audio and CD-ROM use the same disc and laser-scanning technology, and the same mastering and replication methods. A CD-ROM player resembles a CD audio player in both appearance and operation.

The concept of CD-ROM grew up about five years ago when it was realised that because CDs store information in digital form they could perhaps be used with computers for distributing data. The first prototype CD-ROM drives were unveiled in 1984, and the first commercial drives and sub-systems appeared in 1985.

CD audio discs and CD-ROMs both store information in digital form. CD audio players convert this information into analogue signals, which are sent to a stereo amplifier. In a CD-ROM player the digital signals are sent straight to a computer.

It is the storage space on offer that is likely to attract most people to use the small, silver-coloured CD-ROM discs. Each disc measures only 4.7in. in diameter and weighs around 20 grams, but it is capable of storing 550Mbyte of ASCII characters. This is the equivalent of 270,000 pages of A4 text. It would take well over 1,000 standard 5.25in. single-sided floppy discs to hold the same amount.

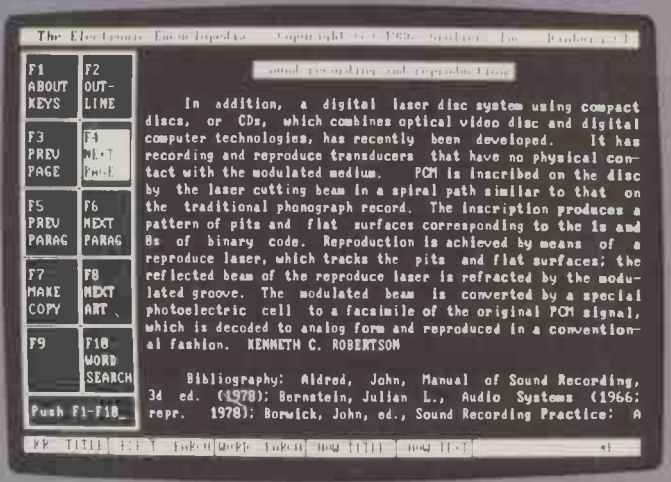
All it takes to access this information is a CD-ROM player, an add-on board and a special adaptor to link the player to a computer. Players normally come in stand-alone form and are about the size of a printer. Hitachi also offers a combined computer and CD-ROM player, called the CDR-2500.

Data stored on CD-ROM can be in the form of program files like spreadsheets or word processors, or data files such as word-processing documents or database records. A disc can carry graphics and diagrams too, but this makes more demands on memory.

EXPENSIVE

CD-ROMs are still an expensive alternative compared to, say, floppy discs. A CD-ROM player can cost anything from £800. In addition there is the cost of assembling data and getting it on to disc. If the information required is not already in machine-readable form it will have to be specially prepared. The process of data preparation, mastering the pressing discs can cost up to £4,000. For a one-off order of 1,000 discs, each disc complete with data costs around £5 to produce.

Although CD-ROM discs offer durability and a vast amount of storage space, manufacturers and users are faced with the task of deciding what to put on them to utilise the space, and of making sure that only the right people have access to certain information. Software is still thin on the ground compared to that available for other storage media, and it is still impossible for users to write, erase or edit data on these read-only discs.



Knowledge Set has produced the Grolier electronic encyclopaedia on CD-ROM disc. You can search for a subject by word and the program will show the number of articles it appears in.

In the compact-disc interactive version (CD-I) proposed by Philips, discs will be able to carry text, sound, video and graphics. CD-I's applications will mainly be in domestic markets, where it will be used for home entertainment, educational and training purposes. Philips is also developing a CD-ROM based in-car navigation system called Carin.

Despite the similarities between CD-ROMs and audio CD discs, the players have some important differences. In particular, CD-ROM players require a more powerful error-correction facility than their audio cousins. On a CD audio disc one 2,340-byte sector represents less than 1/75th of a second of music. So when an error occurs an audio player can substitute information from the previous sector without any detectable effect for the listener. But on a CD-ROM player a single error could have disastrous consequences, so a new process of error-correction coding has been devised that is claimed to give an error rate of only one in 10^{12} bytes.

CD-ROM players also need some way of locating the information held on disc and displaying it on-screen. This is done by the access software, which usually comes on floppy disc with the CD-ROM package. In the future it may become possible to boot from the CD-ROM with the help of access software held on the CD-ROM disc itself.

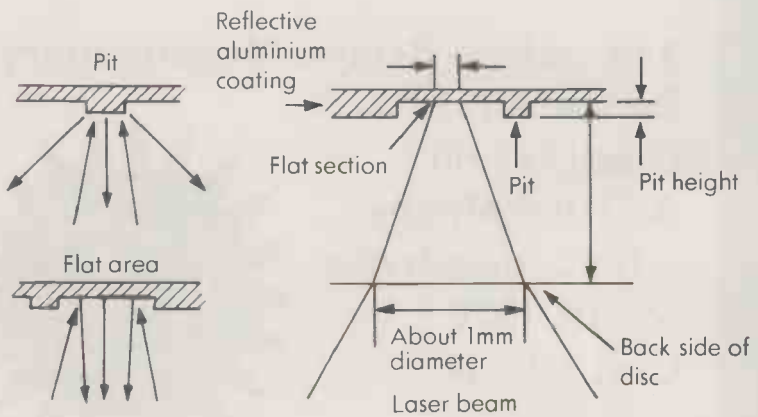
Access times for CD-ROM discs are not as short as for hard discs. To find and move to a given point on a disc takes one to two seconds. Moving from one track to an adjoining track takes less than a millisecond, which is quick considering that there are up to 20,000 tracks on a disc, forming a spiral about three miles long. The average data-transfer rate is 1.4Mbit per second. But despite the fact that CD-ROM takes longer to get to a track, once there it has access to more data and so it surpasses the performance of magnetic media overall.

HOW IT WORKS

A CD-ROM disc holds information in pits that are burned into its surface. There is room for about two billion pits on a single disc. During the mastering process the pits are burnt into the surface of the master disc by a laser beam. The lens controlling the laser beam moves radially while the disc spins, so the information is laid down in a spiral track.

The surface profile of the master is then copied either by electroplating or by photopolymer replication on to physical negatives. The CD-ROM discs themselves are made out of a transparent polycarbonate plastic, and are usually formed from the negative by an injection-moulding process. The surface is then coated with a reflective layer of metal, usually aluminium, followed by a protective layer of lacquer.

Most CD-ROM players use a small gallium arsenide semiconductor laser to generate the light beam which reads the information from the disc. Light striking the pits is diffracted, while light that strikes the area in between is reflected. A photo-detector collects the reflected light and generates a modulated signal corresponding to the pattern of data recorded on the disc. This signal is then decoded and converted to digital data suitable for use by a computer.

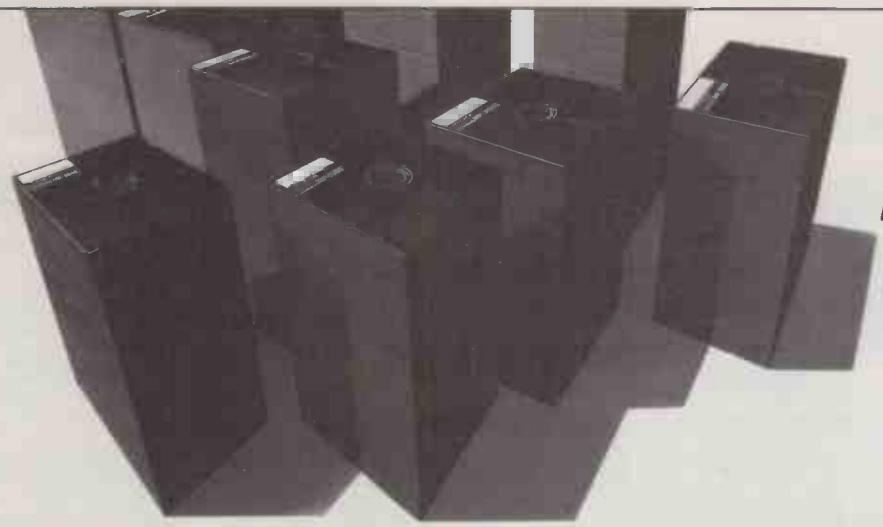


LASERDOS

With such large amounts of data stored on a single disc it is possible to run into trouble with the operating system. For example, PC-DOS can handle only 32Mbyte. One remedy for this is to divide data into 32Mbyte chunks. Some operating systems allow access to larger volumes of data: for example, Laserdos from TMS Research Inc. sits alongside PC-DOS or MS-DOS and will allow users to read from CD-ROM as they would from a conventional system, using the same commands and procedures.

When the audio industry came up with the compact disc it was keen to produce something that would last longer than an ordinary record while maintaining a high quaility of sound. The result is a polycarbonate disc that can be handled quite casually. It is difficult to scratch or warp a disc, and even a disc that has been scratched is still playable. CD-ROMs are also immune to damage from magnetic fields. Compact discs and CD-ROMs do not wear out with continued use as there is no physical contact between the disc and a read

(continued on page 97)



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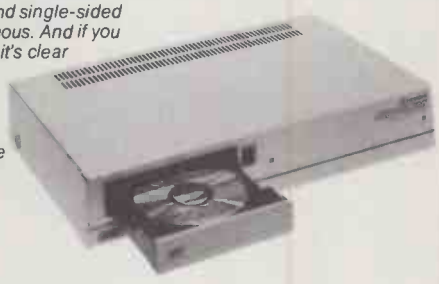

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CD-ROM players are similar in appearance and operation to CD audio systems.

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head. For the same reason it is almost impossible for a crash to occur even when a disc is warped.

However, CD-ROM discs do not last indefinitely. According to recent research carried out for the British Library, which is planning to use CD-ROM for archiving, the life of a disc is likely to be about 10 years. Stresses in the lacquered surface can cause pinprick cracks, which allow air to reach the aluminimum layer beneath and oxidise it.

In the past CD-ROMs have been plagued by the incompatibility of the different standards adopted by various manufacturers. But earlier this year a proposed standard was announced by a group of 13 companies that includes Apple, AT&T, DEC, Hitachi, Knowledge Set, 3M, Microsoft, Sony and Philips. The hope is that the existence of an agreed standard will stimulate growth of the market for CD-ROMs, while preventing any single manufacturer from dominating it.

The proposed standard consists of a definition of a volume table of contents and a directory structure. It has been submitted to both the U.S. National Information Standards Organisation and the European Computer Manufacturer's Association.

The introduction of an SCSI interface for CD-ROM drives has given a wide range of personal computers access to CD-ROMs. But the real test of the standard could well be when it receives IBM's seal of approval. Although IBM is not a member of the group, it has been reported as having attended the recent important meeting.

It is estimated that some 600,000 CD audio players were sold in the U.S. last year, so there is a solid production base on which CD-ROM manufacturers can capitalise. This will help to reduce prices of CD-ROM players too: they are soon expected to fall below £500 and may even drop as low as £250. It is also more than likely that the industry will adopt the CD-I as standard, which means that users will be able to play CD audio discs on the same players as CD-ROM discs.

This does not mean that CD-ROMs are about to replace magnetic media; their read-only status prohibits that at present. However, there have been reports that Philips' American subsidiary has produced a sample PROM based on a compact disc. Philips denies that any machines have been put together but concedes that something similar may be developed in future.

But for the time being CD-ROM's main applications will be to hold databases, directories, manuals, catalogues, programs and documentation, encyclopaedias and suchlike. This in itself is a highly lucrative area. The American market-research organisation International Resource Development (IRD) predicts that business users and consumers will be paying more than $8 billion per year by 1991 to receive data on CD-ROM discs.

COMMS REPLACEMENT

Some suppliers of on-line database services have as much as 80 percent of their gross revenue eaten up by telecommunications costs, so there are clearly savings to be made by distributing this information by other means. IRD forecasts that within five years about $2 billion worth of expected communications service revenues will have evaporated as a result of database publishers transferring to CD-ROM from on-line services.

There are only a few U.K. databases available as yet. Microinfo has implemented the Medline and Aquatic Sciences and Fisheries abstracts. Silverplatter is offering psychological databases, Psylit and Psyinfo, and the Current Index to Journals in Education. Harwell is offering Status software on CD-ROM.

Around 400 software titles are available for CD-ROM at present, most of them American. The software house Office Workstations offers a system called CD-Now. This do-it-yourself CD-ROM kit is designed to give people a taste of CD-ROM by offering the chance to put some information of their own on disc. Other organisations which are considering using CD-ROM include the Ford motor company for its motor catalogue, Whittaker's for its *British Books in Print* and the BBC for the Domesday Project.

You can take it with you

The chief disadvantage of the conventional hard disc is that the media cannot be removed. **Ian Stobie** looks at alternatives which overcome this problem.

Conventional hard discs suffer from one major drawback: the storage medium is permanently attached to the disc drive. This means you cannot hold large amounts of data spread across several discs in the way you can with floppies. The on-line storage capacity of the hard disc, although typically quite high, is also its maximum capacity. It also means hard discs are not very secure. You cannot lock valuable data away in a drawer or safe when you are not using it.

For some time manufacturers have striven to overcome these problems. The goal is a storage system with the speed and on-line capacity of a hard disc, but the security and archival advantages provided by removable media like the floppy. So far three different approaches have yielded workable results: the hard-disc cartridge, the Bernoulli disc and the optical Worm disc.

Although the idea of the removable hard-disc cartridge seems obvious, there are some fundamental difficulties to overcome before it can become a reality. The high storage densities of the hard disc depend on the read/write head getting very close to the surface of the magnetic medium on the surface of the disc. Unfortunately, this makes the system very vulnerable to dirt. Even small particles of ash in cigarette smoke can be enough to cause damage if they get between the head and the rapidly rotating disc.

The usual way around this problem is to seal the heads in the same airtight enclosure as the disc platters, only allowing filtered air to enter. This approach was originally pioneered by IBM in the early 1970s on large systems. It is still commonly referred to by the original IBM code name for the project, Winchester, although the details of the technology have changed over the years.

Early attempts at making removable hard discs stuck to the Winchester principle; the removable cartridge contained the heads as well as the discs, and you removed both. However, this made the removable disc packs rather expensive, so defeating one of the main purposes of making the discs removable in the first place.

(continued on next page)

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The first really practical removable cartridge at the personal computer end of the market was produced by Syquest in 1983. This mechanism and developments from it still lie at the heart of most of the cartridge hard-disc systems now available. Other manufacturers just add their own controllers and casing.

The development which made the Syquest hard-disc cartridge possible was an improvement in disc-coating technology. The disc is usually made of aluminium, which is covered first with a layer of nickel and then with a very thin film of a magnetisable metal such as chrome. A further layer of a dry lubricant such as graphite goes on top.

This so-called thin-film recording material is much less susceptible to damage by dirt than traditional ferric oxide media. As a result, a completely sealed environment is no longer strictly necessary. The heads can therefore stay behind in the drives, while you remove just the disc itself, which is well protected inside a rigid casing.

When you load in a new cartridge everything locks firmly in place and a door opens in the casing to let the read/write heads get at the recording media. As the drive rotates, air is drawn in through a filter. It blows across the hard disc, dislodging any dirt from the surface.

Strictly speaking the Syquest system is not a Winchester drive because the sealed air environment is really the defining feature of that technology. Nevertheless, the drives perform in a similar fashion and the claimed reliability for this system is good.

Several suppliers offer the system boxed up in different ways. Generally you get a hybrid disc unit which consists of a conventional fixed hard disc of perhaps 20Mbyte or 30Mbyte, together with a 5Mbyte or 10Mbyte removable cartridge. It is done this way because removable discs are still more expensive per megabyte than fixed discs. You would typically use the fixed disc for the bulk of your storage — particularly for programs and system utilities that you do not change very often — keeping the removable cartridge for more volatile or security-sensitive data.

Of course you can use the removable cartridges for backing up the fixed disc, which takes much less time than using a tape streamer. Cartridges now cost about £100 to £150, so it is feasible to build up libraries of data on cartridge.

Above left: ISI's 525 Worm drive with a 100Mbyte cartridge.
Above right: The latest Bernoulli Box contains two 20Mbyte removable magnetic discs.
Below: A Flexidisk 10Mbyte cartridge.

A second technology which came on the market at about the same time as the Syquest hard disc is the Bernoulli drive. Again, this type of disc does not require a self-contained air supply like the conventional Winchester, so the head can be left in the drive when you remove the disc platter.

Like floppy discs, Bernoulli discs are made of a flexible plastic. But in operation they behave like a hard disc, rotating very fast in close proximity to the read/write head.

In the Bernoulli drive the disc lies well away from the head when it is at rest. Rotation creates an air flow which pulls the disc up towards the head and then holds it at the correct distance. The drive is named after an 18th-century Swiss mathmetician who first described the laminar flow effects upon which its operation depends.

Compared with a conventional hard disc, Bernoulli drives are less vulnerable to dirt. Because the disc is flexible, a dust particle would just push it away, perhaps causing a read/write error but nothing more permanent. Similarly, a complete power failure would have no chance of damaging data already present on the disc.

Bernoulli drives offer similar performance to a conventional fixed hard disc. They are also extremely robust — so much so that Bernoulli sales persons can sometimes be seen at exhibitions kicking their products. Bernoulli discs come in 10Mbyte and 20Mbyte sizes and cost about £70.

Both Bernoulli and Syquest types of drive are more expensive per on-line megabyte than conventional fixed hard-disc storage. To reduce costs further may mean moving beyond the magnetic storage methods on offer to optical storage, though there are still some problems to be overcome in this area.

The basic principle of optical storage is to represent bits of data as either small pits or small blisters on the surface of a metallised plastic disc. Data can then be read by reflecting laser light off the disc surface. Since the laser head does not need to be anywhere near as close as a magnetic head, dirt does not cause the same problems, and so a filtered air supply is not necessary. Indeed, optical discs seem to be able to cope with quite grubby media. The other great advantage of the technique is that very high data recording densities are possible.

The most widespread optical technology is that used on the compact 4.7in. audio disc and 12in. video discs. Both of these are read-only formats; information has to be put on to them by a factory pressing process. It would be very useful if there were a smaller-scale optical technology which allows users to read, write and erase with relatively cheap equipment. But at the moment manufacturers are only half way to that goal.

The best that is available now is the write-once read-many-times (Worm) drive. With a Worm disc you can alter the recording surface, but you cannot reverse the process.

200MBYTE PER DISC

On the face of it this seems pretty useless, until you consider the sort of storage capacity it is possible to achieve with optical techniques. The typical 5.25in. Worm disc can be used on one side and holds at least 100Mbyte; some types of disc can be used on both sides to give you 200Mbyte. The larger 12in. format holds about one gigabyte (1,024Mbyte) per side.

With enough megabytes to play with you can simply ignore old data and go on to a new area of the disc. To update a record, for instance, you just copy it to a new location and abandon the original site.

(continued on page 100)

The trouble with most mass storage units is that they can't match the Apstor 10+10 in terms of performance and reliability.

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Apstor 60+20	about £4,995	20	60	£75	hard disc; Apstor also does Bernoulli and optical drives
Borsu 10+10	£1,950	2×10	—	£85	Bernoulli; allows you to boot MS-DOS from cartridge
Flexidisk 10	£1,295	10	—	£95	a hard disc, despite the name; also available with IBM-compatible computer thrown in for £1,495
HAL 8-300	£3,090	5	10	£130	hard disc; other configurations available up to £5,990 70Mbyte system
Idea R-10X	£950	10	—	about £100	hard disc; Idea also has Bernoulli system
Iomega Bernoulli Box	£2,800	2×10	—	£75	Iomega makes drive mechanisms for all other Bernoulli suppliers; 2×20Mbyte unit costs £3,480
Honeycomb 10+10	£3,195	2×10	—	£65	Bernoulli
Plus 5 FR-20/10	£2,645	10	20	£110	hard disc; other configurations include 40+10Mbyte for £3,395, and 150+10Mbyte for £8,265

WORM DRIVES

Alcatel Thomson Discus 1000	£18,000	1,000	—	£300	also available with document reader, software and PC for about £50,000
Apstor Storlight	£2,995	100	—	about £130	200Mbyte and 400Mbyte units available
Information Storage ISI-525	£2,999	100	—	£60	double-sided media planned
Optotech 5984	£4,750	200	—	£180	available with either IBM or SCSI interface, and Unix and MS-DOS software

SUPPLIERS

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But although 100Mbyte sounds like a lot of storage space you could still get through it fast using a Worm drive with ordinary personal computer software. Worms make most sense for applications where it is easy to distinguish between data that is purely static and data which can be expected to change. You can then use them sensibly in close conjunction with a magnetic drive, putting the volatile data and temporary files on the magnetic media and keeping the Worm for data with a longer life.

In some cases the fact that Worm data cannot be overwritten is a positive advantage. Where you have large amounts of legally or financially important data to archive, the Worm is certainly worth considering.

Standards have not yet emerged in the optical disc field. ISI and Optotech both offer 5.25in. Worm units, but they have different formats. Toshiba is about to launch another format later this year. As in other areas of the mass-storage market, various manufacturers box up the basic drive mechanisms with their own controllers and software, so it is not always obvious what format a drive uses. There are also higher-capacity 12in. Worm drives from several sources, but the smaller size looks like being the most significant for business use at the micro end of the market.

Optotech's optical drive with one of its 200Mbyte Worm discs.

But while optical storage has plenty of potential for the future it would be a mistake to regard it as a strong contender for the heart of the removable-disc market at present. Until optical discs are fully erasable this position must still belong to the magnetic discs.

With the early Worm discs there were some problems with the recording media, which tended to degenerate over time, threatening eventual data loss. These difficulties appear now to have been largely overcome, and the Worm drives we mention in the table should be good for keeping data for 10 years or so. Indeed two companies, Magstor and Video Media, offer Worm drives as part of turnkey document-archiving systems which are supplied complete with input scanners.

Playing the Winchester card

The idea of putting a hard disc on to an expansion card sounds like a good one. But when **Glyn Moody** tried it he discovered it was not all plain sailing.

When hard discs on cards were announced a year ago they seemed to be one of those obvious strokes of genius that come along once in a while. Someone put together two apparently unrelated facts — that hard discs are small and that people use expansion boards a lot — to come up with a brilliant product. The validity of that intuition has since been confirmed by a host of imitators. On the next page we look at four such products.

The first company in the field was Plus Development with its 10Mbyte Hardcard. But 20Mbyte has now become the standard size and 30Mbyte is beginning to come through as well. Given that conventional hard discs are soaring into the 100Mbyte range no doubt we can look forward to similar sizes on cards once the engineering problems have been sorted out.

A SLOT AND A HALF

The principle underlying all these cards is the same: a standard expansion board carries a 3.5in Winchester, along with the miniaturised control circuitry. Even though the latter is often exposed to the winds you are supposed not to touch it, which can make installation a bit tricky. The card's not inconsiderable weight is supported at both ends and by the expansion connector. Although the boards are designed to occupy only one slot some models, especially the new 20Mbyte ones, require one and half. That is, they require a full slot, but allow you to use a half-length card alongside it.

These cards will not work on every PC or clone and the earliest models of the IBM PC used a ROM BIOS which cannot cope with hard discs at all. Unfortunately BIOS upgrades are hard to come by, though this problem will only affect a few very early machines. Similarly, the power supplies on these early machines are unable to take the strain of a hard disc.

On the face of it, hard discs on cards seem to be the obvious solution for the many owners of floppy-disc models who wish to upgrade without too much fuss. But while the idea of simply plugging in and switching on is attractive, it is also hopelessly optimistic. The problems we experienced varied considerably, but were mostly concerned with the software installation procedure. If these experiences are representative then hard discs on cards are not for beginners. We found that to get them working you have to be familiar with the workings of DOS and formatting, partitions and directories.

Our problems may have been in part the result of using a PC clone, in the shape of the Osborne PC. But it is precisely for such machines and their owners that easy upgrades are designed. Another possible reason was that we used the 2.11 version of MS-DOS, which is only designed to handle up to 16Mbyte of storage. It is generally recommended that DOS 3.0 or 3.1 be used. Whatever the reason, installation was not easy, and we also found that several cards seemed allergic to any DOS which was not official IBM flavour.

Hard discs on a card also fail to meet up to their initial promise in the way they are implemented. For example, in some models power for the unit is drawn through the general bus. But the bus was never designed for this purpose, and using it in this way could risk serious long-term damage. Since the power is going through the common bus, any power surges which arise from malfunction in the hard disc could flood everything else on the bus, including the motherboard itself.

One solution to this problem is to draw the power directly from the power supply, and some units do this. But there still remains the danger that the main power supply will be overstrained by the extra drain on its resources. This is more likely to be a problem with cheap clones, though we had no problems with the Osborne. The rating of your power unit is crucial: it needs to be at least 130W to support the hard disc and a couple of floppies.

HIDDEN INCOMPATIBILITY

A more subtle danger arises out of hidden incompatibilities in the drives. For example, in order to limit the thickness of the unit to only one slot, a non-standard internal design with fewer disc platters than usual may be used. IBM software writes data to disc assuming a certain layout of platters, and super-slim hard discs often use software to patch up the differences. The danger is that a very fastidious piece of software may detect the difference.

Hard discs on cards became possible when the power required for hard discs dropped sufficiently. But however efficient their design, they still generate a fair quantity of heat. In an attempt to ensure that ventilation is adequate, several manufacturers of hard discs on cards supply you with a piece of tape to place over some ventilation slots at the front of the IBM to reroute cooling air.

Although we experienced no problems caused by heat, some of the units did get very warm. Even if this poses no threat to the hard-disc units themselves, when they are placed alongside memory-expansion cards the poor old IBM's innards can soon become a miniature oven. Such a marked increase in the machine's ambient temperature could lead to premature failures in components.

WHY COMPROMISE?

The final and perhaps most telling point against hard discs on cards is that they are overpriced and unnecessary. As we reported last month in our review of the Osborne PC, you can pick up a 20Mbyte drive for around £450, and higher-capacity discs will soon be available for not much more. So rather than fiddle around with a product whose engineering is very neat but essentially a compromise, why not get the real thing? You may have to discard your second floppy in order to accommodate the new drive, but in practical terms you will lose little by doing so.

In many ways, hard discs on cards only really have a point if you are upgrading your existing Winchester machine, though the usefulness of two separate hard discs is a good deal less than one larger one. This will become increasingly true as time goes on, and fewer floppy-disc machines are sold for business purposes. After all, as the price for an XT clone drops down to well under £1,000, and that for a 20Mbyte AT-alike to under £2,000, there is no reason to make do with floppy systems.

On the other hand, it is likely that hard discs on cards will continue to come with larger capacites on smaller cards needing less power. It may well be that for your needs they will offer the best solution. The important thing is not to be dazzled by their apparent simplicity, nor disappointed by their current lack of it.

For this feature we contacted nine U.K. suppliers of card-mounted hard discs. Four of them sent us units to look at, and they are described in the detailed reviews on the next page. The products not available for review were Business Card from Tandon on (0527) 468000, Dinasti from Microsolve Consultants on 01-669 2858, Hardcard from CMA on (04867) 4555, Maynard On Board from Softsel on 01-568 8866, and Olivetti from PCU on (0932) 231100.

(continued on next page)

DRIVECARD

With its smart white plastic cover, the Mountain Drivecard was the most neatly packaged of the four hard discs on cards we reviewed. It did, however, look slightly flimsy. As with all the cards, the chips and circuitry seemed very exposed, bearing in mind that you have to manhandle it into its slots. In addition to being the best packaged, it also has the fullest manuals plus a disc of utilities.

The unit requires a slot and a half unless slot number one is used. In the latter case, you have to move the internal speaker to make room. In addition to the metal bracket on the end that slots into the gap at the rear of the machine, there is a small plastic edge guide supplied for the front. Power is drawn through the expansion bus.

After the unit has been inserted, it must be installed. You do this by running Install from the utility disc provided. Initially, we thought of installing the Drivecard on an IBM PC/XT. But prominent messages to the effect that the installation process may destroy all data on existing hard discs warned us off, and we moved on to another machine.

After running Install, we found that we had to use Fdisk to create an active partition on the disc, then Format to format it. It was then possible to use it as disc drive C. This does not correspond to the outline in the installation manual, but proved to be the only way to get the system working.

In use, the Drivecard seemed slightly noiser than the other models; it also became quite warm. Running the Bagshaw Disc Benchmarks gave a total figure of 184 seconds, which is considerably faster than the standard IBM PC/XT's figure of 254 seconds. A big advantage of this model is that you can hook up an internal hard disc directly to it.

Price: 20Mbyte card £895, projected 30Mbyte version around £1,295.
Supplier: P&P, Todd Hall Road, Carrs Industrial Estate, Haslingden, Rossendale, Lancashire BB4 5HU. Telephone: (0706) 217744.

FILECARD 20

In contrast with the tastefully packaged Drivecard, the Filecard looks severely functional with its black metal frame. The circuitry is better protected, though the PCB is still exposed, as is much of the disc drive's mechanics. Overall, it looked more robust than the Drivecard. The manuals are less impressive and consist of a few loose-leaf pages, presumably destined for the IBM PC manual binder.

We found installing the card harder, if only because the fit was tighter. As with the Drivecard, one and half slots are needed. The Filecard draws all its power through the bus, so you do not need any extra power cables. The insertion process is much the same as with the Drivecard; again a card guide is provided.

Theoretically, the software installation should be easy. Once you have plugged in the unit and powered-up you simply type

C: INSTALL

for automatic installation. Unfortunately, this did not work with the unit we tested. Instead, we had to go through the same procedure as with the Drivecard, using Fdisk follwed by Format.

Running the Disc Benchmarks produced a figure of 221 seconds — rather slower than the Drivecard, but still acceptably faster than the IBM. The unit was not especially noisy. The fact that it is such a tight fit may cause overheating problems when it is used in conjunction with other hot-running chips positioned nearby.

The manual also contains information on Xtree, a file-management program included free with the Filecard. It lets you view directories and subdirectories, and delete, copy and rename files or groups of files.

Price: £795
Supplier: ADT, Standard House, James Street, York YO1 3BU. Telephone: (0904) 647881.

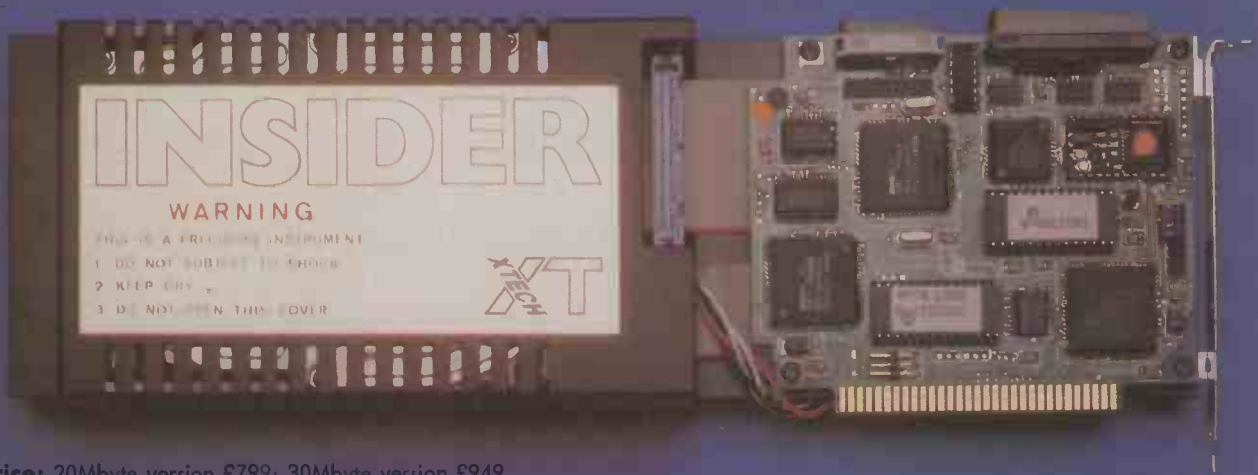
INSIDER 20

The U.K.-built Insider is similar in appearance to Filecard. Once again it has a black metal case, though this time the chips are exposed. However, the drive itself is completely enclosed. A simple manual is provided, but no utilities.

The Insider requires one and half slots. Installation is as before, expect that you have to connect up some extra leads to the power supply. This card does not draw its power from the main bus. There are two parts to the lead. One connects to the power-supply cable which normally goes to the floppy disc, the other daisy-chains the power back to the floppy. On the Osborne PC it was easy to fit since extra power cables were supplied, but on the IBM PC/XT it was a nightmare. The power cables are awkwardly placed, and hard to remove and reconnect.

The Insider is supposed to be ready to receive DOS directly, but once again we found it necessary to go through the same procedures as before, and even this proved difficult. It transpired that the Insider was very particular about which DOS was installed. Once again there is a warning that if you use the Insider with a PC/XT the installation process may destroy all your data. The 30Mbyte version gave a Bagshaw Benchmark total of 199 seconds.

The metal casing got very hot, but Xtech insists that this is good because it ensures that the heat is conducted away, unlike with plastic units. Xtech also emphasises the virtues of its automatically parking heads and the fully shock-mounted assembly. Also worth noting is that the disc drive is standard design, not a super-slim version.



Price: 20Mbyte version £799; 30Mbyte version £949.
Supplier: Xtech, Court Farm Estate, Greens Norton Road, Towcester, Northamptonshire NN12 8AN. Telephone: (0327) 53399.

QUBIE HARDPACK 20

Qubie's hard disc on a card is something of an oddity. For a start, it eschews the full-length card format in favour of a double-decker version with the circuitry folded back on the disc drive to give a fat half-length card. This allows you to fit the card behind the floppy-disc drive on an IBM PC/XT or twin-floppy model, thereby only using one slot.

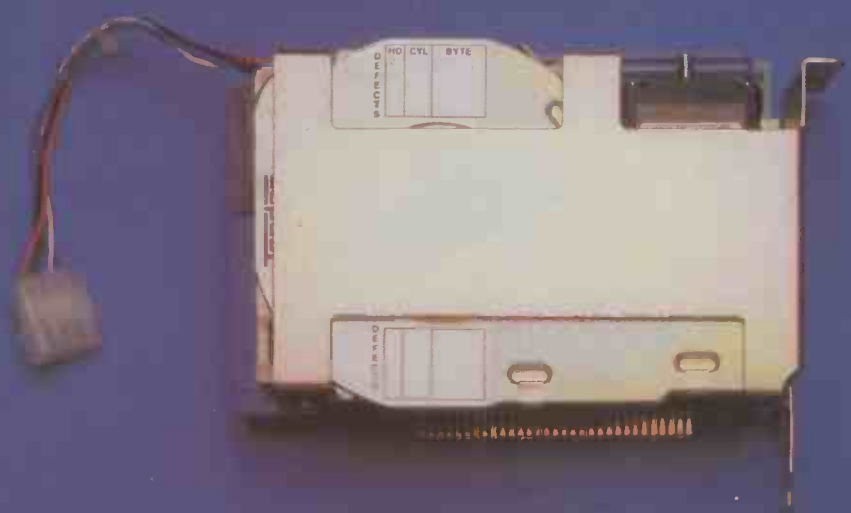
There are two small circuit boards piggybacked on top of the drive. Both the boards and the drive are unprotected by casing of any kind. The metal bracket which secures the unit to the back wall is extra large, and has two screw holes for security. The manual is thin and not very clear.

Like the Insider, the Hardpack takes its power from the main power supply. In addition to the lead from the hard-disc unit, there is a Y-piece which allows you to insert it between the power supply and the disc drive. Hardpack presents the same problems as the Insider in getting at the connectors on the PC/XT. Otherwise installation is easier because it is not such a tight fit as the full-length cards.

The same software installation process of using Fdisk and Format was used to prepare the disc for use. Of all the hard discs we tested, the Hardpack proved easiest to get up and running.

Running the Bagshaw Disc Benchmarks gave a total figure of 229 seconds, marginally the slowest of the group. In use, the unit did not appear to get as hot as some of the others.

As with Filecard, a file-management system is supplied. The documentation for this looks very cheaply produced, but the provision of such facilities is thoughtful, if nothing else.



Price: £695
Supplier: Qubie, 7 Farrier Street, London SW18 1SN. Telephone: 01-871 2855.

AST's Rampage board lets you store programs as well as data in expanded memory.

Through the memory barrier

Steve Malone explains how memory expansion cards extend on-line memory beyond the 640K limit normally accessible to the IBM PC.

Massive software packages requiring enormous quantities of memory, unthinkable a year or two ago, are now commonplace. The hitch is that many of these powerful programs would benefit from access to more memory than the 640K maximum that the architecture of the IBM PC allows.

The restriction is a purely artificial one as the 8088 CPU can actually address 1Mbyte of RAM. This memory is divided into 16 64K segments, numbered 0 to F in hexadecimal. But only the first 10 segments are accessible to the user under MS-DOS, hence the 640K limit.

The remaining segments, A to F, are set aside for machine use. Segments A and B are assigned to the machine's video memory, while C is used by the expansion ROMs for the XT hard disc, extended graphics card and the 3270 PC. D and E were originally reserved for the PCjr, to allow it to make use of ROM cartridges. The final block, F, is set aside for the IBM BIOS ROM.

A fair amount of the potential memory has thus been lost. However, it is easy to be wise with hindsight. When the IBM PC was designed, memory chips were expensive and 640K was beyond anyone's wildest dreams. And if ROM cartridges had taken off in a big way we would all be complaining loudly had IBM not provided space for them.

But as RAM has become cheaper, programs have been written to take advantage of large quantities of memory, even though the PC itself has been unable to adapt to the change. The first signs of trouble appeared with the giant integrated packages like Lotus 1-2-3 and Symphony. The programs themselves take up around 256K, and when businesses began large-scale financial modelling the unthinkable happened as people began to run out of addressable memory.

With its software shackled in this way, Lotus Development had good reason to try and remedy the problem. Together with Intel and Microsoft it developed the Lotus/Intel/Microsoft (LIM) Expanded Memory Specification.

The LIM EMS standard uses a technique known as bank switching. The idea is that in addition to the standard RAM there is an area of expanded memory which shares the same addresses but can hold different information. The processor can only see one area of memory at a time, so although the PC might contain 2Mbyte of memory the addressable limit of 1Mbyte remains.

The best-known implementation of the LIM EMS is the Intel Above Board. This board sets aside a 64K area known as a page frame to be used as the work area for switching. Page frames can be any available segment from C4000 upwards. The 64K page is further subdivided into four 16K windows.

MEMORY MANAGER

When information stored in the expanded memory is required by the processor, a system utility called the expanded memory manager (EMM) swaps a current 16K window with another in expanded memory, allowing the 8088 access to the data. The LIM standard can allow up to 8Mbyte to be stored in four slots on the PC and up to 16Mbyte piggybacked in slots on the AT. The 16K windows can be drawn from anywhere within the 8Mbyte expanded memory.

An alternative method of configuring the expanded memory on the Above Board is as a RAM disc. Under this arrangement the operating system is fooled into believing that the extra RAM is a disc drive, with its own drive letter. The user can run all the disc commands like Copy and Chkdsk on the RAM disc, but because it is in fact made up of memory chips rather than a physical disc it runs up to 10 times faster than a conventional floppy disc.

The drawback to this technique is that the information held on the RAM disc is as volatile as any other data held in RAM. You have to remember to copy data you wish to keep on to a conventional magnetic disc before switching off. However, this is not a problem if you buy the PS version of the Above Board, as it is fitted with battery backup.

Installing the Above Board should simply be a matter of plugging it into a long slot within the PC and transferring a few files across to your system disc. If the computer does not have the full 640K of addressable RAM already fitted, some of the Above Board's memory can be reconfigured to make up the difference simply by adjusting the DIP switches on the PC's motherboard.

We found installation of the drivers a tricky business at first. Supplied with the Above Board is a program called Setup, which is supposed to install the drivers on your systems disc. We used MS-DOS 2.11, but Setup informed us that this was an early version of DOS which it did not recognise, even though it said it would be happy with versions 2.0, 2.10 and 3.

The Above Board manual was not much use in this situation, as its answer to every problem seems to be to rerun Setup. We finally got the board installed with the help of First Software's technical support, who were equally baffled by Setup's behaviour as they had no trouble using version 2.11 on the Compaq. Maybe it was just our machine.

Installing the Above Board software by hand means configuring the relevant EMM, RAM disc and RAM buffer drivers in the Config.Sys file. When we phoned First Software we were told which ones to use, but it would have been better if that infor-

(continued on page 106)

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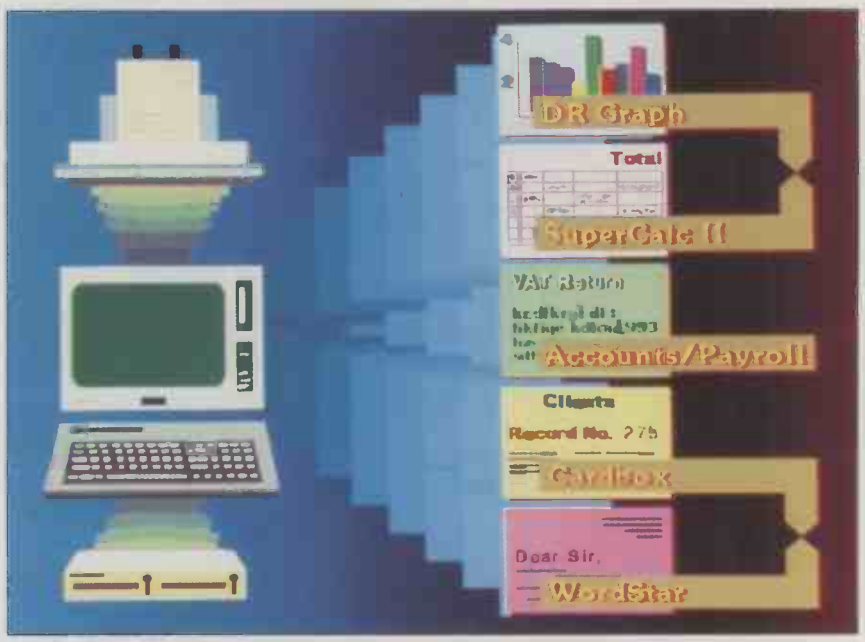

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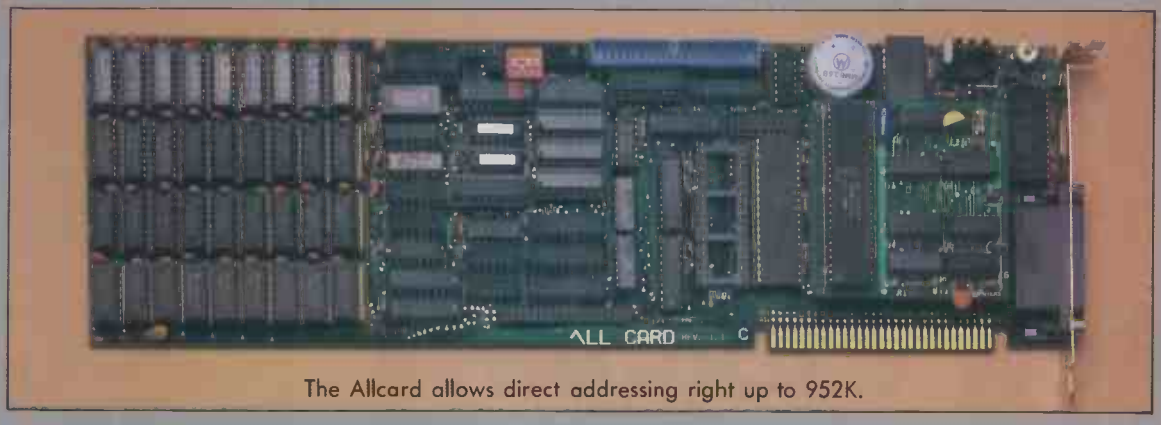

The Allcard allows direct addressing right up to 952K.

(continued from page 104)

mation had been included in the manual.

The LIM EMS provides a workable solution for creators of gigantic spreadsheets. The Above Board can hold large quantities of additional memory while remaining totally transparent for applications able to use it. There are, however, problems with the LIM specification. Mostly these are to do with the 64K page frame. The LIM EMS requires the page frame to be contiguous and not split into four windows scattered around memory, and there can only be a single page frame within main memory, no matter how many expanded memory boards you have fitted.

This has two effects which are detrimental to the operation of the system. To begin with, it means that the processor can only view 64K of expanded memory at a time. Since most serious application programs are much bigger than this they cannot be held in expanded memory. The extra 8Mbyte that the Above Board can provide is really only usable for data. Programs like 1-2-3 fit happily within the 640K limit so this limitation will not worry Lotus very much. But people who would like to use the expanded memory for program storage might think differently.

The other problem that users might encounter with the LIM EMS standard occurs when the program is attempting to access data held in a number of different windows. The processor spends so much time switching data between main memory and expanded memory that it has little time left to run the application.

EEMS

To counter the problems inherent in the LIM EMS, the American peripheral manufacturer AST has taken the basic specification and added to it. The result is known as the Enhanced Expanded Memory Specification (EEMS) and is implemented on AST's Rampage board. The EEMS can use any available 16K area of physical memory as a window. Furthermore Rampage can use as many windows as are available; it is not limited to just four. This allows sufficient expanded memory to be banked in physical memory to store programs.

Because Rampage uses the LIM specification as its foundation, AST is able to claim full compatibility with the Above Board. It can indeed perform the same functions and run the same programs, but this does not mean that Rampage and Above Board can be used together in the same computer. When we tried, the result was a string of parity errors. AST told us that this was due to hardware differences on the boards. As to their supposed compatibility, we were informed this meant only that they do the same thing. Nevertheless, the EEMS format, with its more flexible use of windows, shows more long-term promise than the standard EMS.

The potential of Rampage is indicated by the response of Digital Research to the format. For some time DR has been attempting to wean PC users away from MS-DOS by extolling the multi-user/multi-tasking virtues of Concurrent DOS. The trouble has been that 640K of RAM does not go very far when shared between four or five users and the operating system. Digitial Research has therefore rewritten Concurrent DOS in order to take advantage of the memory storage space offered by the Rampage board.

CONCURRENT DOS XM

The new version, known as Concurrent DOS XM, works by reserving the bottom 256K of user memory for itself and configuring the remaining 384K of user memory as a series of windows. It operates in conjunction with the Rampage memory manager (REMM) to share out the memory. Each task or user can be assigned up to 384K of expanded memory for programs and data, which can be banked in and out of main memory. Thus for the first time a multi-user system based around the PC becomes a realistic proposition.

Although the AST EEMS is a considerable improvement over the LIM EMS specification, it has only alleviated the problems. It has not made them go away. However, a Canadian company, All Computers, has come up with a possible solution borrowed from mini and mainframe addressing methods. The secret lies in the technique that is already used on the PC/AT, where a device known as a memory-management unit (MMU) extends the memory up to 3Mbyte. This extended memory is different to the expanded memory of the LIM EMS standard. Where the EMS switches addresses between the expanded memory and main memory, the MMU redirects call addresses to a location within the extended memory.

The Allcard MMU works in a similar fashion to the AT device. It acts as a pre-processor to the CPU by adding four bits to the beginning of the usual memory addresses. The resulting 24-bit address can then be used to access up to 10Mbyte of memory. The Allcard goes further than the AT MMU in that it reconfigures the entire memory map of the PC. The calls to the video RAM, hard disc and ROM BIOS are redirected by the MMU to the F segment of memory.

When you power-up with the Allcard installed the operating system finds no barriers placed in its way at 640K and will initialise user memory all the way up to 952K. The MMU can also set extended memory up to 10Mbyte without the need for bank switching. The Allcard MMU needs to work closely with the 8088 CPU, so the chip together with any optional 8087 has to be removed from the motherboard and installed on the Allcard. Special cables which run from the Allcard direct processor signals back to their original sockets.

The future for memory-expansions techniques looks bright, and their prospects can only improve with the advanced versions of DOS that have been promised. As memory capacity continues to rise and prices fall 16Mbyte might soon come to be considered the minimum for a machine that conforms to the IBM standard. PC

SUPPLIERS

Above Board: 256K basic configuration with upgrade chips to 1Mbyte costs £520 from First Software, Intec 1, Wade Road, Basingstoke, Hampshire RG24 0NE. Telephone: (0256) 463344

Rampage: 1Mbyte configuration costs £510 from AST Europe, AST House, Goat Wharf, Brentford, Middlesex TW8 0BA. Telephone: 01-568 4350

Allcard: 1Mbyte configuration with memory-management unit costs £695 from All Computers, Second Floor, Prince Rupert House, 64 Queen Street, London EC4R 1AD. Telephone: 01-248 8895

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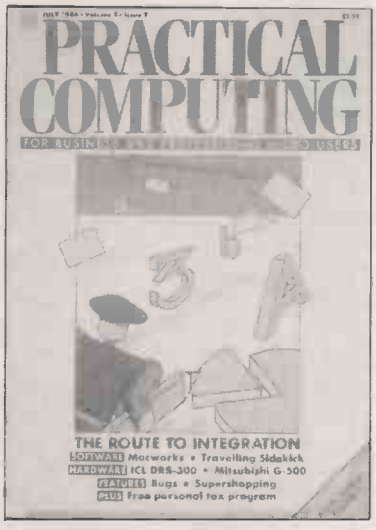

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Open File offers programming tips and software to key in. We welcome submissions from readers. We are interested in business programs for any of the main machines such as IBM, Apple, Amiga, Atari 520ST, BBC and Amstrad PCW-8256. We are also interested in applications written in dBase, or for standard spreadsheets like 1-2-3. Utilities are also welcomed.

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.

Please send your contributions to

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COMMS SOFTWARE

DOWNLOADER

Geoffrey Bernstein presents three simple Basic programs which allow you to set up communications through the RS-232 port.

VIRTUALLY any computer with an RS-232 serial interface can be used for accessing a remote database or bulletin board. All you need is a suitable modem and a suitable piece of communications software. Modems can now be bought for well under £100, and a wide and growing range of public-domain communications software is available free of charge.

The problem is that this software is itself found on bulletin boards, so you need some way of getting at it in the first place. The programs presented in this article are intended for just this purpose. The simplest version is only 10 lines long, and it should work on any machine that runs Microsoft Basic and has an RS-232 interface.

Microsoft Basic has two functions designed for communicating with the RS-232 interface. Inp is for inputting a character from the port, and Out is for outputting a character to it. Basic has to be told which port number to use to reach the RS-232 interface if the program is to work.

The program in listing 1 has two parameters, Main and Status, which you will need to set correctly for your machine. The Main parameter is the internal address of the RS-232 interface's data port. This is the address to which any data being transmitted out of the interface has to be sent; it can also be read to get data received by the interface.

The RS-232 interface also has a status port which gives information about the present state of the interface; the Status parameter is the address of this port. By reading the status port it is possible to tell whether the interface is busy trying to send a character, or whether a character has just been received but has not yet been read.

The simplest way of finding the right numbers for your machine is to look them up in the manual. If you have a CP/M machine there may well be a similar entry in the listing of the BIOS supplied on the system utilities disc. Look for a file called something like Bios.ASM. In my setup you can find the required data in the section headed "Table of Equates — I/O Devices".

LISTING 1

```
10 MAIN=&H58: STATUS=&H59: MASKIN=&H2: MASKOUT=&H5: WIDTH 79
20 A$=INKEY$: IF A$="" THEN 80
30 ' CHECK OK TO OUTPUT BYTE
40 B=INP(STATUS):B= B AND MASKOUT : IF B<> MASKOUT THEN 40
50 ' OK - SO OUTPUT IT TO MAIN PORT
60 OUT MAIN,ASC(A$)
70 ' CHECK TO SEE IF INPUT BYTE WAITING
80 B=INP (STATUS): B = B AND MASKIN: IF B <> MASKIN THEN 20
90 ' IF NO INPUT BYTE AT MAIN PORT THEN LOOP BACK FOR
   KEYBOARD CHARACTER
100 C=INP(MAIN) : PRINT CHR$(C); : GOTO 20
```

LISTING 2

```
10 OPEN "COM1:300,N,8,2,RS,CS 0,DS 0,CD 0,BIN" AS 1
20 WIDTH 79
30 A$=INKEY$: IF A$<>"" THEN PRINT £1, A$;
40 IF LOC(1) >0 THEN PRINT INPUT$(LOC(1),1);
50 GOTO 30
```

The £ sign in this listing should be entered as #

LISTING 3

```
1 CLEAR ,32000
4 STORE=0: LOW=32001: PLACE=LOW
10 MAIN=&H58: STATUS=&H59: MASKIN=&H2: MASKOUT=&H5: WIDTH 79
20 A$=INKEY$: IF A$="" THEN 80
21 IF A$=CHR$(1) THEN STORE =1 : GOTO 80
22 IF A$=CHR$(2) THEN GOTO 2000
30 ' CHECK OK TO OUTPUT BYTE
40 B=INP(STATUS):B= B AND MASKOUT : IF B<> MASKOUT THEN 40
50 ' OK - SO OUTPUT IT TO MAIN PORT
60 OUT MAIN,ASC(A$)
70 ' CHECK TO SEE IF INPUT BYTE WAITING
80 B=INP (STATUS): B = B AND MASKIN: IF B <> MASKIN THEN 20
90 ' IF NO INPUT BYTE AT MAIN PORT THEN LOOP BACK FOR
   KEYBOARD CHARACTER
100 C=INP(MAIN):PRINT CHR$(C);: IF STORE =0 THEN 20
110 POKE PLACE,C
120 PLACE=PLACE+1
130 GOTO 20
2000 ' FILE OUTPUT
2010 OPEN "O", £1, "COMMS.DAT"
2020 FOR I = LOW TO PLACE -1
2030 J = PEEK (I).
2040 PRINT£1, CHR$(J);
2050 NEXT I
2060 CLOSE £1
2070 GOTO 1
```

The numbers used for Maskin and Maskout are designed to work with the 8251A Uart chip. Most machines are fitted with this chip or a compatible one. The final parameter in line 10 sets the line width.

In line 20 the Inkey$ function is used to see if a key on the keyboard has been pressed. If it has, the appropriate value is put into A$; lines 30 to 60 are to do with outputting it through the RS-232 interface. If no key is pressed the routine jumps straight to line 80.

Line 40 reads the status of the RS-232 interface and compares it with Maskout. The And function is used to mask off the irrelevant bits. If the RS-232 interface is trying to transmit a character, the program loops round line 40 until the interface is free. Line 60 simply uses the Out function to actually transmit the data.

The program will comfortably keep up with 300 baud transmissions — equivalent to about 30 characters per second. To stop the program you simply type Control-C.

If you have an IBM-compatible or MS-DOS machine you should use the program shown in listing 2. It works in a similar way to the previous program, but makes use of the extended features of 16-bit versions of Microsoft Basic. This program automatically sets the RS-232 port configuration.

The version of the program shown in listing 3 includes a download facility so that you can store data that has been received down the phone line. Line 1 clears space for storing data in the area above the Basic interpreter and program. The variable Store in line 4 is a simple switch which tells the program when to start recording the data it is receiving. The parameter Low is the point in memory from which the program starts storing data; Place is a marker to show how far the recording has progressed through memory. Line 110 places the received data in memory, and line 120 increments the place marker.

To start saving part of the transmission you type Control-A. When you have finished receiving the data you require, type Control-B and it will automatically be saved on disc in a file called Comms.Dat. If you want to use another name you can alter line 2010. Line 21 looks for the Control-A character, CHR$(1). Similarly, Control-B is trapped in line 22 and forces a jump to the file-output routine.

The program stores data directly into memory, starting at location 32000. It will continue to store data until you tell it to stop. On many machines there is an effective limit of about 20,000 characters at which you start overwriting the part of memory which contains the operating system — with disastrous results for your data. So do not try using this program with very large files.

To use your RS-232 to communicate with another machine you will have to configure it so that the two machines match up. If you have a program called Config or Configur on your systems disc you can use it to set the following parameters: baud rate is set to 300; word length is set to 8; parity is set to No Parity; and stop bit is set to 2. If you have the option of choosing between asynchronous or synchronous communications you should select the former. PC

AMSTRAD PCW-8256

SIERPINSKI'S CURVE

D L Gates presents some refinements to the DR Logo routines published in last February's *Practical Computing* to allow you to produce more complex designs.

READERS who enjoyed Obhijit Chatterjee's article on Sierpinski's curve in the February issue of *Practical Computing* may wish to elaborate both the procedures for generating such curves and the designs used for the two required lists of drawing instructions. The set of procedures presented in this article includes several such refinements.

The co-ordinates for where the curve begins are automatically adjusted so that any curve up to the fifth generation will be contained within the screen limits and will have the same overall dimension. Halving the primary side length each time will not do, since the basic overall dimensions of the squares are not in a simple 2:1 ratio. The overall body of the first-generation curve is

$$1+2*\sin(45)$$

including the projections or "ears" at the corners. Without the ears the dimension is

$$1+\sin(45)$$

If you examine the sequence of higher generations of the same curve you will see, for example, that the second generation is three bodies wide, the third is seven bodies wide, and so on. In general the width of generation G is

$$2^G-1$$

including the extension of the ears only at the extreme left and right of the total curve, but not including the others. To produce two generations of the same curve that maintain the same overall dimensions then requires that the starting co-ordinates and the primary side length :l be adjusted in accordance with the properties of an exponential progression that also addresses the trigonometric relationships.

The other messy part of altering Sierpinksi for various generations is assembling the basic instructions list for the actual drawing — that is the sequence of a's and b's, in Chatterjee's notation. The procedure Pattern accomplishes this automatically. After running a fourth- or fifth-generation curve you could enter

```
pr (se thing "a thing "b thing "a)
```

It would be laborious to have to determine and then type into the procedure such an instruction list every time you wanted a different generation of the curve.

The fun of Sierpinski's curve lies in the possibility of coming up with exotic variations on the theme using only the basic square and some basic drawing tools. An advantage of DR Logo for this type of design development is that the Sin, Cos and Arctan functions accept degrees rather than radians as arguments.

DR Logo's multi-digit accuracy also means that you can direct the turtle very precisely. For example, if you want a squiggle midway along the primary side of the square that shoots off at length :l and returns to the main side one-third of the way farther along, the required angle to turn right or left is

$$\text{arc}\cos(1/6)$$

or 80.405932 degrees. DR Logo takes this in its stride produces a very accurate version of 80.405932 degrees; if you turn back 160.81186 degrees and

```
fd :l
```

you will be right on target on the primary side once again.

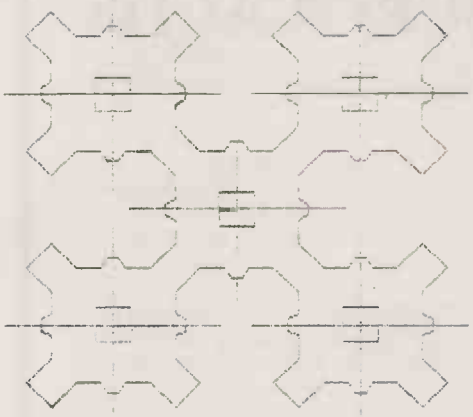
The illustrations on the opposite page show how fairly simple doodlings on a large first-generation square can result in interesting and beautiful designs when taken to just a few generations. You may find ideas among Moorish or Sufi decorative designs — which involve the same type of repetitive geometrics.

SIERPINSKI

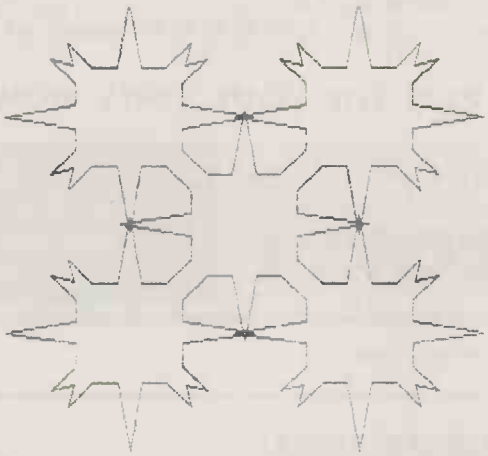
```
?po "sierpinski
to sierpinski :g :first :second :hd
make "l 510
make "k 1 make "r 1
repeat :g [make "k (:k * 2) make "r (:r * (:k - 1) / (:r * ((2 * :k) - 1))) make "l :l * !
:r]
make "h :l / 2 make "th :l / 3
make "k 1 repeat :g [make "k :k * 2]
make "y ((((:l + (:l * sin (45))) * (:k - 1)) / 2) + (0.5 * sin (45) * :l))
make "x ((0 - :g) - ((sin (45)) * :l * 0.5))
make "y :y + 20
ss setsplit 2 ht pu setpos (se thing "x thing "y) seth :hd clean pd
make "a (se thing "first)
make "z (se thing "second)
make "b (se thing "first thing "second thing "first)
if :g = 1 [repeat 4 [run thing "a]]
if :g = 2 [repeat 4 [run thing "b]]
if :g > 2 [repeat (:g - 2) [pattern] repeat 4 [run thing "a run thing "b if :g > 4 [recyc!
le] run thing "a recycle]]
setcursor [0 32]
pr (se "Sierpinski "Curve "generation thing "g "Segments thing "first "and thing "second !
"Initial "heading thing "hd)
end
?po "pattern
to pattern
make "b (se thing "a thing "z thing "z thing "z thing "a)
make "a (se thing "a thing "z thing "a)
make "z thing "b
end

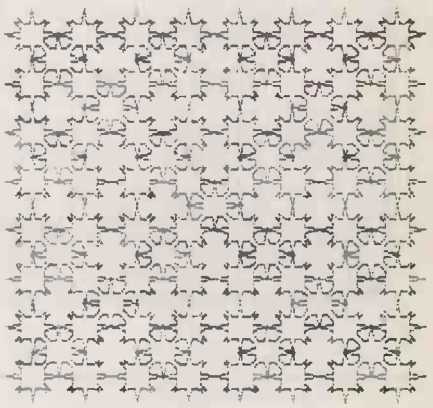


?po "z1
to z1
rt 90 fd :h rt 90 fd :h
lt 45 fd :l lt 45 fd :h
end
?po "z2
to z2
z1
repeat 2 [lt 45 fd :h lt 45 fd :l]
end
?po "c1
to c1
rt 90 fd :h rt 90 fd :h lt 45 fd :th lt 60 fd :th / 2 rt 60 fd :th / 4 rt 90 fd :l square!
 bk :l bk :h fd :h lt 90 fd :th / 4 rt 60 fd :th / 2 lt 60 fd :th lt 45 fd :h
end
?po "c2
to c2
rt 90 fd :h rt 90 fd :h repeat 3 [lt 45 fd :th lt 60 fd :th / 2 rt 60 fd :th / 4 rt 90 fd!
 :l square bk :l bk :h fd :h lt 90 fd :th / 4 rt 60 fd :th / 2 lt 60 fd :th lt 45 fd :h]
end
?po "e1
to e1
rt 150 fd :th lt 120 fd :th rt 150 fd :h lt 45 fd :th rt 60 fd :th lt 120 fd :th rt 60 fd!
 :th lt 45 fd :h
end
?po "e2
to e2
rt 150 fd :th lt 120 fd :th rt 150 fd :h repeat 3 [lt 45 fd :th rt 60 fd :th lt 120 fd :t!
h rt 60 fd :th lt 45 fd :h]
end
```

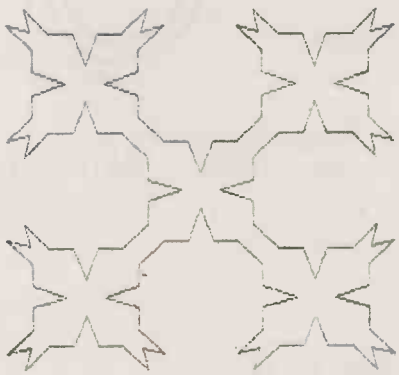


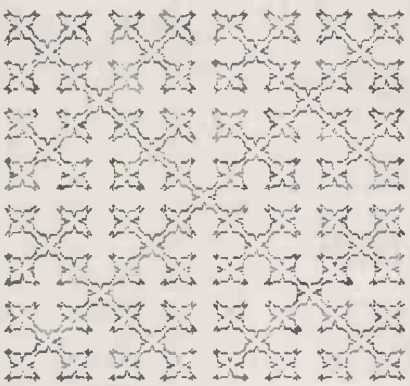
Segments c1 and c2, initial heading 315, generations 2 and 4.



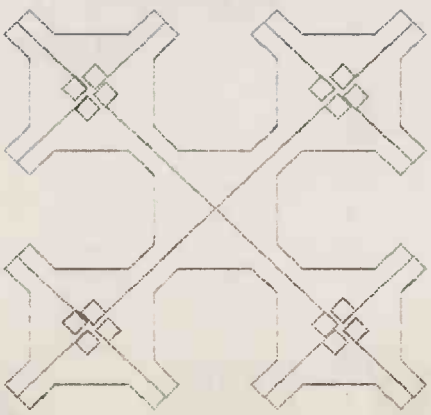


Segments k1 and k2, initial heading 315, generations 2 and 4.





Segments f1 and f2, initial heading 315, generations 2 and 4.



Segments n1 and n2, initial heading 315, generations 2 and 4.

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BUSINESS STATISTICS

VARIANCE RATIO TEST

It is often important to be able to distinguish between two sets of data on the basis of their variability rather than their mean. **Owen Bishop** and **Daniel Bishop** explain how it can be done.

THIS TEST makes use of a statistical parameter known as variance, which is in turn related to another parameter, standard deviation, mentioned in the May 1986 issue. Standard deviation and variance are a convenient way of expressing the spread of values found in a given set of data.

To calculate the variance and the standard deviation of a set of data you first find the mean of the set and then calculate the deviation for each value — that is, the difference between each value and the mean. The deviations of values greater than the mean are positive while those for values less than the mean are negative. Squaring each deviation gets rid of the negative signs; adding the squares, and dividing this sum by the number of values gives the variance. The standard deviation is simply the square root of the variance.

At first encounter, variance may seem an odd sort of quantity to be working with. If the data refers to numbers of meals served in a works canteen, for example, the variance is expressed in units of square meals. But variance has mathematical properties which make it an extremely useful parameter. The tests described in this article — and those which will appear in the following two months — are all based on it.

The table shows two sets of data which a buyer of widgets might wish to compare. The two columns represent the performance of widgets supplied by two firms. The buyer takes 20 widgets from each firm and keeps a record of how long, in hours, each is in use before it fails and has to be replaced. Thus the first widget bought from firm A fails after 435 hours of use, the next widget from A lasts 465 hours, and so on.

After testing 20 widgets from each firm it appears that there is virtually no difference in their mean life. Indeed, applying the t-test — see article in *Practical Computing*, June 1986 — to this data, the value of t is only 0.5, indicating that there is no significant difference between the means. Other things being equal, it does not seem to matter who supplies the widgets.

However, closer examination of the data shows that there is a difference which has so far been overlooked but which is detected by last month's 2-sample runs test: the two sets of data have different spread or standard deviation. This can be confirmed by using the Essential Statistics program published in the May issue to examine the data. The standard deviation for set A is 10, while that for set B is 15.

What this implies can be seen by looking again at the data in the table. Data in column A ranges from 434 to 472, while data in column B ranges more widely from 422 to 479. Widgets from firm B seem to be more variable in quality that those from firm A.

Looking at range — that is, the lowest and highest values — provides a rough appreciation of the situation. But this approach is unreliable because it deals only with the extreme values. The majority of values are clustered more closely around the mean, and it is essential that these should be taken fully into account in the test.

The variance ratio test calculates the variance of each set of data and then works out the ratio, F, between the larger variance and the smaller one. If the two sets have approximately equal variances, F is close to 1. The more the variances differ, the higher the value of F.

Standard statistical tables are available which show the probability of obtaining by chance various values of F when two sets of data are actually drawn from the same population — for instance, when two sets of widgets come from the same manufacturer, or if there are two manufacturers who are producing identical widgets. If, from a given set of data, you obtain a value of F which is less than the tabulated value, you will

VARIANCE RATIO TEST

```
   10 REM- VARIANCE RATIO
   20 REM- A Statistical Utility Program
   30 REM- ------------------------------
   40 REM- by Owen and Daniel Bishop
   50 REM- --------------------------
   60 REM- Version 1.0 - 30/12/85
   70 REM- For the BBC Micro Model B
   80 REM- --------------------------
   90 *FX4,1
  100 *TV 255,1
  110 L$=STRING$(10,CHR$32)
  120 MODE7:PROCcol:PRINT"VAR. RATIO"
  130 PROCbtm:PROCcol:PRINT "Enter name
of file to be loaded":PROCalpha("(max 7
letters): ",7)
  140 ON ERROR PROCfserror:VDU31,15,0:PR
OCcls:GOTO 130
  150 FILE$=OR$:A=OPENIN FILE$
  160 VDU31,15,0:PRINT FILE$
  170 INPUT#A,DF$:VDU31,24,0:PRINT"DATE:
";DF$
  180 INPUT#A,NC,NR:PROCcol:PRINT"COLS:
";NC;" ROWS: ";NR
  190 IF NC<2 THEN CLOSE#0:PRINTTAB(1,6)
"AT LEAST 2 COLUMNS OF DATA REQUIRED":FO
R J=1 TO 4000:NEXT:RUN
  200 DIM SC(NC+4,NR+4),CL$(NC+4),RL$(NR
+4),DP(16),U(103,4),F(4),V(2)
  210 INPUT#A,CW,LC:CW=10
  220 IF LC=0 THEN LC=1:GOTO240
  230 FOR J=1 TO NC:INPUT#A,CL$(J):NEXT
  240 INPUT#A,LR
  250 IF LR=0 THEN LR=1:GOTO270
  260 FOR J=1 TO NR:INPUT#A,RL$(J):NEXT
  270 FOR J=1 TO NR:FOR K=1 TO NC:INPUT#
A,SC(K,J):NEXT:NEXT
  280 FOR J=1 TO NC:INPUT#A,DP(J):NEXT:I
NPUT#A,DP$
  290 HI=0:FOR J=1 TO NC:IF DP(J)>HI THE
N HI=DP(J)
  300 NEXT:FOR J=1 TO NC+4:DP(J)=HI:NEXT
  310 CLOSE#0:ON ERROR OFF
  320 NC=NC+4:NR=NR+4
  330 CL$(NC-3)="MEAN":CL$(NC-2)="SDS":C
L$(NC-1)="ESDP":CL$(NC)="ESDM":RL$(NR-3)
="MEAN":RL$(NR-2)="SDS":RL$(NR-1)="ESDP"
:RL$(NR)="ESDM"
  340 DIM NV%(NC-4),SV%(NR-4)
  350 SW=36-7*LR:CC=INT(SW/CW):IF NC<CC
THEN CC=NC
  360 CS=0:RS=0:HB=4+7*LR
  370 IF LR=0 AND NR>=100 THEN HB=5
  380 RB=NR+4:IF NR>16 THEN RB=24
  390 FR=0:FOR J=1 TO NC:IF DP(J)>0 THEN
 FR=1
  400 NEXT
  410 VDU31,0,2:PROCcls
  420 PROCbtm :PROCcol:PRINTSPC(5)"Pleas
e wait while calculating":PROCmean:PROCb
tm
  430 RD=16:IF NR-RS<RD THEN RD=NR-RS
  440 CD=CC:IF NC-CS<CD THEN CD=NC-CS
  450 PROCcolumns:PROCrows:PROCdata
  460 PROCbtm
  470 *FX21,0
  480 VDU31,39,22:K$=GET$
  490 IF K$=CHR$139 AND RS>0 THEN RS=RS-
16:GOTO 430
  500 IF K$=CHR$136 AND CS>0 THEN CS=CS-
CC:GOTO 430
  510 IF K$=CHR$137 AND CS+CD<NC THEN CS
=CS+CD:GOTO 430
  520 IF K$=CHR$138 AND RS+RD<NR THEN RS
=RS+RD:GOTO 430
  530 IF K$="R" THEN RUN
  540 IF K$="T" THEN 560
  550 VDU7:GOTO 470
  560IF NC=6 THEN C1=1:C2=2:GOTO620
  570PROCbtm:PROCcol:PROCnum("Which colu
mn? (1-"+STR$(NC-4)+")",1,1,1,NC-4)
  580 C1=QN
  590PROCbtm:PROCcol:PROCnum("Which othe
r column? (1-"+STR$(NC-4)+")",1,1,1,NC-4
)
  600IF QN=C1 THEN VDU7:GOTO590
  610C2=QN
```

WORKING LIFE

	Firm A	Firm B
	435	452
	465	471
	445	459
	434	466
	445	452
	442	455
	459	451
	452	438
	452	479
	464	467
	442	438
	442	428
	450	443
	449	451
	451	424
	453	430
	440	438
	460	422
	461	456
	472	454
Mean life	451	449

have no reason to believe that the two sets differ in their variances. A value of F greater than the one in the table suggests that the two sets differ significantly.

The Variance Ratio Test program shown below calculates that F equals 2.21. The variance of set B is more than twice that of set A. The program then calculates that the chance of obtaining a value of F as high as this at random is only 0.094, or 9.4 percent. Consequently, if you say that A's widgets are of more consistent quality than B's you do so with only a 9.4 percent chance of being wrong. If you require a reliable product, it might be better to purchase only from A in future.

The t-test was mentioned earlier in this article as a way of assessing the significance of differences between means. One assumption on which the t-test depends is that the variances of the two samples are not significantly different. So before subjecting data to the t-test, it should be tested by the variance ratio test. If this shows that variances differ significantly, the results of the t-test should be treated with caution.

In the example, the variance ratio test indicates a reasonably significant difference of variance ratio, but since the t-test showed no significant difference of means you can leave it at that. If the t-test had indicated that there might be a difference of means, you could have gone on to use a test such as Cochran's test or the 2-sample runs to test for differences of their means, since these tests do not rely on equal variances.

To use the Variance Ratio Test program you need a data table containing two or more columns. Any pair of columns can be selected for comparison. A disc file containing the data is first prepared using the Data Maker program published in the February issue. Load and run the program Var-Rat. Put the data disc in the drive and load the required data file. The table is displayed and can be examined using cursor keys if necessary. The values of means, standard deviation of the sample (SDS), estimated standard deviation of the population (ESDP), and estimated standard deviation of the means (ESDM) are also displayed as in the essential statistics program.

Key T to test, selecting the columns for testing if the table has more than two columns. The variance ratio F is calculated and displayed, together with the number of degrees of freedom. You can then use statistical tables of the distribution of F to establish the level of significance. The calculated value of F must equal or exceed the tabulated value to indicate significance at the given level.

Alternatively, key P to have the probability calculated directly. Under certain conditions, if F is greater than 9 or if the number of degrees of freedom is less than 4 — that is, with five items in each column — the algorithm does not produce an accurate result and the message

· Probability not available

is displayed. The same thing happens when the number of degrees of freedom is large, since the values concerned are too big for the program to handle.

If no probability is available because F is large, the differences between variances is usually highly significant. If no probability is available because the amount of data is too small you can collect more data and repeat the test. Key N for the next test, or R to rerun the program.

The statistics programs and tests covered in this series include histograms, scattergrams, essential statistics, chi-square test, runs test, variant ratio test, analysis of variants 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.

```
  620VDU31,0,2:PROCcls
  630VR1=SC(C1,NR-1)^2:VR2=SC(C2,NR-1)^2
  640IFVR1>VR2 THEN FP=VR1/VR2 ELSE FP=V
R2/VR1
  650 VDU31,0,2:PROCcls:VDU31,0,5:PRINT"
F = ";INT((FP+.005)*100)/100
  660V1=NV%(C1)-1:IFV1>NV%(C2)-1 THEN V2
=NV%(C2)-1 ELSE V2=V1:V1=NV%(C2)-1
  670PRINT'"with ";V1;" and ";V2;" degre
es of freedom"
  680PROCbtm
  690*FX21,0
  700VDU31,39,22:K$=GET$
  710 IF K$="P" THEN 750
  720 IF K$="R" THEN RUN
  730 IF K$="N" AND NC>6 THEN 450
  740 VDU7:GOTO690
  750 IF (V1<4 OR V2<4)OR FP>9 THEN 880
  760 ON ERROR GOTO 880
  770 PROCbtm:PROCcol:PRINT"Calculating
probability of F"
  780P=FNF*2:ON ERROR OFF:IF P<0 OR P>1
THEN 890
  790@%=&20306
  800 VDU31,0,12:PRINT"Probability is ";
P
  810@%=&90A
  820PROCbtm
  830*FX21,0
  840VDU31,39,22:K$=GET$
  850 IF K$="R" THEN RUN
  860IF K$="N" AND NC>6 THEN 450
  870 VDU7:GOTO830
  880 ON ERROR OFF
  890VDU31,0,12:PRINT"Probability not av
ailable"
  900 GOTO820
  910 DEF PROCmean
  920 LOCAL J%,K%,C%,SUM,NT%
  930 FOR J%=1 TO NC-4:C%=0:FOR K%=1 TO
NR-4:IF SC(J%,K%)<>1E-29 THEN C%=C%+1
  940 NEXT:NV%(J%)=C%:NEXT:FOR J%=1 TO N
R-4:C%=0:FOR K%=1 TO NC-4:IF SC(K%,J%)<>
1E-29 THEN C%=C%+1
  950 NEXT:SV%(J%)=C%:NEXT
  960 NT%=0:FOR J%=1 TO NC-4:NT%=NT%+NV%
(J%):NEXT
  970 FOR J%=NC-3 TO NC:FOR K%=NR-3 TO N
R:SC(J%,K%)=1E-29:NEXT:NEXT
  980 FOR J%=1 TO NC-4:SUM=0:FOR K%=1 TO
 NR-4:IF SC(J%,K%)<>1E-29 THEN SUM=SUM+S
C(J%,K%)
  990 NEXT:SC(J%,NR-3)=SUM:NEXT
 1000 FOR J%=1 TO NR-3:SUM=0:FOR K%=1 TO
 NC-4:IF SC(K%,J%)<>1E-29 THEN SUM=SUM+S
C(K%,J%)
 1010 NEXT:SC(NC-3,J%)=SUM:NEXT
 1020 FOR J%=1 TO NC-4:SUM=0:FOR K%=1 TO
 NR-4:IF SC(J%,K%)<>1E-29 THEN SUM=SUM+S
C(J%,K%)*SC(J%,K%)
 1030 NEXT:SC(J%,NR-2)=SUM:NEXT
 1040 FOR J%=1 TO NR-4:SUM=0:FOR K%=1 TO
 NC-4:IF SC(K%,J%)<>1E-29 THEN SUM=SUM+S
C(K%,J%)*SC(K%,J%)
 1050 NEXT:SC(NC-2,J%)=SUM:NEXT:SUM=0:FO
R J%=1 TO NC-4:SUM=SUM+SC(J%,NR-2):NEXT:
SC(NC-2,NR-2)=SUM
 1060 FOR J%=1 TO NR-4:IF SV%(J%)<>0 THE
N SC(NC-2,J%)=SC(NC-2,J%)-(SC(NC-3,J%)*S
C(NC-3,J%))/SV%(J%)
 1070 NEXT
 1080 FOR J%=1 TO NC-4:IF NV%(J%)<>0 THE
N SC(J%,NR-2)=SC(J%,NR-2)-(SC(J%,NR-3)*S
C(J%,NR-3))/NV%(J%)
 1090 NEXT
 1100 SC(NC-2,NR-2)=SC(NC-2,NR-2)-(SC(NC
-3,NR-3)*SC(NC-3,NR-3))/NT%
 1110 FOR J%=1 TO NR-4:IF SV%(J%)>1 THEN
 SC(NC-1,J%)=SQR(SC(NC-2,J%)/(SV%(J%)-1)
) ELSE SC(NC-1,J%)=1E-29
 1120 NEXT: FOR J%=1 TO NC-4:IF NV%(J%)>
1 THEN SC(J%,NR-1)=SQR(SC(J%,NR-2)/(NV%(
J%)-1)) ELSE SC(J%,NR-1)=1E-29
 1130 NEXT:IF NT%>1 THEN SC(NC-1,NR-1)=S
QR(SC(NC-2,NR-2)/(NT%-1)) ELSE SC(NC-1,N
R-1)=1E-29
```

(continued on next page)

VARIANCE RATIO TEST

(continued from previous page)

```
 1140 FOR J%=1 TO NR-4:IF SV%(J%)<>0 THE
N SC(NC-2,J%)=SQR(SC(NC-2,J%)/SV%(J%)) E
LSE SC(NC-2,J%)=1E-29
 1150 NEXT:FOR J%=1 TO NC-4:IF NV%(J%)<>
0 THEN SC(J%,NR-2)=SQR(SC(J%,NR-2)/NV%(J
%)) ELSE SC(J%,NR-2)=1E-29
 1160 NEXT:SC(NC-2,NR-2)=SQR(SC(NC-2,NR-
2)/NT%)
 1170 FOR J%=1 TO NR-4:IF SV%(J%)<>0 THE
N SC(NC-3,J%)=SC(NC-3,J%)/SV%(J%) ELSE S
C(NC-3,J%)=1E-29
 1180 NEXT:FOR J%=1 TO NC-4:IF NV%(J%)<>
0 THEN SC(J%,NR-3)=SC(J%,NR-3)/NV%(J%) E
LSE SC(J%,NR-3)=1E-29
 1190 NEXT:SC(NC-3,NR-3)=SC(NC-3,NR-3)/N
T%
 1200 FOR J%=1 TO NR-4:IF SV%(J%)<>0 THE
N SC(NC,J%)=SC(NC-1,J%)/SQR(SV%(J%)) ELS
E SC(NC,J%)=1E-29
 1210 NEXT:FOR J%=1 TO NC-4:IF NV%(J%)<>
0 THEN SC(J%,NR)=SC(J%,NR-1)/SQR(NV%(J%)
) ELSE SC(J%,NR)=1E-29
 1220 NEXT:SC(NC,NR)=SC(NC-1,NR-1)/SQR(N
T%)
 1230 ENDPROC
 1240 DEF FNF
 1250DF=.1:IFFP>5 THEN DF=INT(FP)*.04
 1260 FOR J=0 TO 2:V(J)=1:NEXT
 1270 FOR J=0 TO 4:F(J)=0:NEXT
 1280FOR J=0 TO 103:FOR K=0TO4:U(J,K)=0:
NEXT:NEXT
 1290D=2/DF:VF=V1/2-1:FQ=INT((FP+.5*DF)/
DF)*2:VG=V1/2:VH=V2/2
 1300VV=V1+V2:VN=0
 1310PROCcalc
 1320VV=V1:VN=1
 1330PROCcalc
 1340VV=V2:VN=2
 1350PROCcalc
 1360AA=V(0)/V(1)/V(2)*V1^VG*V2^VH
 1370VI=VG-1:VJ=(V1+V2)/2
 1380FORJ=3 TO FQ+3
 1390JF=J/D-DF
 1400U(J,0)=JF^VI/(V2+V1*JF)^VJ
 1410NEXT
 1420FORK=1 TO 4
 1430FU=3-K
 1440FORJ=1TOFQ+FU:U(J,K)=U(J+1,K-1)-U(J
,K-1):NEXT
 1450NEXT
 1460FORK=0 TO 4 STEP 2
 1470FORJ=3-K/2 TO FQ+1-K/2 STEP 2 :F(K)
=F(K)+U(J,K):NEXT
 1480NEXT
 1490A=DF*(F(0)+F(2)/6+F(4)/180)
 1500=1-A*AA
 1510 DEF PROCcalc
 1520IF VV/2=INT(VV/2)THEN1590
 1530VW=VV/2
 1540FORJ=1TOVW-.5
 1550V(VN)=V(VN)*(VW-J)
 1560NEXT
 1570V(VN)=V(VN)*1.77245
 1580GOTO1630
 1590VW=VV/2-1
 1600FORJ=1 TO VW
 1610V(VN)=V(VN)*J
 1620NEXT
 1630ENDPROC
 1640 DEF PROCdata:LOCAL J,K:VDU23,1,0;0
;0;0;:FOR J=5 TO 20:VDU31,HB-1,J-1:PROCc
ll:NEXT
 1650 FOR J=1+CS TO CD+CS:HH=HB-1+(J-CS-
1)*CW
 1660 FOR K=1+RS TO RD+RS
 1670 IF SC(J,K)=1E-29 THEN 1690 ELSE @%
=&0102000A+(DP(J)*&100):A$=STR$(SC(J,K))
:IF RIGHT$(A$,1)="."THEN A$=LEFT$(A$,LEN
(A$)-1)
 1680 VDU31,HH-1,3+K-RS:PRINT RIGHT$(L$+
A$,CW):@%=&90A
 1690 NEXT:NEXT
 1700 VDU23,1,1;0;0;0;
 1710 ENDPROC
 1720 DEF PROCcolumns:LOCAL J:VDU23,1,0;
0;0;0;:VDU31,0,2:PROCcll:VDU31,0,3:PROCc
ll
 1730 VDU31,0,2:FOR J=1 TO CD
 1740 VDU31,(HB-1+(J-1)*CW),2:PRINT;J+CS
;
 1750 NEXT
 1760 IF LC=0 THEN VDU23,1,1;0;0;0;:ENDP
ROC
 1770 VDU31,0,3:FOR J=1 TO CD
 1780 VDU31,(HB-1+(J-1)*CW),3:PRINTCL$(J
+CS);
 1790 NEXT:VDU23,1,1;0;0;0;:ENDPROC
 1800 DEF PROCrows:LOCAL K:VDU23,1,0;0;0
;0;:FOR K=5 TO 20:VDU31,0,K-1:PROCcll:NE
XT
 1810 FOR K=1 TO RD:VDU31,0,K+3:PRINT;K+
RS:NEXT
 1820 IF LR=0 THEN VDU23,1,1;0;0;0;:ENDP
ROC
 1830 FOR K=1 TO RD:VDU31,3,3+K:PRINT RL
$(K+RS)
 1840 NEXT:VDU23,1,1;0;0;0;:ENDPROC
 1850 DEF PROCnum(Q$,Q1,Q2,Q3,Q4)
 1860 *FX21,0
 1870 PROCcol:PRINT Q$;:INPUT""QN$
 1880 QN=VAL(QN$)
 1890 IF QN=0 AND QN$<>"0" THEN 1920
 1900 IF QN<>INT(QN) THEN 1920
 1910 IF (Q3=0 OR QN<=Q4) AND (Q1=0 OR Q
N>=Q2) THEN ENDPROC
 1920 PROCline
 1930 GOTO 1860
 1940 ENDPROC
 1950 DEF PROCalpha(Q$,Q1)
 1960 *FX21,0
 1970 PROCcol:PRINT Q$;:INPUT""QR$
 1980 IF LEN(QR$)<=Q1 OR Q1=0 THEN ENDPR
OC
 1990 PROCline:GOTO 1960
 2000 DEF PROCline:VDU11:PROCcll:VDU7:EN
DPROC
 2010 DEF PROCbtm:VDU31,0,20:PROCcls:VDU
31,0,20:ENDPROC
 2020 DEF PROCcol
 2030 PRINT CHR$130;
 2040 ENDPROC
 2050 DEF PROCcls
 2060 LOCAL CRS%,V,H
 2070 V=VPOS:H=POS
 2080 CRS%=999-H-(40*V)
 2090 VDU23,1,0;0;0;0;
 2100 REPEAT:IF CRS%<255 THEN 2120
 2110 CRS%=CRS%-255:PRINTSTRING$(255,CHR
$32);
 2120 UNTIL CRS%<255
 2130 PRINTSTRING$(CRS%,CHR$32);
 2140 VDU31,H,V
 2150 VDU23,1,1;0;0;0;
 2160 ENDPROC
 2170 DEF PROCcll
 2180 LOCAL V,H
 2190 V=VPOS:H=POS
 2200 PRINT STRING$(40-H,CHR$32);
 2210 VDU31,H,V
 2220 ENDPROC
 2230 DEF PROCfserror
 2240 ON ERROR OFF
 2250 CLOSE#0
 2260 VDU7
 2270 IF ERR>44 OR ERR=6 THEN 2310
 2280 CLS:VDU11:REPORT:PRINT " at line "
;ERL
 2290 *FX4,0
 2300 END
 2310 PROCbtm:IF ERR=222 THEN PRINT"No s
uch file";:PROCcol ELSE VDU11:REPORT:PRO
Ccol
 2320 PRINT" error. ":PROCcol:PRINT"Pres
s SPACEBAR, when you are ready "
 2330 *FX21,0
 2340 REPEAT:A=GET:UNTIL A=32
 2350 VDU11,11:PROCcls
 2360 ENDPROC
```

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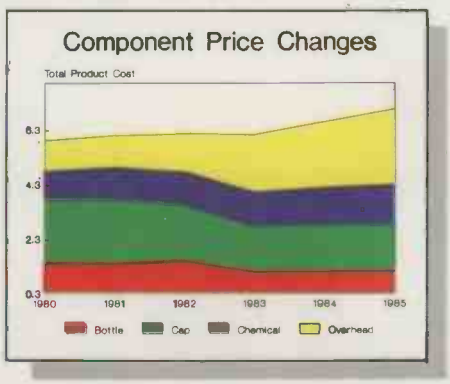

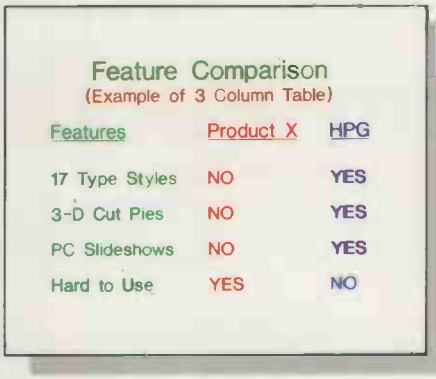

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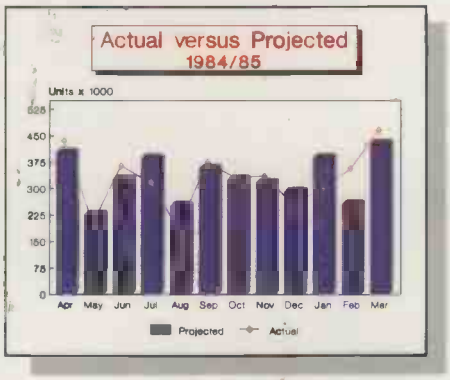

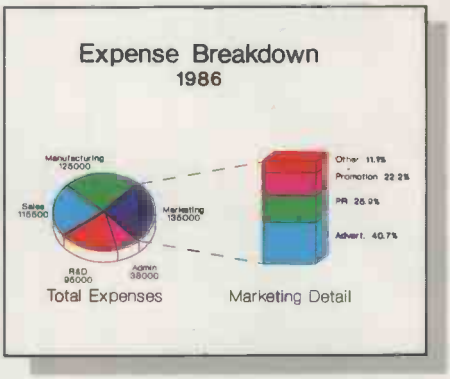

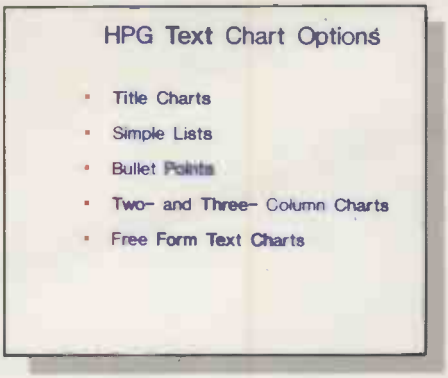

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