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**I CONNECTORS**

<table>
<thead>
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<th>Headers</th>
<th>Recessances</th>
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<td>550p</td>
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<thead>
<tr>
<th>Model</th>
<th>Specifications</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Sanyo MBC 550</td>
<td>16 Bit Micro, 256k RAM, Built in full colour graphics, MS DOS 1.25 operating system, Free green monitor. Free software including WordStar and CalcStar.</td>
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<tr>
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<tr>
<td>Sanyo 550-360X With Dual 360k Disc Drives</td>
<td>MS DOS 2.11 operating system.</td>
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<td>Sanyo 550-800X With Dual 800k Disc Drives</td>
<td>MS DOS 2.11 operating system.</td>
<td>£999 + VAT £1149</td>
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**SANYO 555 SERIES**

<table>
<thead>
<tr>
<th>Model</th>
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<th>Price</th>
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<tr>
<td>Sanyo MBC 555</td>
<td>16 Bit Micro, 256k RAM, Built in full colour graphics, MS DOS 1.25 operating system, Free green monitor. Free software including WordStar and CalcStar.</td>
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<tr>
<th>Model</th>
<th>Specifications</th>
<th>Price</th>
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<tbody>
<tr>
<td>CD 3125 Standard Res Colour Monitor</td>
<td>£155 + VAT £178</td>
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<tr>
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<td>£16.50</td>
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Transfer data from MASTERFILE to TASWORD TWO. Letters and forms typed on TASWORD TWO can be printed with addresses and data taken from MASTERFILE. The mail merge facility allows, for example, multiple copies of a letter to be printed, each containing a different name and address taken from your MASTERFILE data. To use TASMERGE you must have one or more microdrives as well as TASWORD TWO and MASTERFILE by Campbell Systems (version 9 or later).
TASMERGE ZX 48K Spectrum £10.90

TASWIDE

The Screen Stretcher
With this machine code utility you can write your own Basic programs that will, with normal PRINT statements, print onto the screen in the compact lettering used by TASWORD TWO. With TASWIDE you can double the information shown on the screen!
TASWIDE ZX 16K + 48k Spectrum £5.50

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Plug into your Spectrum and drive any printer fitted with the Centronics standard parallel interface. Supplied complete with ribbon cable and driving software. The user changeable interface software makes it easy to send control codes to your printer. Using the method so successfully pioneered with TASWORD TWO. The cassette contains fast machine code high resolution full width SCREEN COPY SOFTWARE for Epson, Minolta, Star, and Tandy Colour Graphic Printers. TASCOPY, shaded screen copy software for this interface (value £9.90 - see description on left) is included in this package.
CENTRONICS INTERFACE ZX Spectrum £39.90

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**FORMULA II**: Unique information management system with exceptional capabilities for Application Generation. Multiple files and indexes, transaction processing, interactive, no programming language required...

**dBASE II**: The most popular of data management systems, very powerful application generator...

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**CARDBOX**: Highly popular electronic card Index system. Easy to use, with powerful retrieval facilities...

**FRIDAY**: End user file management system from the authors of dBASE II. File definition, input and reporting under user control...

**OPEN ACCESS**: Multi-function Executives Information System...

**FORMULA IV MULTI-USER**: Database for PC DOS...

**EVERYMAN**: Database Systems...

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## UTILITIES

**ASCII**: The most flexible asynchronous communications package available to the micro world. Interactive, batch, menu-driven. Available for CP/M, CP/M-86, MS/PC/DOS...

**ТRANSLATE**: System for exchanging files between CP/M systems Provided with full FORTRAN source code...

**CONVMS**: Operating system converter. Runs MS/PC/DOS programs under CP/M-86...

**CONVCP**: Operating system converter. Runs CP/M-86 programs under MS/PC/DOS...

**ASSEMBLER PLUS**: Disassembler for 80386 and 286 programs...

**DISKEDIT**: Facility for editing disk data by sector. Irreversible edit...

**IBM-CP/M COMPATIBILITY**: Set of programs that enable IBM 286 disks to be used on CP/M, permitting transfer of files to IBM mainframes...

**FASTFORM**: Speed Programming Package for use with Pascal/MT + ...

**XLT86**: Converts 8080 assembler code to 8086...

**CONVCP**: Operating system converter...

**SUPERSORT**: Full function Sort/Merge/Selection package...

**BASHORT**: Short cut to full blown BASHORT...

**STAYTIME**: Utility to improve CP/M performance...

**SUPERSORT**: Full function Sort/Merge package...

**RAINBOW**: Simple communications program for exchanging tiles between CP/M systems...

**CONVMS**: Operating system converter...

**ACCESS MANAGER**: File handling productivity aid for Digital Research compilers...

**ACCESS MANAGER**: File handling productivity aid for Digital Research compilers...

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**MULTIPLAN**: Exceptional electronic spreadsheet from Microsoft...

**MULTI-TOOL**: Word Processor with optional Mouse for added flexibility...

**SUPERCALC**: Easy to use spreadsheet...

**ABSTAT**: Powerful statistical package...

**GRAPHSTAT**: Versatile statistics and graphics package...

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**ALIAS PAYROLL**: Standalone or Integrated system with online access to ALIAS accounts...

**RCS LEDGERS**: Sales, Purchase, Nominal ledgers in dBASE IV source code...

**RCS PAYROLL**: Full function, highly used package...

**STATISTICS PACK**: Over 25 easily used routines in dBASE IV...

## MISCELLANEOUS

**CP/M 2.2**: Standard operating system on 8" disk...

**CP/M-86**: Standard 16-bit operating system...

**SUPERSORT**: Full function Sort/Selection package...

**MSORT**: Standalone and COBOL hosted Sort package...

**MAGSAM**: dBASE utility to provide multi-key ISAM file facilities...

**TOUCH 'N' GO**: Teach yourself keyboard skills...

**MICROSOFT MOUSE**: Mouse, interface card and software...

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ADAM DENNING
The computer language C is now regarded as one of the most important systems programming languages available, as it is compact, economical and relatively easy to use.
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Paperback 0 412 27140 0 £7.95

The Hitch-Hiker's Guide to Artificial Intelligence

RICHARD FORSYTH AND CHRIS NAYLOR
This book is a practical, do-it-yourself guide for home micro users who want to delve into the exciting world of AI (Artificial Intelligence). It begins with a clear introduction to the principles of AI with an explanation of why its concepts are so important, how it can be fun to explore on micros. The book avoids the specialist AI programming languages and presents all programs in BASIC.
August 1984 234 x 156 184 pages
BBC BASIC edition: 0 412 26970 8 £8.95
Apple BASIC edition 0 412 27090 0 £8.95

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DAVID JANDA
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<td>Many Cable RIBBONS ECT</td>
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**FREE** with Deals

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**BUDGET 30 STORAGE BOX** (capacity thirty disks)

**FREE** with Deals

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<th>Colour Code</th>
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**BUDGET 50 STORAGE BOX** (capacity fifty disks)

**FREE** with Deals

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**Prices exc VAT — All diskettes individually certified & with hubrings**

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<th>30 + 3 colours</th>
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<td>Deal D 63.60</td>
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<td>2D D/S D/D 48 tpi</td>
<td>Deal F 17.90</td>
<td>Deal G 35.80</td>
<td>Deal H 53.70</td>
<td>Deal J 71.60</td>
<td>Deal K 89.50</td>
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<td>1DD S/S D/D 96 tpi</td>
<td>Deal L 17.90</td>
<td>Deal M 35.80</td>
<td>Deal N 53.70</td>
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<td>2DD D/S D/D 96 tpi</td>
<td>Deal R 19.90</td>
<td>Deal S 39.80</td>
<td>Deal T 59.70</td>
<td>Deal U 79.60</td>
<td>Deal V 99.50</td>
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**ALL DEALS GET:**

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  - Red (R), Orange (O)
  - Yellow (Y), Green (G), Pale Blue (P), Blue (B)

**FREE** storage box of your choice

**FREE** Pack of Disking Colour Coder Felts

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**Deal C** 47.70

**Deal D** 63.60

**Deal E** 79.50

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**£2 D D/S D/D 48 tpi**

**Deal F** 17.90

**Deal G** 35.80

**Deal H** 53.70

**Deal J** 71.60

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**£1 DD S/S D/D 96 tpi**

**Deal L** 17.90

**Deal M** 35.80

**Deal N** 53.70

**Deal P** 71.60

**Deal Q** 89.50

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**£2 DD D/S D/D 96 tpi**

**Deal R** 19.90

**Deal S** 39.80

**Deal T** 59.70

**Deal U** 79.60

**Deal V** 99.50

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**£1 DD S/S D/D 96 tpi**

**Deal A** 15.90

**Deal B** 31.80

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**Deal M** 35.80

**Deal N** 53.70

**Deal P** 71.60

**Deal Q** 89.50

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**£2 DD D/S D/D 96 tpi**

**Deal R** 19.90

**Deal S** 39.80

**Deal T** 59.70

**Deal U** 79.60

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These diskette mailers come packed in 100s and are of a very clever copyright design. They well hold up to 5 diskettes complete with dividers and are extremely robust.

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<tr>
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<th>3.5 packs each (1.75p)</th>
<th>2 packs each (1.60p)</th>
<th>5 packs each (1.00p)</th>
<th>10 packs each (0.50p)</th>
<th>10+ packs POST FREE</th>
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<tr>
<td>5 1/4 Coloured Diskettes</td>
<td>1-3 packs $0.50 each pack</td>
<td>1-2 packs $0.50 each pack</td>
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<td>6-9 packs $0.50 each pack</td>
<td>10+ packs $0.50 each pack</td>
<td>10+ packs POST FREE</td>
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| 630     | 30 Minidisk capacity if buying 3 to get one FREE, £1.00 unit rate please. |

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We supply all Government Bodies and institutions, including schools, Universities, Colleges, Hospitals, the Utilities, Research Establishments, Armed Forces, the Ministries and Local Authorities world wide. We will look after your orders as the small one-off order number received direct by post at this time, and orders are handled in the section concerned so the attention of the department. We will arrange a personal call at the department to pay against.

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**Memorex Cleaning Kits**

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**Disk drive head cleaning kit**

Price exc VAT

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<th>Description</th>
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<tr>
<td>Case/keyboard cleaning kit</td>
<td>4.90</td>
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<td>VDU screen cleaning kit</td>
<td>6.90</td>
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<td>Disk head cleaning kit</td>
<td>8.90</td>
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**Disk drive head cleaning kit**

**UK Shipping Rates**

5 1/4 Disks or microdisks:

| 1-2 packs each pack | 1.60 |
| 3 packs each | 1.20 |
| 5 packs each | 1.00 |
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| Part No | Description | Price exc VAT |
| EM50 | Executive Micro 50 50 microdisk capacity | 19.90 |

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| Part No | Description | Price exc VAT |
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By the time 1-2-3 calculates it correctly, you may have retired.

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Or if you’d like to quickly create a file directory under program control. 1-2-3 can’t do that at all.

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We’d like you to go down to your software dealer or send for a free demo-disk and see a new product called SuperCalc * 3 Release 2, which, unlike Lotus 1-2-3, does all of the above.

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THE NEW AMSTRAD CPC 664 WITH BUILT-IN DISC DRIVE

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If you know anything about computers you'll know that disc drives are up to fifty times faster than cassette when you're loading and saving programs. In fact, a disc drive makes computing faster, more reliable, more efficient and more fun. But up till now the only way to gain these advantages for a home computer was to buy a separate disc drive attachment. Now Amstrad are pleased to announce the first complete home computer with built-in disc drive: The Amstrad CPC 664.

And when you buy a CPC 664 you'll find it's not just the disc drive that's built-in. You'll get everything you need, including a monitor (green screen or full colour). We'll even give you a free CPM and Logo disc, so all you do is plug in and you're in business.

BUSINESS OR PLEASURE

Although a disc drive will make games more fun (and there are loads of them to choose from) it also makes the CPC 664 a serious proposition for the business user.

There are accounting, word-processing, spread-sheet and database programs (to name but a few).

The CPC 664 is also supplied with CP/M* to help make your business more efficient and effective by providing access to the famous range of CP/M* software.

Amsoft Business Control, is a complete suite of programs for integrated sales invoicing, stock control and sales ledger. For around £99. (Requires an additional FD-1 disc drive around £159 and DL-2 cable around £7).

Wordprocessing with Amsword can improve the productivity of everyone from unskilled typist to trained secretary. Around £23.95.

With a green screen monitor the cost is just £339. With a full colour screen it costs £449. And after you've saved money on the price of the computer itself, you go on saving on the price of software.

There are hundreds of programs for business or pleasure available on disc (and cassette) to CPC 664 users. Many from Amsof, others from other famous-name software houses. Few will cost you more than £49 and most will cost you considerably less.

AN EXPANDING SYSTEM

There is a complete range of peripherals available to CPC 664 users which plug directly into the built-in interfaces. These include a joystick, additional disc drive (to double your on-line storage) and the Amstrad DMP-1 dot-matrix printer. (There's also a cassette interface so that you can use CPC 464 programs on tape). And there are many more peripherals from Amstrad and other manufacturers which can be used to enhance the CPC 664.

Wordprocessing with Amsword can improve the productivity of everyone from unskilled typist to trained secretary. Around £23.95.

HIGH PERFORMANCE - LOW COST

The one thing you won't need a computer to work out is that the Amstrad CPC 664 represents outstanding value for money.

You only have to check the cost of buying all the elements separately (64K computer, disc-drive, monitor) to realise that the Amstrad package is very hard to beat.

With a green screen monitor the cost is just £339. With a full colour screen it costs £449. And after you've saved money on the price of the computer itself, you go on saving on the price of software.

There are hundreds of programs for business or pleasure available on disc (and cassette) to CPC 664 users. Many from Amsof, others from other famous-name software houses. Few will cost you more than £49 and most will cost you considerably less.

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Brains before beauty

The important part of last month's announcement about the new Amstrad was the missing bit — the fact that a much nicer Amstrad is still waiting in the wings and will actually be fully CP/M-compatible.

But until then, the Tatung Einstein, one of last year's forgotten launches, has a chance — and with the assistance of Dixons, it is going for it in a big way.

The difference between the Einstein and the Amstrad family is that they have different crippling limitations as CP/M machines. Neither is guaranteed to run CP/M applications straight from the CP/M user group — the Amstrad because of memory problems, the Einstein because of screen problems.

The Amstrad family is short on memory. CP/M distributors have flatly refused to support the machine, on the fairly obvious grounds that there isn't anything in it for them. As one put it: 'We might sell a few copies of SuperCalc One — big deal! WordStar won't run, so what's the point?'

That's exaggerating, but not by much (and Amstrad does have an implementation of WordStar running).

The Tatung machine, however, was handicapped by a similar bodge-up — a 40-column screen. Try running any CP/M software on that, and see what sense you can make of what you see ... and, it turns out, a cumbersome screen display system adds to the problem.

No-one is saying how long we have to wait for the 84k TPA (transient program area) version of the Amstrad. But in the meantime, the Einstein has repaired its missing limb by releasing a module to give it 80-column display, and has cut its price to give the Amstrad a run. For around £500, the Einstein now comes with a high-resolution monitor (good enough for 80 characters in colour, which I warmly suggest you don't try on a colour Amstrad) and two disks, and is supported by Xitan, the CP/M specialist distributors of Southampton.

Geoff Lynch is quite excited by the amount of interest, if a little miffed at the timing. 'We'd run down the CP/M market quite gently,' he grumbled happily, 'and suddenly we're having phone calls from all these Dixons branch managers wanting software for the Einstein.'

Dixons bought 10,000 Einsteins inside two months, and if they sell, will buy more.

At the price, you can't really fault the machine unless you want to do one thing. That thing is: communications.

It will, my sources tell me, run the universal communications program, Bstam, which is widely used by programmers for getting software from one machine directly into another when they can't read each other's disks. With a little care, Bstam can even be used to drive a modem, but not easily, nor by a beginner (nor by me!).

But Bstam is a line-buffered program. Most terminal programs like to display each key on the screen as you type it; Bstam waits until there is a whole line, and then puts it up.

Each character on the Einstein takes five milliseconds to display, with the internal software grinding away furiously. That makes it impossible to use the machine as a terminal, even at 300 baud duplex — there isn't time to get the characters onto the screen at that speed.

A solution, apparently, is on the way. Despite several attempts to contact Tatung staff in the week before going to press, I couldn't get any 'horse's mouth' information on when, or how, or whether previous users will be able to buy it.

In the meantime, anyone wanting the Einstein should contact their nearest Dixons store for details.

Multi-tracking

That sinking feeling you get when, at the end of a really hard bit of program writing, the lights go out, can be avoided. Use the auto-save feature given to a BBC Micro by Software Services' new ROM, and it will make a copy to disk every four minutes.

This is one of 14 new features provided by the ROM, including a very suspicious feature called *CONVERT, which makes a complete copy of any (40-track) disk in four minutes.

The one I like, however, is *COPY, which turns a 40-track disk into an 80-track disk with 40 spare tracks.

Full details of the £30 chip on (051) 427 8984.

Sharp chips

Sharp makes chips as well as micros — chips rather more successfully than micros, actually. And its latest release is really rather exciting in its small way — it gives 280 systems a way of working on multiple tasks.

The component is the LH 8575, and it is a 'multi-tasking support processor', or MTSP. It will control multiple tasks on a priority basis, up to a maximum of 256.

Altek Microcomponents, the distribution company which drew the product to my attention, points out that the device (which is widely used by programmers for getting software from one machine directly into another when they can't read each other's disks. With a little care, Bstam can even be used to drive a modem, but not easily, nor by a beginner (nor by me!) Be) can even be used to drive a modem, but not easily, nor by a beginner (nor by me!)

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In the meantime, anyone wanting the Einstein should contact their nearest Dixons store for details.
something quite different), and instead of switching between word processor and communications, your interrupt is likely to fill the screen with the dreaded ‘Game Over’ message.

At least the possibility now exists of doing a multi-tasking Spectrum, cheaply. Details from Bob Green on (0734) 791579.

**Spectrum life-saver**

One step better than the ‘Romantic Robot’ for transferring programs from tape to Spectrum Microdrive is the Mirage Microdriver from Mirage Microcomputers.

The Romantic Robot was foolproof in untangling programs that wanted to live on audio cassette, but some program writers, more concerned with security than sales, actually prevented it from working by building timing routines into the load process. Loading from Microdrive would be too quick, and the program wouldn’t load. This was supposed to be clever.

The Mirage Microdriver is a bit of hardware, not just a program like Romantic Robot. It costs £40, and is available by mail order only from Mirage at 24 Bank Street, Braintree, Essex CM7 7UL. In the interest of clarity, I must point out that this product hasn’t been tested, nor do I have any personal evidence that the company exists other than the announcement, so you order entirely at your own risk.

However, assuming that the product is available, it works rather like the Quickshot on the Apple II by taking a photograph (so to speak) of what is in the memory of the computer and saving it to Microdriver, as follows.

The user loads and runs programs in the usual way, with the Microdriver attached to the Interface 1 expansion port. At any time, the button on the Microdriver can be pressed, and program operation is halted.

At this point, the Microdriver stores the contents of the Z80 processor registers and selected areas of memory in its internal 2K of RAM, and two lines of text appear at the top of the Spectrum display. These are used to print a menu, and there are other prompts to guide the user through saving and loading.

The drawback (from a pirate’s point of view!!) is that the version of the software now stored on Microdrive will only run with the Microdriver itself. When the program is run, it will restart exactly from the point reached when the button was pressed.

This gives a whole new feature which Mirage doesn’t go into — game ‘save’ ability.

A game which has been taken through the third level after 10 minutes work is often only just getting interesting. At that point, inevitably, the phone rings, and you have to watch in agony as your remaining three lives, so carefully conserved through the aeons of painstaking play in the boring initial stages, are squandered by a little man on the screen who lets the snakes eat him, the dwarf hit him on the head with the sausages, the pit open up under his feet, or tranny run off with the bottle of milk.

Fear not! — the Microdriver will save the game at this point, and let you restart it, from this point.

You can also modify the program, as there is an option in the Microdriver menu to return to Basic and use the POKE command to change critical memory locations giving infinite lives, for example. Again, the saved program will only work if run with the Microdriver.

Phone (0376) 48321 for details.

**PC Prestel**

There are many ways of using an IBM PC to watch Prestel, and most of them involve hard work. Almost without exception, you are required to plug a chip into the main board to provide the Prestel characters.

The exception is Datasoft’s communications package, which costs a generous £315 including modem, and does all screen-handling purely with software. The modem is a Thorne-EMIO DataTech VX543/10, but a version of the program is also available to drive ‘any suitable modem’, says the company.

It’s quite a comprehensive list of features which Datasoft has sent me with its announcement, and I look forward to testing it — but, just picked out from the list, I note that there is a window-driven option, a full-screen videotext editor, a file encryption option, and voice-call support.

Details from Datasoft on (04605) 4809.

**Charting Success**

‘Obviously’, says JVC (UK) Limited, as though only a fool could fail to see it — ‘obviously all the rather dubious press the MSX computer format has received over the past few months has been slightly off the beam.’

The fact that makes this obvious is the appearance of what JVC rather endearingly calls ‘three software titles’ (slippers! a fur muff??) in the computer ‘software top 50’.

‘It’s very kind of JVC to draw our attention to the appearance of Zaxxon, Buck Rogers, and The Hobbit in MSX format in the top 50 — but most people, I’m afraid, will fail to agree that ‘MSX as a format is gaining considerable support from the computer-buying public’. One might note that the most outrageously successful program ever for the BBC Micro, Elite, never made it to the top of the chart because...
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There's no other home computer in the world that's so expandable or so updatable as the new Enterprise 64.

And if you're wondering quite how we've managed that, kindly take a closer look at the outputs on our remarkable new machine.

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But plug in our special Rampacks to the base unit, and you can progressively increase that figure to a truly extraordinary 3,900K.
Not that that's the only challenge we present to today's ambitious programmers.

With a screen resolution of up to 672 x 512 pixels, 256 colours and a high speed video processor, the Enterprise will outgun all but the highest quality TV monitors.

And the sophisticated sound chip generates no fewer than 4 voices across 8 octaves in full stereo.

Combine the two and you can create effects that leave today's games looking like pub video tennis of the mid-seventies.

For anyone with literary aspirations, the Enterprise also comes complete with an integrated word processor.

Whilst the really serious user will be delighted to discover analogue RGB and TV outputs, as well as parallel, RS423 serial and network ports.

Both Cobol and 'C' will be available with CP/M running, and you can even use Lisp, Forth and Z80 assembly language on cartridge without encroaching on user RAM.

The new Enterprise 64.

It hasn't just overtaken technology. It's left every other home computer straggling in the distance.
The Electronic Assistant is here today . . .

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The frustration of having a no more about the industry ran, and anyone who knows format is not even an also-
Spectrum, very much a the BBC is, by comparison
clumsy double-type for instead to use WordStar's
subscripts, and genuine print, tiny superscripts and capable of the highest-quality
ever used WordStar will know problems
Patching the

By any other name
You may feel entitled to be puzzled by the simultaneous announcement by First Software of Basingstoke of add-on boards for the PC/AT, and the announcement by First Software of First publishing, of a set of business software packages for the Commodore 64. The first First Software was, of course, the American company. That has set up in this country in association with John Weatherhead’s Reflex software distribution business, and is distributing Tecmar add-ons for IBM machines. The Maestro multi-
function board is its launch. However, the title First Software was actually being used around September last year by Sara Galbraith, ex-

Peachtree, who (as far as I can determine) registered the company name around two weeks before Weatherhead’s lot did.
Sara Galbraith has worked on the assumption (very reasonably) that people who use IBM PCs at work can’t afford to buy another for home use (and we all know how portable they are). She’s trying to produce software which fulfills similar functions, so that executives with a 64 at home can get some useful work done.

Galbraith’s First Software is part of her new company, First Publishing, which does books for the 64, too. Her software starts off with an assembler/monitor for £19.99, a word processor at £35.99, and includes a database manager, Pascal, and a Basic compiler. The books include Anatomy of the 1541 disk drive which ‘unravels the mysteries of using the misunderstood disk drive,’ which makes it sound as though the horrible little box has made at least one friend.
The squeable over the name will no doubt proceed until it is resolved, and I’ll let you know as soon as it is. And when Galbraith lets me have a phone number, I’ll give you that, too. Meanwhile, contact her through the energetic Peter Jones, her publicist, on (01) 580 8418. He’s a sweetie, but a trifle inclined to take his job single-mindedly (‘In answer to your question, I’ve contacted them, and they do have it in stock. What price? I’ll have to ask. I’ll call you back’), so make sure you know what you want in detail before you call.

Weatherhead’s outfit,

The ‘half-price Apple II for education’ schma has been widened to include the Macintosh, which is going out at a 30 per cent discount — not greatly to anyone’s surprise. However, what is surprising is the announcement by Symbiotic, which does hard disks and local nets on Apple hardware, that it is joining in. It is offering a 50 per cent reduction on its Symbnet which normally costs £4000 including a 10 Mbyte disk, and now starts at £2000.
**MORSE: THE TOP TEN SYSTEMS**

<table>
<thead>
<tr>
<th>Rank</th>
<th>System</th>
<th>Description</th>
<th>Price</th>
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<tr>
<td>1</td>
<td>IBM Personal Computer</td>
<td>The World's best selling Personal Computer, as well as ours. Although a recent increase by IBM has pushed our price slightly higher, we can still offer the PC with twin 360K disks, monochrome display, UK keyboard, printer adaptor and DOS 2.1 with full 12 month warranty, and bundle 6 utility programs, simple spreadsheet, text editor and 10 others. <strong>SAVE £560 ON IBM PC's NORMAL PRICE!</strong></td>
<td><strong>£1600</strong></td>
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<tr>
<td>2</td>
<td>IBM COLOUR PC</td>
<td>Like the above system this IBM PC has two 360K IBM disk drives, keyboard, DOS 2.1, Basic and full 12 month warranty, but we've exchanged the IBM monochrome display for the colour display and graphics adaptor. Morse also supply a selection of free programs including utilities, spreadsheet &amp; word-processor. Printer adaptor £87, extra memory, £70 each 64K. This system normally over £2480!</td>
<td><strong>£1900</strong></td>
</tr>
<tr>
<td>3</td>
<td>IBM XT</td>
<td>The 10Mb Winchester version of the PC is still as popular as ever, and we suspect the shortage of AT's is the reason. Our 128K RAM, monochrome system with communication port is ideal for planning, database or accounts applications. <strong>SAVE OVER £410!</strong> IBM XT now:</td>
<td><strong>£3190</strong></td>
</tr>
<tr>
<td>4</td>
<td>COMPAQ DESKPRO</td>
<td>This superfast machine almost matches the IBM AT's performance, and 30Mb disk option is in stock NOW! With 640K, 10Mb disk, tape backup, we supply with <strong>FRAMEWORK</strong> or <strong>SYMPHONY,</strong> NEC monitor, printer, disks, cable at NO EXTRA COST, <strong>SAVING £970!</strong></td>
<td><strong>£5595</strong></td>
</tr>
<tr>
<td>5</td>
<td>COMPAQ PLUS</td>
<td>Compaq Portable + 10Mb Winchester = strength + value. This 256K computer has a reputation for being really tough and reliable. Morse stock this popular machine at nearly 10% <strong>below the list price,</strong> so you can store more and pay less. <strong>SAVE £355! Only £3590</strong></td>
<td><strong>£3590</strong></td>
</tr>
<tr>
<td>6</td>
<td>COMPAQ PORTABLE</td>
<td>The no 2 PC in the U.S. and the best of all compatibles. With 256K, unique graphics and text display, dual 360K disk drives and of course, portability, the Compaq is great value. Now it's even better value because you save <strong>£200</strong> at Morse. Why pay any more?</td>
<td><strong>£1990</strong></td>
</tr>
<tr>
<td>7</td>
<td>APRICOT XI</td>
<td>Superfast and super powerful 10Mb version of the Apricot. Full hard disk computing at even lower prices. Morse have cut the price by £50, and are giving away the NEC nig printer &amp; cable worth £380; Bundled with Superwriter etc. <strong>SAVE £680!</strong></td>
<td><strong>£2690</strong></td>
</tr>
<tr>
<td>8</td>
<td>APRICOT PORTABLE</td>
<td>The computer you can talk to! Remarkable piece of technology with flat liquid crystal display and speech recognition. 256K as standard, 720K disk drive, loads of software, all in a 12lb. pack. Morse can supply it from stock. <strong>WITH FREE £95 MOUSE!</strong></td>
<td><strong>£1490</strong></td>
</tr>
<tr>
<td>9</td>
<td>APRICOT F1</td>
<td>Incredible value full specification business micro. Bright colour display, 256K memory, 720K disk drive, infra-red cordless keyboard. Bundled with word-processor and spreadsheet. In stock now. Mono display £200, Mouse £95.</td>
<td><strong>£995</strong></td>
</tr>
<tr>
<td>10</td>
<td>SANYO SUPERDEALS!</td>
<td>The Sanyo MBC 550 series has proved very popular. It's ideal as the basis of an office system. Now Morse have even better prices! SANYO MBC 550, 100K disk drive, 128K RAM, WordStar &amp; CalcStar. <strong>MSDOS,</strong> (RRP £579), now £600. MBC 555, 2 x 160K drives, 128K, Word, Spell, Info &amp; CalcStar. Mailman etc. (RRP £995). SANYO MBC 555 (x2), as above, with twin 360K disk drives (£1395) £995. <strong>£950</strong></td>
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**MORSE HARDWARE**

Digital wordprocessors make some of the finest wordprocessors, and the dedicated DEC MATE II can be found in many offices. Morse offer the DecMate II (list price £3049) at **£1790,** saving **£1259.**

**NEW PRODUCTS AT MORSE.** By now we should have the new grey Apricot X1's, with 512K and 20Mb hard disks. The HP7475 6-pen plotter is just in. Use with 1-2-3 or Chart. Coming soon Tapestry, IBM's network. You can link up with **£1600 IBM PC's at Morse.**

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Selling like hot cakes, the 64K EPSON PX8 Lap-held CP/M, with 80 column LC display, WordStar, CardBox, Calc, diary etc only £795. **NOW IN STOCK: PF10 battery operated 360K disk drive. £395.**

**EPSON AT MORSE**

**SAVING £680!** EPSON FX80 seven colour printer, £560. CASIO FP200 portable computer. Basic, CETL etc, (list £299). With **FREE £35 database and other software,** at Morse only **£230.**

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Completely IBM PC compatible computer with 128K memory, good-looking 14" graphics display, twin 360K disk drives. Runs Flight Simulator, Framework, 1-2-3 & 10 others. Morse are offering at **£1290.**

**NEW SOFTWARE AT MORSE.** IBM Topview is expected very soon. On our shelves now, Apricot WordStar, Framework, 1-2-3 etc without any problems. List price **£1990,** unbeatable at only **£1290.**

**MORSE COMPUTERS**

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NEWSPRINT

"Switching off the power on the Spectrum," comments Nidd Valley Micro, "to cure a program crash is about as nonsensible as switching off the National Grid to change a light bulb."

What one wants is a reset button. 'The Z80 processor,' observes Nidd Valley, 'is provided with a proper reset line which gently resets the system. No power is lost to the computer or peripherals, so by using this, there is less likelihood of damage to microdrive programs. While programmable interfaces like joysticks remain programmed, only the game or program needs to be reloaded.' That's what 'reset' means.

Of course, but Sinclair Research always said it would add too much to the cost of the Spectrum to provide one. It adds a whole £5, including VAT and delivery. It is also a quite useful extender to the back end of the Spectrum, making it easier to fit keyboards and add-ons — what more do you need to know?

The phone number is (0432) 864488; the address is Stepping Stones House, Thistle Hill, Knaresborough HG5 8JW, North Yorkshire.

Surprise response

The Department of Education's Microelectronics in Education Programme (MEP) has learned a lot of painful lessons.

It has spent five years looking at software, and at the end of this, has produced a book with suggestions of what to do, what not to do, and how to avoid doing it, aimed at education people. The book will be of interest to programmers and analysts, particularly to those who programme interfaces like joysticks remain programmed, only the game or program needs to be reloaded. That's what 'reset' means.

The phone number is (0432) 864488; the address is Stepping Stones House, Thistle Hill, Knaresborough HG5 8JW, North Yorkshire.

3LD. Don't ring the MEP about it — it is delightfully 'other-worldly' about this sort of thing. I mentioned the book one day on my Oracle page (557, plug) and got a bewildered phone call from Cambridge asking why 'all these people were calling them for details?' as if the last these people were calling Cambridge asking why 'all these people were calling them for details?' as if the last these people were calling

Mac BCPL

BCPL, an ancestor of the C language, is still much adored by programmers in Cambridge, where Top Express has now produced a version for the Apple Macintosh.

The package 'includes Mac BCPL on a disk, a demonstration program source, a complete systems manual, and a copy of a book, BCPL: the language and its compiler, published separately by Cambridge University Press,' explains the publicity blur.

We fully intend to review this product in some way or other (to follow this month's review of BBC and QL implementations), but this isn't the moment: if I put the disk into my Mac, I'll never get around to writing another word. For details, contact Top Express on (0223) 355427.

Forward booking

A few dates for the next few months. A show for construction people using computers is scheduled for 25-27 June. At the time of writing, I know only that the Second Construction Industry Computer Fair will be held at the Barbican, but nowhere in the information sent to me on the First Construction Industry Computer Fair do the organisers mention the trivial detail of exactly where to go. I suggest you contact them on (01) 637 8991 if you are interested.

A seminar on IBM's impact in Europe is being held by Frost and Sullivan at the Hyde Park Hotel on 27-28 June. This one costs, and details of who pays how much are available from Anne Drayton on (01) 486 0334/5.

For education people, the Microcomputer Users in Education (MUSE) group is running a July Summer Course/Conference, aimed at teachers at all levels from primary to higher education. There are 28 speakers, so I will refrain from attempting a list. Details available from MUSE at PO Box 43, Hull HU1 2HD, or phone (0482) 20268.

It could be argued that setting up a special centre to train disabled people in the skills of computing, as Rank Xerox has just done, isn't going to get the company's profits up — so it must be a search for publicity. Well, if it is (and machines like the Mac, Atari, Amiga, QL, and so on) Metacomco, has moved well up from its normal assembler programs for all those machines, some of them still secret, heh, heh) to announce an artificial intelligence language, Cambridge Lisp 68000, 'for any machine running CP/M 68K'. It should be available on everything except the Mac, and also on things like the Stride and the Wildcat, the U-Man 1000 and the Sord 68.

Morals in question

It is immoral to sell someone software, and then claim that you haven't sold software but 'Bookings should be made before 1 July,' it says cryptically, 'though late applications will be regarded with sympathy.' Flowers only, please.

Finally, for personnel experts, a conference and exhibitions on Computers in Personnel is being organised by the Institute of Manpower Studies with the Institute of Personnel Management. The 'double event' will be from 9-11 July at the Royal Lancaster Hotel, London W2. Details on (0273) 686751, the Institute of Manpower Studies.

68000 expertise

Those experts on the 68000 (and machines like the Mac, Atari, Amiga, QL, and so on) Metacomco, has moved well up from its normal assembler programs for all those machines, some of them still secret, heh, heh) to announce an artificial intelligence language, Cambridge Lisp 68000, 'for any machine running CP/M 68K'. It should be available on everything except the Mac, and also on things like the Stride and the Wildcat, the U-Man 1000 and the Sord 68.
Amstrad azimuth
People with difficulties loading software (unless they have been stuck with one of the new, 'improved' Commodore tape drives that won't recognise old TurboLoad tapes) often find that the playback head on their unit isn't exactly where it was on the unit that made the tape.

Interceptor Micros report high sales of a kit to adjust the 'azimuth' of the head on the 64, and has now produced one for the Amstrad. The £9 kit includes software, a test program, a manual, a special screwdriver and a pointer. It is available from retailers, or contact Interceptor on (07356) 71505.

Apparently, a Spectrum version is on the way, a prospect which fascinates me since Spectrum users don't have standard tape drives.

The proof's in the running
Minicomputer-builder DEC has a bone to pick with micro-maker Intel: apparently, Intel has been telling fibs about how fast its micros are, compared with DEC's minis. In 1981, an American magazine (Byte) supposedly printed a Benchmark which Intel picked to illustrate the power of its System 86/330. When Intel ran the

Benchmarks in 1982, it said that its system was 'clearly superior to the LSI-11 on this Benchmark'. The LSI-11 is DEC's micro version of its PDP mini.

Digital has now run the Benchmark and finds that 'on the contrary, just the opposite is true — both the LSI-11/2 and 11/23 executed the Benchmark faster and required less memory than the System 86/330'.

All good fun? What I found fascinating was the fact that this (Pascal) Benchmark was tried out on 20 different combinations of machine and compiler; the fastest being the PDP-11/70, a powerful mini, with NBS Pascal. That took 2.6 seconds, compared with the Intel system's 9.20 seconds. The best 8-bit system was a Z80 with MT+Pascal, taking 19 seconds.

No, that isn't the amusing bit. The amusing bit is the time taken by the Apple II with UCSD Pascal. It took 516 seconds . . .

Goodwill to all men
The reason modem-maker OEL called in the receivers earlier this year was partly a question of bad debts from Prism and Oric, and partly the failure of a chip maker to produce a central processor on time.

The company made the QL modem, which has been announced but not shipped,
Qume ribbons, developed and refined by Qume and made in Britain for use with all Qume Printers here in the U.K. and in Europe.

Why gamble with imitations, when, for a very small premium you can get Qume Originals. The best ribbons for all Qume Printers without a doubt.

Be sure your printer sees "red" when you fit your next Multistrike I, Multistrike II, or Multistrike IV.
It's amazing what you can squeeze out of an apricot.
Anybody in business who is hungry for information should seriously consider Communiqué, a service exclusive to owners of Apricot computers.

For a modest outlay of £395 + VAT you gain access to a mind-boggling array of information.

First you fit the modem and then slot the Communiqué disk into any one of Apricot's wide range.

You can then plug your computer into the telephone system and all the information services Communiqué has to offer.

No other computer offers so much from a single monitor. Included in the basic package is free access to the Telecom Gold system.

This electronic mail facility enables you to despatch printed material from computer to computer, office to office, in the twinkling of an eye.

By the same token, Easylink offers you a worldwide, low cost, telex service operating from your desktop computer.

THE JUICIEST FACTS AND FIGURES.

Communiqué saves you money and the time spent ploughing through a mountain of desk research.

One press of a button on your Apricot keyboard and over 300,000 pages of Prestel information and services are yours for the asking.

Questions regarding almost a million of the UK’s registered companies will be answered by Pergamon Infoline.

For digests of financial and business-based articles published worldwide, simply call on the services of either Data-Star or Textline.

The latest prices, investment ratios and share tables are all brought to your desk by Extel Priceline at the touch of a button.

Solicitors and Accountants will find Eurolex particularly relevant and useful.

This provides you with a legal database, taxation details as well as case histories.

We’ve barely scratched the surface of the services Apricot’s Communiqué has to offer here but, as you will have gathered by now, what it does provide is an absolute torrent of topical information.

THE PICK OF THE CROP

Whereas you would normally need a separate telex and monitor for each of these services, one Apricot computer acts as your fount of all knowledge.

Each can be locally networked as well as being perfectly happy to work under its own steam.

To make Apricots even sweeter, they are fully capable of interfacing with mini and mainframe computers.

Furthermore, if you are responsible for your firm’s accounts, Apricot Accountant makes it all a piece of cake.

It’s an accountancy software system that takes away all the time and boring effort in unnecessarily shuffling paper.

To top the lot, Apricot computers have the largest published library of software in the UK. Whatever your needs, we can meet them in 3,000 different ways.

And that includes the best-selling business software in the world, Lotus 1-2-3 as well as Symphony, their new all-in-one system for managers and professionals.

If we have whetted your appetite for Apricots and Communiqué call in one of our dealers.

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TO FIND OUT WHERE YOUR LOCAL DEALER IS, OR FOR MORE INFORMATION ABOUT APRICOT COMPUTERS OR THE APRICOT ACCOUNTANT, EITHER CALL US ON 0454 6761 OR WRITE TO ACT LIMITED, FREEPOST BS4251, PATCHWAY, BRISTOL BS12 4YZ. YOU CAN ALSO REACH US ON TELECOM GOLD SYSTEM 81-JET 077. "PRICE EXCLUDES MONITOR OR VAT AND IS CORRECT AT TIME OF GOING TO PRESS."
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122 PCW JUNE 1985
This man is reading a telex which has arrived on his Telecom Gold electronic mailbox. It cost him 50p. The service is welcome: it had previously been possible to use Gold to send telexes, but never receive them. Nonetheless, I'm a bit disappointed. There was an exciting-sounding development related to the telex service: 'A simple routine is also available', said the announcement, 'which will convert standard telex upper-case format into lower-case, making text much simpler for the recipient to edit when required.'

This can be quite easily done, of course, with the CP/M command PIP, so hardly warrants much fuss. What I had been hoping for, however, was something more clever—a way of providing upper and lower case through telex.

Without doing any research at all (well, I wrote to Telecom Gold, but since I used electronic mail, I have only myself to blame for not having received an answer) it occurs to me that telex uses several 'invisible' characters. For example, the NUMBERS character switches from alpha to numeric, and back. Two NUMBERS characters sent together could be interpreted as a depression of a SHIFT LOCK key by Gold users, but would be totally ignored by telex machines.

I'm sure there's a very good reason why that won't work, and I'm almost sure that one day, Telecom Gold executives will read their mailboxes and tell me why... but don't hold your breath waiting for the answer.

and had announced (and started shipping) a teletext adaptor. The teletext adaptor (for the Spectrum) was publicised on 4-Tel, Channel 4's own Oracle-based service which has dreams of publishing software for Spectrum owners. However, in the absence of any software, the adaptor was only useful for people who wanted to read Oracle. And since, to read the ads, you had to have Oracle anyway, sales of two decoders were quite impressive, really.

The QL modem is apparently completed, working and approved, but late. Its central microprocessor has 4k of code built into it at the factory, and Texas Instruments was given the order after General Instrument failed to deliver, say staff. They don't blame Texas for having it late—it takes time to design a chip mask including 4k of program, and build the part. But late it was, which meant long costs and no revenue.

For customers, of course, this is good news. Send money to a company which is struggling, and you are likely to get a note from the receiver pointing out that you are now an 'unsecured creditor' and good-bye money. Send money to a company being run by the receiver, and you will get your goods.

For those people in the industry who have written software, supplied prototypes, and extended credit, of course, it is a disaster, and their only hope is that the QL modem looks a sufficiently convincing 'winner' for the receiver to be able to sell off the company as a going concern.

The goodwill inside the group is encouraging: the factory staff were working for two weeks without pay after being laid off, before the receiver was called in, in order to try to keep the company going.

Where Unix goes, others follow

It's not a bandwagon I feel like jumping on, but the Unix one certainly looks like being it's beginning to roll.

The business industry's big guns, IBM and AT&T, neither of whom get all their shots on target, are both on there—plus a host of other companies including Hewlett-Packard (whose Integral PC is reviewed in this issue) and Commodore, which has been receiving some bad publicity recently.

Systems house Digitus, for one, is convinced that the operating system's time has come. It's published a £35 report on the Unix market which says that 'with sales doubling in 1984 and 180 per cent growth predicted by 1986, it is set to become one of the most dominant multi-user systems'. However, Digitus doesn't expect the shortage of IBM PC/ATs to be corrected until the end of the year, and it's even less optimistic about multi-user Xenix. This AT implementation of the Microsoft Unix lookalike isn't expected until next year.

To make life even more confusing, Commodore's contender is based on another Unix clone, Coherent. The Commodore machine should come in two versions, both called the 900. There's a personal workstation with a very high-resolution (1024x800) bit-mapped monitor coupled with Commodore window manager software and mouse control, or alternatively you can plump for the multi-user option with a 67Mbyte hard disk from which you can hang up to eight terminals. Both versions come with 512k of RAM as standard, and are based on an obscure Zilog 16-bit processor, and Z-8001. Coherent at the moment is compatible with System Seven Unix, but will in time be made compatible with the more widely available System Five, says Commodore.

The best I could get in the way of a price is 'approximately half the price of its nearest rival' or 'very...
Another triumph of ingenuity over sense: the Seiko RC-1000 is 'the world's smallest computer terminal'. It is 'an ingenious way of carrying data which would normally be kept at home in a personal computer'.

You feed the information from your home micro into the wristwatch, and later you can scan through 80 'pages' of 24 characters each, with phone numbers, reminders...

No I don’t believe it either, and it did arrive at the end of March. But a horrible, sinking feeling tells me that if you ring Hattori UK (publicity agents Headway Public Relations will take calls on (01) 379 6339), the company will not say 'April Fool', but will take your money.

There’s no accounting for the mountains people will climb just to prove they can do it.

expected later this year. Happily it is using the same mechanism as the music compact disks so we can expect the price to drop as music CDs drop and the disks themselves should be relatively abundant.

The CDR-1502S is expected to sell for just under £1000 which is twice the price of its audio counterpart, apparently the addition of an extra chip will allow it to be used as an audio-CD player which makes it sound more reasonable. A number of computer manufacturers have expressed an interest in it with a view to replacing their bulky instruction manuals with a single disk. In addition it seems as if the race is on between the CD-ROM manufacturers to sign a deal with Encyclopedia Britannica to be the first to offer this on CD.

Acorn anti-climax

If you’ve been holding your breath waiting to see what Acorn does next, news of the BBC B+ is likely to leave you a little disappointed.

The machine provides 64k of RAM and two more ROM sockets. Oh yes, and all the ROM sockets have been moved to make them easier to get at. That’s about it, although the disk interface chip is included in the expected recommended retail price of £498.

Seemingly, BBC B prices will be cut with the availability of the new model, but no-one would tell me by how much — the phrase used was that 'price differentials between models will be maintained'.

Not much was being said about the Communicator either, which will appear first as an OEM machine, probably in the autumn. Meanwhile, the ABC 200s are scheduled to continue under the Acorn name, pitched at the scientific market, while the 300s are also waiting for an OEM deal.

The Show principle

On the principle that PCW readers are busy people who like to plan ahead, I’ve some early details on this year’s PCW Show.

The Olympia centre in west London is the venue again, and the dates to note in your diary are Wednesday to Sunday, 4-8 September.

But this year’s event has something of a new look. The Olympia 2 hall is set aside for business computing, while all the consumer electronics computers is next door in the National hall. That’s where the big names like Acorn, Atari, Commodore and Sharp will be, together with all the related software and peripherals.

New features in the National hall include Tomorrow’s Micro Home, where one of the MSX companies will give a glimpse of its vision of the future, with the computer at the centre of the 'wired living room'. Old favourites in this area include the Top 20 Games and, of course, the Association of Computer Clubs, which will have a larger presence than in previous years.

In Olympia 2, visitors will be able to get impartial advice on choosing a micro for business, courtesy of the NCC Microsystems Centre. The NCC will be running daily seminars at the show, and it will also have a stand to which visitors can take individual queries.

Philip Virgo, the centre’s end-user systems manager, reckons that buying a micro system in the early 1980s is 'like buying a delivery van in the early 1930s. The world is full of enthusiastic amateurs and ex-châuffeurs discussing the relative merits of Raleigh Runabouts and Rolls-Royces, united only in their denigration of the Model T Ford'. The NCC promises to provide a more sensible approach.

Also in the business area will be the PCW Show applications advisory service. If you want to know exactly what software is available for your particular business problem, that will be the place to ask: the database directory will list all known applications software. This hall has its own entrance, with separate ticketing for trade and business visitors who can register in advance to walk straight in at the door.

Further details from: PCW Show, 11 Manchester Square, London W1M 5AB.

Guy Kewney can be contacted on electronic mail. His numbers are Source TCK 106, and Telecom Gold 81: JDS018. The Prestel mailbox number is 01-802 2679.

competitive’, which could mean anything between £2500 and £7500. Delivery starts towards the end of 1985, although software developers are getting the machines now.

For me, optimism based on Unix is misplaced optimism, but I’m pleased to be able to record it so that we can look back with hindsight in a year’s time. AT&T is placing its future trust on its 7300 personal micro, which looks like a Macintosh but runs Unix software.

That machine uses the 68000 processor, a close relative to the one inside the Macintosh, but don’t run away with the idea that programs will need relatively little conversion from Mac to Bell. Most programs written for the Mac don’t address the chip but use the high-level routines built into the Macintosh by Apple. Unless AT&T produces an emulator of the window manager, there is going to be a whole host of nothing to run on the 7300 for a long time. Except, of course, for the possibility of converting Xenix applications — and despite the theory that Xenix is very like Unix, that won’t be the work of a couple of weeks, either.

CD ROM is here!

It looks as though compact disk ROMs are finally arriving with the announcement by Hitachi of the CDR-1502S — a CD-ROM with parallel interface for the IBM PC.

Memory is not quite up to the one giga-byte first speculated, with the Hitachi drives storing 522Mbytes which is still about 270,000 A4 pages. Interfaces for other machines are
**SYSTEM 1**

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The hard sell

With over 27,000 personal computer software packages on the market, it's impossible for a computer store to carry more than about 1 percent of the total offerings. Even the largest software distributors, Softsel and First Software, carry less than 20 percent. Thus, software manufacturers are turning to a variety of other methods of selling their wares.

Some vendors saw electronic distribution as the answer, but it has not proved commercially successful. Nevertheless, General Electric, AT&T and several new companies are continuing to experiment with such systems, and are convinced they will be in widespread use by the end of the decade.

An alternative to direct electronic distribution is provided by One Point, a distributor that maintains an electronic software catalogue of some 7000 titles. A customer can dial up the catalogue from his home computer or one in a retail store, and receive product descriptions and reviews of packages. If he is interested, he can place an order which will be shipped within 48 hours.

Unimart is trying an approach which allows a customer to dial up a software package and try it out with his own data. If he likes it, he can buy it.

Several software vendors have turned to outlets other than the traditional computer or software store. Intuit, for example, sells its home finance package through banks. Several vendors sell packages through trade associations, and at least one vendor sells its package through home builders who include a computer and a home management software system in every new home that they build.

Away from home?

Although some industry watchers have interpreted IBM's decision to stop producing the PCjr as the death knell for the home market, I disagree. The PCjr never completely recovered from its initial introduction in the US with a Chintech-style keyboard and limited expansion capabilities, although the deep price cuts for a bundled system before Christmas gave it a short-term boost.

If anything, IBM's exit provides some opportunities for Apple and Tandy who currently market full-featured systems in the under-$1000 price range.

Later this year when the new Commodore and Atari computers hit the shelves, the competition will be tough but the time window seems to be wide open for Apple and Tandy for the next few months.

Is IBM out of the home market for good? Not likely. It is reportedly still looking at building a MSX machine at a very attractive price, and you can be sure that when IBM sees significant profits in the market, it will jump back in with both feet.

Meanwhile, the bundled PCjr price of late 1984 prompted Apple into responding with a cash rebate program on the Apple II. Although the program ended on 30 April, it still caused a (needless) loss of revenue for Apple.

Below target

Kaypro, with its cheap but functional computers and direct distribution to retailers, was riding high a year ago while companies with more advanced products and 'purer' distribution schemes were hurting.

However, an antitrust complaint was filed against Kaypro in March for threatening some of its dealers with termination for not selling at list prices.

Kaypro paid $19,500 in civil penalties and court costs to settle the suit and, although the company did not admit or deny the allegations, it will now have to give its dealers greater latitude of action in setting prices, selling to non-Kaypro dealers, and advertising mail order sales.

 Dealers have also expressed concern that Kaypro has the ability to support its recently-announced 286i, a high-end IBM PC/AT clone, or even the K-16, and XT-type entry. The 80286-based 286i with 512k and dual floppy disk drives sells for $4550, while a 250k, 10Mbyte hard disk version of the K-16 sells for $3295. All Kaypro systems include bundled software. Although the Kaypro prices are 18-25 percent under the cost of similar IBM units, the IBM systems are frequently discounted by approximately 20 percent. Therefore, the only advantage of the Kaypro is the bundled software.

Several dealers to whom I've spoken feel that the extra software — said to be worth $2000 by a Kaypro spokesman — is not enough. After all, Columbia, Eagle and TeleVideo also have such an advantage and were largely unsuccessful against IBM.

Most dealers agree that while many customers are looking for an alternative to IBM, the three magical letters — I, B and M — are still the most sought.

One said: 'I hope Kaypro can do in the AT world what Compaq did in the PC world, but they're going to have a tough, tough time.'

Random bits

The Software Publishers Association reports that sales of Macintosh software have jumped from nil to 8 percent in early 1985. In March, Compaq shipped its 200,000th personal computer. IDC predicts that the market for business graphics will grow from $59 million in 1984 to over $1 billion in 1989.

Acorn has had a tough time in the US market, but may get an unexpected boost from Olivetti's $49.3 percent stake in the company. AT&T, 25 percent owner of Olivetti, is said to be considering an agreement to help Acorn crack the US education market, now dominated by Apple. Consumer Products, a maverick division of giant AT&T, has released an image capture board (for the IBM PC) which captures a standard composite video image, and allows modification and manipulation of it by the computer. It is made possible by the development of a new design architecture using RARAM memory, a high-density, low-cost, two-port dynamic memory with a very fast access time.

Having discontinued its 16/8 and 520 family of mainframes in February, Xerox is negotiating with Olivetti to sell the M-24 IBM-compatible unit. Lotus and Cullinet have joined forces to develop and market products to connect Lotus 1-2-3 and Symphony to powerful IBM (and compatibles) mainframes and computers. One catch: while the integrated package, Symphony Link, is expected to cost only $500, customers will have to buy a communications peripheral for each PC (about $1100 each) plus Cullinet's mainframe Information Centre Management System package for a cool $150,000. Its no secret that videotext has been a colossal failure in the US. The operators of three experimental systems (Viewtron, Keyfax, and Gateway) spent a total of $90 million in development yet attracted fewer than 5000 subscribers in total. Nevertheless, even bigger players are planning to enter the business, specifically three joint ventures: one between IBM, CBS and Sears; another between AT&T, Time Inc, Bank of America and Chemical Bank; and a third between RCA, Citicorp and a third unnamed partner.
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JUNE 1985 PCW 129
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The basic unit comprises a slim 80 track double sided 5.25" floppy disc drive, giving a formatted capacity of 800 Kb. The drive comes complete with MS-DOS driver software and interface/controller card, which locates in one of the expansion slots on the Apricot PC XI or F1. The sub-system is thus configured as a second or third drive, with a capacity exceeding that of the Apricot's own double sided micro-floppy.

FX-800 IBM-PC/Apricot compatible floppy disc drive.

**Description.** Add-on 5½" floppy disc drive with plug-in interface/controller which allows software compatibility between the Apricot PC, XI & F1 range and the IBM-PC computers running MS-DOS/PC-DOS.

- IBM-PC DOS compatibility
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- Optional 2nd additional drive
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**Price £395 + VAT.**
Oh no, not again!

I am typing this on my week-old Amstrad CPC 464 (called 'Arno'), and I believe I am hooked! The printer is hooked too, but the whole system is. In fact, the printer has the same serial port as the keyboard, which means that I can use it as a text editor. I have been writing programs for a long time, but this is the first time I have been able to do it on my own computer. I have been using microprocessors for a while, but I never thought I would be able to do it on my own. I am really interested in learning more about programming on the Amstrad CPC 464.

Programs, please

I am a lecturer at a college of further education in the Cleveland area. Having previously worked as a microprocessor development engineer, I knew the type of systems that were available in the 'real world' and the capabilities of such systems. One of my responsibilities is the development of courses in assembly languages and interfacing techniques. In the latter part of 1983, I did a major search of the then current personal computers with a view to choosing one which would become the basis for the development of such courses. The system I chose was the Memotech MTX512. The main reasons behind this choice were:

i) Integration of Basic, 290 assembler and a text processing language Noddy.

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i) Integration of Basic, 290 assembler and a text processing language Noddy.
appear at regular intervals. Having consulted many sources here in Riyadh, I still was unable to print graphics successfully, so I wrote to Star Germany and to the technical support group in California.

Less than three weeks later, Star Germany sent me a brand new serial interface board (its latest version) free of charge, and the technical support group sent me the latest manual — also free of charge. Both these items were accompanied by covering letters containing detailed answers to some technical questions I had asked.

The new interface board works faultlessly at 9600 baud with the Spectrum, and the manual is full of useful programs to help me get the most from the printer (even though the Spectrum is not actually mentioned).

All in all, Star deserves a lot of praise as far as I am concerned. After all, service like this from a large company is not too frequently heard of these days.

Jon Calvert, Riyadh, Saudi Arabia

**Not all bad taste**

The Music System is without doubt the best program I have ever used on the BBC Micro. It is well-written, well-behaved, user-friendly, well-documented, beautifully presented, stimulating, educational, and its many facets are a pleasure to explore.

Like Frank Valloton (PCW, 'Letters') I find the advertisement for The Music System distasteful, but this advert is totally at variance with the style and presentation of the program itself. Fortunately, I buy from reviews, not from advertising, and all the reviews that I have read have been unequivocally enthusiastic. Had I only seen the advertisement, I should never have dreamed of buying the program.

Margaret J Leonard, London

**All tied up**

In the daytime I am a respectable minicomputer consultant, working with high-resolution dedicated terminals. At night I am a secret home computer enthusiast. Until recently, I found the appalling quality of even high-resolution colour monitors difficult to live with. I thought I had found the solution when I discovered the wonderful CEAF Romag filter, which lifts the quality to just the right side of the pain barrier. However, the damned thing kept falling off due to the sub-standard glue used to hold on the little sticky pads.

But just today I have discovered the ideal solution, and I can now supply any users of the Romag filter suffering from this problem with unlimited quantities of Serial Television Receiver Image Enhancement Girth at the knock-down price of £1 per yard.

Cofin Walls, Bristol Business Centre, Bristol 8

Is this a firm offer?

**Pin trouble**

I would like to issue a few words of warning to other readers. I have just bought a Canon PW-1080A printer to attach to my Apricot PC but found that everything I printed was double-spaced. After much headscratching, I compared the printer interface description with that for my old Centronics printer. The answer is that the Centronics and the Apricot expect pin 14 of the interface to be ground, but the Canon (and, presumably, the similar Taxan/Kaga model) uses pin 14 as 'auto line-feed'.

When this pin is held low (ground) the printer performs a line-feed after a carriage return. The solution is simple: do not connect pin 14 of the Centronics interface of this type of intelligent printer. This seems to be the only conflict at this time, but I'm sure there will be others in the future. What price standards?

Jonathan Hurwitt, Greenford

**New version spotlight**

Following the review of Spotlight (PCW, 'Office Practice', March), I was a little disappointed that no mention was made in the review of the extra facilities embodied in the newer 1.1 version of Spotlight (auto-dial, full AT and hi-res screen support, Kaleidoscope, and so on), although we went to great lengths to ensure that these were known about.

It is also surprising that no mention was made of the very important aspect of stability — as far as we can ascertain, Spotlight is much more reliable in this respect, particularly when run with some of the more popular application programs.

A factual error was made in the summary — Spotlight costs £103.48 excluding VAT, and not £125 as reported. This is also important, bearing in mind the emphasis the reviewer puts on value for money.

RAD Summer, Software Arts International, Ipswich, Suffolk

We reviewed what we had, which was version 1.

Apologies for getting the price wrong — but Sidekick is still cheaper. As far as stability goes, we had no problems with any of the packages.

**New links**

We are currently looking into the possibility of setting up a scheme to offer the following facilities to disabled people in the Winchester area.

i) A bulletin board system for the deaf. Typed messages would be passed on through the normal voice phone network by the system operator — and the deaf user would receive a reply in his mailbox. Hopefully — we would be able to reduce the normal four-five day wait for a reply to a letter to less than an hour. This would not be an emergency system; it would be for use in the same way as the normal phone system.

ii) Transcription of one of our local papers into Braille, possibly using some kind of optical character recognition system.

iii) Cheap or free access to normal computing facilities for people who, because of a disability — might not be able to leave their homes or afford to buy a computer.

We would be grateful for any help, either details of experience with similar schemes or just general technical assistance that any readers might be able to offer.

Alan Walker, assistant secretary, Winchester Unemployed Peoples Centre, 28 Staple Gdns, Winchester

**HP9836 Benchmarks**

I read with interest in PCW, January the article "Benchmarks ‘On your marks’ and, in particular the report on the Pinnacle, whose Benchmarks must surely be hard to surpass.

Before reading the report, I really thought I was in with a chance of providing the leader in desk top computers. I obtained the following results on a Hewlett Packard 9836 machine, which uses a 286 microprocessor running at 8MHz (all timings are in seconds).

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Despite being displaced from the top of your table by the Pinnacle circle, I think noting that the HP desk-top's Basic operates in a truly interpretive manner and has a slower MPU clock than an Apple 12MHz version of the same machine, and it would be interesting to discover its Benchmark rating.

The HP9836 is, in general, used as an engineering workstation and number cruncher rather than a business machine, although I believe there are a number of standard business packages available for it.

R Soja, Clarkston, Glasgow

**Loading problems**

The most common and frustrating fault with the Commodore 64 system is loading problems with the C2N tape deck. Users may frequently find that their tape will not load on their own system but will on another. The reason for this is that the tape deck is set up in production to accommodate a data transfer rate of 300 baud, but currently much of the software is designed to run at 1200 or even 3000 baud, and at this rate the alignment angle of the head to the tape is critical if a clear signal is to be transferred to the computer.

I have solved this problem by using the newly developed Azimuth Head Alignment Tape marketed by Interceptor Micros. The process can be done in a matter of minutes. A game on the reverse side of the tape loads at 3000 baud and gives a final accuracy check.

Michael A Jay, Solihull, West Midlands
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6th COMMODORE COMPUTER SHOW

Novotel, Shortlands, Hammersmith, London W6

Opening times: 7th & 8th June 1985 - 10am - 6pm
9th June 1985 - 10am - 5pm.

Admission: Adults £2.00, Children (under 14) £1.
Ivor’s dream

Ivor Catt’s vision of a quick, convenient successor to the Von Neumann method of processor control has come to fruition with the help of Sinclair. Martin Banks tells the story.

Seven years ago I met a man called Ivor Catt, a man who was trying very hard to make a great many waves, and seemed to be creating a large number of enemies along the way.

Ivor, you see, had a dream. He had worked in and around the semiconductor industry for some time, and before that had worked with Ferranti on computer systems when computer systems really were ‘clever stuff’. Ivor could, therefore, point to a large number of serious machines that were the archetype; they had less power than a Sinclair ZX81 and really were as big as a house. He had seen how the computer had come to be organised along the lines established by John Von Neumann, the man who developed the first stored-program computer system.

Ivor’s dream was that the so-called Von Neumann architecture, the classic way in which the processor controls all the activities of the memory, peripherals, and so on, was bunk: there were other ways of doing things, he felt. Ways that were quicker, more convenient and, given the majority of tasks that computers are used for, more logical than a centralised single processor having to ‘housekeep’ an entire computer system.

Like all dreamers, Ivor was laughed at. Most of the semiconductor establishment of the day were refusing to have anything to do with him. ‘After all, the world is full of crazy guys who know they have the answer’ would be a suitable paraphrase of their collective views on Ivor’s dream.

What Ivor needed, of course, was money. This would have shown once and for all whether his dream could be made into a working reality. He managed to get enough in the way of research grants to keep the idea alive, with small projects running at places like Middlesex Polytechnic. He kept body and soul together in those days by running a course on digital electronics, plus some consultancy work.

To the semiconductor industry in general, however, as well as the mainstream computer industry, he was something of a pariah. But that was way back when.

There was a certain wry grin on my face when the Inmos Transputer appeared, for here were some of Ivor’s ideas about the structure of computers appearing, in a different form it is true, but without Ivor.

It was with some interest I heard that Ivor had suddenly surfaced again, and not just surfaced like a piece of driftwood. He had risen meaningfully in the harbour of Sinclair Research. There, if anywhere, Ivor could find a home for outlandish ideas, a home where many such ideas have been shown to be perfectly practicable with enough applied courage.

Ivor’s dream is about to see some reality as an add-on for Sinclair’s QL. If it works, it could point the way to a radical change in the way we all think about computers and their peripheral systems.

I rather liked the idea of Ivor’s dream the first time I heard him expound upon it. Certainly, the criticisms he had of Von Neumann’s architecture made considerable sense. Imagine for just a second what this architectural structure actually involves. All actions in a computer are controlled by a single processor in a Von Neumann system. It is the processor which goes to memory and receives a program instruction; it’s the processor which then goes to memory to get a byte or word of data, it’s the processor which then executes the instruction; and it’s the processor which then sends that processed data back to memory. Every single action is controlled and executed by the one single processor. It is a fundamental tenet of Ivor’s dream that this structure is inherently slow. It can only be speeded up by increasing the speed of the processor, and there must be a finite limit to that capability.

Although such a structure is good at number-crunching applications, the majority of computers are used to performing mundane data manipulations of the ‘add this data to that record-in-the-file-named-xxx’ variety. All very boring and, what is more, all involving intensive processor I/O activity. Essentially, Ivor’s dream said: ‘Do the processing where the data is — in memory.’

Stage one of a plan to produce such a system (that is, proving the technology) would seem to be what Sinclair is about to launch. Ivor’s dream is coming alive as a ‘solid-state Winchester disk’, an add-on system for the QL which will provide half a megabyte of storage which is available at an access time of less than 100 times faster than anything that can be achieved with a real electro-mechanical system.

It has to be said that this first product will not see a full culmination of Ivor’s true dream. It will be a high-speed secondary data storage system that should give the QL some respectable clout as a computer, and which could overcome the drawbacks of the often-criticised Microdrives. It will, however, utilise the technology he has proposed for so many years.

This is wafer-scale integration. Instead of cutting up the devices on a semiconductor wafer into individual chips and packaging them for sale, leave them on the wafer and, if the right combinations of chip are put together, connect them up to make a working sub-system or system. The problem with this is that the defects inherent in semiconductor manufacture mean that it would be almost impossible to get a full, working wafer. Ivor Catt found a way round that all those years ago. He called it the Content Addressable Memory, a basic structure, which is now to be used in the Sinclair ‘Winchester’, is also the vehicle by which the full dream of processing in memory can be achieved.

The physical structure of the Sinclair wafer is a collection of serial registers, each with a small amount of switching logic added. The logic dynamically links these registers together in chains, finding workable registers by successively injecting test patterns into neighbours on the wafer. This means that the system is inherently fault-tolerant and can find its way round any defective wafer elements.

This technology is being used first of all to produce what is, in effect, a cheap RAM disk. It will be cheap because one wafer will be easier to produce than lots of separated memory chips. Add a bit more logic, however, and there is the basis of a pipelined processing system. Here, probably, lies the basis of Sinclair’s aspirations for fifth-generation computing.
Atari 520ST

The Atari 520ST is based on the powerful 68000 processor with user-friendly GEM, lots of I/O facilities, large RAM and a low price tag. Peter Bright finds out if this is really the all-singing, all-dancing machine it claims to be.
The 520ST is well-endowed with I/O facilities — including a MIDI synthesiser port.

Maybe I’m getting old. Then again maybe the micro world is just becoming a little boring, but there are very few new micros that I get excited about any more. The last one was the Sinclair QL and look what happened to that.

At the beginning of the year I went to the CES show in the US and saw a machine worth getting excited about — the Atari 520ST. At the time the machine was announced there were two models — the 130ST and the 520ST. Both based on the ultra-powerful Motorola 68000 processor, both offering the GEM user-friendly interface in ROM lots of I/O facilities including both floppy and hard disk interfaces, and either 128k of RAM (130ST) or 512k of RAM (520ST). All this was promised at an unheard of low price level.

We have been trying to get a review machine ever since. Unfortunately even review machines are in short supply and tend to move around a great deal. Just when we thought we had one, we were told ‘sorry it’s gone to Hanover in Germany’. So if Mohammed won’t go to the mountain . . .

When I arrived at the Hanover trade show I was told that Atari had decided to drop the 128k 130ST and concentrate instead on the 512k 520ST. That was fine because that was the machine I wanted to look at anyway. So here I am sitting on the grass next to the fountains at the Hanover show typing my thoughts on the 520ST into a trusty Hewlett Packard 110. It’s a hard life!

Hardware
The Atari 520ST is a surprisingly good looking beast. Jack Tramiel’s previous machines haven’t been renowned for their design content or overwhelming good looks. The 520ST, however, comes in a sleek mid-grey casing with matched mouse, disk drive and a range of monitors.

The keyboard takes up most of the front of the machine with ventilation slots using up the rest of the available top surface space. The design shows neat touches throughout: for example, the way the function keys are sloped to match the ventilation slots. The overall effect is very good. Apart from the keyboard and the ventilation slots the only other objects of note on the top of the unit are a small red LED power indicator and the Atari badge.

If there is one thing the 520ST is not short of, it is I/O ports. They take up the whole of the back of the machines as well as part of each side.

The left side houses a ROM-pack expansion slot which is capable of handling up to 128k of ROM. The right side houses two joystick ports, one of which is usually used as a mouse port

The back panel houses: power-in, MIDI-in, MIDI-out, RS232 serial-port, Centronics parallel-port, TV video-out, RGB video-out, composite video-out, floppy disk port and Winchester port.

That’s quite a long list of I/O ports for what is, after all, a comparatively cheap machine.

Perhaps the most interesting ports on the above list are MIDI-in and MIDI-out. MIDI is a standard interface designed to allow synthesisers and other electronic musical instruments to be hooked together so that they can communicate and control each other.

I’m surprised that the MIDI interface is comparatively rare as a standard fitment on home micros. All it requires in hardware terms is a couple of fast (31,250 bits per second) serial ports, one for input and one for output. Even if you don’t want to hang a synthesiser onto your Atari, the two MIDI ports needn’t be wasted. As Atari points out,
of the board giving a total of 192k of ROM. This can be expanded if necessary by adding an external 128k ROM cartridge.

The rest of the PCB is taken up with a few logic chips and standard control- ler such as a Western Digital floppy controller and an ATY-3-8910 sound chip. Atari says that versions of this machine will be available with more RAM, but unless the company can find cheap one megabit RAM chips, I think it will have to re-engineer the board.

As well as manufacturing the 520ST, Atari is also producing a range of peripherals for the machine. These include 3½in micro-floppy disk drives and 5¼in hard disks.

The 520ST comes with a Western Digital floppy disk controller as standard, so adding a floppy disk drive to the system is simply a question of plugging it in. Although floppy disk drives are sold as optional extras to the 520ST, you’d be pretty silly if you didn’t buy one. The 520ST doesn’t have a cassette port, so disks of some description are necessary if you are going to get anything out of the machine.

Floppy disks are available in two versions: either 500k (unformatted) or one megabyte (unformatted). They depart from Atari and Commodore traditions by using parallel connection rather than the old (and very slow) serial connection. You can daisy chain a maximum of two floppy disk drives onto the system.

Hard disks are expected to be available in either 10 or 20 megabyte specifications and to connect via the hard disk interface to the DMA controller.

By doing this the system achieves a maximum data transfer rate of 10 megabits per second.

Like most micros of this type, the keyboard is an integral part of the main casing of the 520ST. The keyboard is laid out in a fairly conventional manner with a total of 94 keys in four main areas. Most of the space is taken up by the main qwerty typing area. Above this are 10 programmable function keys which are shaped to blend in with the cooling slots behind them. To the right of the main typing area is the editing section with ‘Help’, ‘Undo’, ‘Insert’ and ‘Clear’ keys as well as the four usual cursor-control keys. Finally to the right of the editing keys is a numeric keypad with all the usual mathematical functions and an ‘Enter’ key.

I liked the keyboard on this machine. The unit is wide enough to allow the different functional areas to be well spaced out, making it easy to find the key you want without risking hitting spurious ones. I also liked the spurious ones. I also liked the feel of this keyboard. It dispels the QL myth that because you have a cheap machine, the keyboard must also automatically feel cheap.

Both the keyboard and the joystick (mouse) ports are controlled by a dedicated intelligent controller chip mounted underneath the keyboard base plate. The mouse movements simply return control codes into the keyboard buffer. This means that you can mimic the mouse movements from the keyboard if you need to.

The mouse itself is a stylish looking two-button affair with the layout of one of the joystick ports via a standard ‘D’ plug. In use the mouse cursor movement was very smooth with none of the jerking that you find on some mouse systems.

The 520ST is very well endowed with display facilities. In fact it boasts virtually every display standard going and a TV modulator, RGB and composite video.

Atari has announced a wide range of monitors which are designed for use with the 520ST. Your choice of monitor governs the display resolution of the 520ST. If you use a domestic television, you can choose between medium resolution (320 x 200 pixels) up to 16 colours on screen. If you use an RGB monitor, you can choose between low resolution (320 x 200 in 16 colours) or medium resolution (640 x 200 pixels in four colours). Finally if you use a composite video monitor, you can access the highest resolution of the machine (640 x 400 pixels in two colours, black and white).

Whichever monitor you use, the machine will automatically set itself to the correct resolution. I suspect that the majority of people will go for the medium resolution RGB monitor because it gives you access to either low resolution with lots of colour or medium resolution with four colours. Both of these modes allow you to produce very impressive graphics although GEM does look a little odd in lo-res.

I think that the hi-res black and white composite video monitor will only appeal to the dedicated Mac immitators and computer-aided design freaks among us. Having said that, I must admit that it was my personal favourite. In addition to the straight RGB and composite monitors, Atari can also

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supply a natty little monitor with built-in disk drive. This makes the 520ST system into a very neat desktop package.

**System Software**
The system software in the Atari 520ST works at two levels. On the top is a friendly Mac-like front and underneath is a fairly standard disk operating system.

Both the front end and the disk operating system are supplied by Digital Research (DR). In fact Ataris has licensed the entire range of DR's products ranging from operating systems through utilities to all its languages. So we can expect any advantages DR reflected in Atari products. Unlike most other disk-based machines both the DOS and the front end are contained in ROM. This allows the machine to go directly into its operating system on start-up without having to read from disk.

Although it is unlikely that the average user will ever want to descend into the DOS, I think it is a good idea to look at how it works at two levels. On the top is a System Software, a friendly Mac-like front end will be the face of the machine. To understand this we need to look at how GEM works.

One of the functions of GEM is to provide a standardised interface to the graphics screen and graphics devices in much the same way as a disk operating system provides a standardised interface to the disks. By using GEM, a programmer can write to this Virtual Device Interface rather than having to go directly to the hardware of the specific machine he is writing for. This makes it much easier for the programmer to move his masterpiece to other machines which use the GEM environment.

Originally, Digital Research demonstrated GEM on the IBM PC, but it also works on compatibles and machines like the Apple IIe and the Atari.

GEM Desktop on the Atari looks very similar to GEM on most other machines. You have the disk icons and trash can at the right of the screen, a menu bar along the top, and windows can be opened, closed and moved in the same way as on other GEM machines. However, because of its fast 68000 processor, GEM moves along with much more of a clip than the IBM PC or an Apricot which can sometimes be quite slow — especially when updating more than one window at a time.

Atari has added a couple of desk accessories into the 'Desk' pull-down menu. These included a Macintosh-style 'Control Panel' which allows you to play around with some of the system settings such as the colours used to display the GEM Desktop. It also allows the Atari to have also included a simple terminal emulator and a utility to set up the RS232 serial port.

One of the nice features of GEM is that it adapts itself to the different specifications of the hardware it is running on. Consequently, as you would expect, there is quite a difference between the way it looks in the hi-res black and white mode to the lo-res colour modes.

Personally I liked the hi-res mode more than the colourful lo-res modes. Other people seem to prefer the colourful modes. In its hi-res black and white mode, GEM makes the 520ST look more like the Macintosh than any other GEM machine I have seen.

One nice feature of GEM on the 520ST is that it allows you to have two logical disk icons operative, even if you only have one physical disk drive attached to the system. GEM treats them as separate disks and allows you to do all the things you would do on a twin-drive system by prompting you to change disks in the drive when necessary. I found this was extremely useful, especially when I was trying to copy disks.

Over all, the implementation of GEM on the Atari is very good. Having GEM in ROM makes the loading process much faster than the tedious rigmarole you have to go through to get it to load on something like the IBM PC. It also means that if the machine ever dies for any reason, it goes to GEM as the base routine rather than some obscure monitor or suchlike.

Although the Atari implementation is good, what you can do with the GEM Desktop is still limited to some extent by the operating system underneath GEM.

**Applications software**

When the 520ST goes on sale, it will be supplied with GEM, Basic and Logo. At the time of writing there still seems to be some debate within Atari as to whether these will all be in the internal ROM or whether they will be on a disk. It seems likely that early machines will have software on disk for debugging purposes and later machines will have the software in ROM.

Both of the programming languages are again supplied by Digital Research. The Basic is the Personal Basic and the Logo is its DR Logo. Both of these products are widely available on other machines, although they have been modified somewhat for the Atari machine.

In its usual form, Personal Basic is functionally very similar to standard Microsoft Basic. At the time of writing the Atari modifications were far from finished. The most obvious difference between the standard version and the Atari version is that the user interface has been changed. Whereas before you had a simple command line, there are now pull-down control menus, mouse control, and different windows for editing output and so on.

Eventually your Basic programs should be able to control the whole GEM user interface. So you should be able to write mouse-driven high resolution colour programs with lots of windows, bells and whistles. However, at the time of writing the only way to do this was by using loads of PEEKs.
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Tramiel’s last machine was the Commodore 64! Enough said. The people at Atari believe them, remember that Jack Tramiel’s last machine was the Commodore 64! Enough said.

CALLs. The people at Atari believe them, remember that Jack Tramiel’s last machine was the Commodore 64! Enough said. The people at Atari are in another. Very pretty.

The most interesting new product, however, is the addition of a CD ROM unit. We ran an article on CD ROMs a couple of months ago (see PCW, April 1985). They use the same kind of optical-digital compact disks as the home hi-fi systems except that the computer versions don’t need the complex digital-to-analogue converters as in the audio units. Instead of carrying digitised audio signals, computer compact disks store digital computer data.

The main differences between compact disks and magnetic disks is that whereas you can get about 720k on a double-sided magnetic disk, you can get 550megabytes of data on one compact disk. The trouble is that whereas you can write to a magnetic disk, you can only read from a laser disk — hence the name CD ROM.

Atari plans to launch its CD reader for around $500 which is about half the price everyone else is charging. Its first piece of CD software will be a fully indexed (right-down-to-word-level) multi-volume encyclopedia on a single compact disk. This should get into the shops later this year.

Documentation

As this was a pre-production machine no documentation was available.

Prices

The 520ST with single 500k disk drive will sell for £699.99. Prices of the other peripherals in the range were still being discussed as we went to press.

Conclusion

There can be no doubt that the Atari 520ST is a very impressive machine. From the technical viewpoint the machine seems to have everything going for it — good keyboard, lots of I/O facilities, lots of RAM and what, for many, is the nicest 16-bit processor around.

When you add in the GEM friendly user interface and the availability of cheap disk drives, you end up with a very impressive system indeed. I’m still not sure whether to classify it as a home or business machine. Its abilities are well suited to both. I have a feeling that in the US it will be treated more as a home machine and over here it will appeal to business users.

Having said that, it is a good machine, there are still two areas that you should think about before you rush off to your local Atari dealer to part with your hard earned cash.

The first is the availability of good applications software. It’s a virtual certainty that Digital Research’s word-processing and graphics applications programs will be available soon, as will Atari’s Infinity integrated package. But I’m not so sure if or when third party applications will begin to appear. Remember, it took the best part of a year for applications to start appearing on the QL.

The second point to watch is the price of the system. The original 130ST was set to sell in the US for $399. This set people thinking that the range is cheap. While this is still true when you consider what you get, remember that the 130ST has been dropped and you are looking at about £700 for a 520ST and disk drive. When you add a monitor and other bits and pieces, you won’t see much change out of £1000.

Even so, the bottom line is that when the machine appears in the shops, I’ll be at the front of the queue to buy one.

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Technical specifications

Processor: Motorola 68000 running at 8MHz
ROM: 192k containing OS and GEM
RAM: 512k
Mass/Storage: 500k or one megabyte (unformatted) 3½in micro-floppy disks, choice of hard disk capacities.
Keyboard: 94 keys including 10 function keys.
I/O: RS232 serial, Centronics parallel, floppy disk, Winchester, TV video, RGB video, composite video, MIDI-in, MIDI-out, joystick, mouse, ROM cartridge
DOS: TOS, GEM
Bundled software: Personal Basic, DR Logo

In perspective

By the time you’ve got a 520ST, disk drive, monitor and so on, you are looking at a system that is just about below the magic £1000 price barrier. This puts the 520ST into competition with machines such as the Sinclair QL and the ACT Apricot F1 (or the even cheaper ‘e’ version).

As far as technical specification goes, the 520ST is far ahead of both these machines — it’s got a better processor, more RAM and a friendlier user interface than either of them.

However, things get much closer when you look at the way these machines compare in terms of usability. This is especially true of the Apricot F1. Where the 520ST has a faster processor and more RAM, the Apricot F1 has access to a far wider range of applications programs. Both machines run (or are capable of running) GEM. The Apricot F1 has a 3½in disk drive built-in — the 520ST offers a cheap external 3½in drive. The more I think about it the more functionally similar the 520ST and Apricot F1 become.

The Atari 520ST is extremely competitive in the sub £1000 market. In terms of technical merit it is far ahead of the field. In terms of usability for the money, it beats the QL but the Apricot F1 comes very close.
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Hewlett-Packard has attempted to build the ultimate portable — minicomputer specification and power in a compact, modern design. Nick Walker takes a look at the single-user, Unix-based Integral PC.
The Integral PC is encased in extremely durable hard, grey plastic

The Hewlett-Packard (HP) Integral Personal Computer has a specification that reads like a list of state-of-the-art micro-computer technology: 68000 processor with electroluminescent display; Think-Jet printer; 3¼in microfloppy disk drive; and the Unix operating system.

I expected a large multi-user system with the traditional hefty Hewlett-Packard price tag. In fact, the machine is single-user and contained in one 25lb transportable box — the only thing I was right about was the price.

Hardware

At 25lbs and with physical dimensions similar to that of a sewing machine, the Integral is most definitely in the luggable category. It is smaller than other luggables, such as the Osborne, and fits comfortably on overhead shelves or under aircraft seats. When packed away the machine is encased in hard, grey plastic capable of taking the bumps and knocks of life on the road. HP went to some length to ensure the machine’s durability, including dropping it from over three feet onto a solid floor.

To open the unit, slide two metal catches on the top outwards; the lid then slides back to reveal the printer. The keyboard detaches from the side, exposing the screen. You then plug in the keyboard at the front, mains power at the back and switch on. The first thing that strikes you is that the machine looks odd compared to other luggables. Due to the screen being so thin, the Integral can remain in its standing position (unlike other luggables that are tilted onto their side) so that it takes up considerably less desk space.

The Integral PC is based on a 16/32bit 68000 micro-processor running at 8MHz, supplemented with a 16-bit custom graphics processor. Standard RAM is 512k made up of 256k by 1-bit DRAM chips with no parity chips. This is expandable to 1.5Mbytes internally, or 5Mbytes by means of an expansion card on one of the expansion ports. An extra 32k of RAM is reserved for the display and graphics processor, and hence is not seen by the user. The ROM is a massive 256k containing the Unix operating system, a window manager and a user-friendly interface.

Within the case is an almost silent fan. HP claims that the Integral will work in extreme conditions (that is 40 degrees C and 80 per cent humidity).

The real centrepiece of this machine is the electroluminescent display, which is as slim as an LCD but much clearer, faster and quite readable in direct sunlight. Such displays are not common as they are still an emerging technology and hence expensive, and, more importantly for portable manufacturers, really require mains power.

The Integral can display a full-size 24 lines by 80 columns on its amber-only display. The screen itself measures 8 ins by 4 ins (twice the size of the Grid Compass display — the only other machine with the same screen technology) and when used graphically with its 512 x 256 bit-mapped pixels gives very high resolution. A number of fonts are provided for character displays, as well as a font editor to create your own. The viewing angle is adjusted by pulling the bottom of the screen.

Only one true interface is available on the back of the machine, the (Hewlett-Packard) standard IEEE-488 HP-IB interface. To this can be added standard HP peripherals such as plotters or other HP printers. In addition, this port is designed to accept a wide range of instrument controllers as used on HP scientific computers. A bus expander is available to hook up more instruments and peripherals. Further I/O capabilities such as RS232 communication are available with the purchase of an additional I/O board which plugs into one of the two expansion ports (also used for adding external memory). The two small British Telecom-style jack plugs on the front of the machine provide communication to HP’s personal computer input devices HP-HIL (Hewlett-Packard Human Interface Loop); the keyboard plugs into one, leaving the other free for mouse, touch tablet or any other HP-HIL device.

The low-profile detachable keyboard is a full-size qwerty device with 90 keys including numeric keypad, eight function keys and numerous control keys. It has a good feel and a tilt mechanism at the rear to bring it to the right angle. The numeric keypad also has special functions which are accessed via the SHIFT key, such as delete line and insert character, and at its base are the cursor.
control keys. The integral also has a SELECT key, used to select the active window for human interaction; an EXTENDED key for special characters; a PRINT key to dump any screen to the printer. The RESET/BREAK and STOP keys are in the top left-hand corner out of harm's way. The keyboard is completely soft-mappable, with the current definition of the function keys shown on the bottom lines of the display.

Probably the biggest disappointment on a machine of this price is that HP has only included one disk drive. This is a 3½in micro-floppy drive to the right of the screen with disks inserted at 90 degrees to the normal. Although the lack of a second drive was somewhat compensated for by the OS being entirely in ROM and the ability to define half of the available RAM as a RAM disk, I still missed a second drive. If the RAM was expanded to 1.5Mbytes and a reasonable amount was set aside for a RAM disk, the loss wouldn't be as bad. The Integral takes hard-sectored, double-sided, double-density disks with a total storage capacity of 710k per disk. You can have more mass storage externally right up to a 55Mbyte hard disk drive.

The Integral has a built-in HP ThinkJet printer which uses a sack of ink squirted onto the paper in a controlled manner. HP also sells this printer as a peripheral with a Centronics interface to hook on to an IBM PC, BBC or any other machine with a Centronics port. Before using the printer for the first time, you have to insert an ink sack complete with a strategically placed piece of blotting paper to catch the initial spurt of ink when the machine is switched on. The cartridge contains enough ink for 500 pages of text and the entire print head mechanism (a solid-state column of 12 individual squirters), so when you change the cartridge you also insert a new print head.

Although the printer will work with almost any paper, the mechanism is actually shooting droplets of ink at the paper, so very absorbent paper suffers
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from some fuzziness. HP supplies its own paper that works excellently. Two things about the paper loading annoyed me: firstly, a pile of paper behind the machine substantially increases the desk area used; and secondly, there is no platen knob so care is needed with the line-feed button.

In operation I was impressed by how everything worked; there are no print head pins hitting the paper. It is also fast and flexible, printing at up to 150 characters a second in four different pitches. Graphics printing is supported, and any screen dumped will be printed accurately. The print quality falls between that of dot-matrix and daisy-wheel, and is certainly good enough for general letter-writing.

Electrical paths lead from each squirts to the front of the ink sack, where they meet with contacts on the carriage assembly. When the contact is activated, a small squirt of ink is projected facing the paper beneath the roller.

The Think-Jet's four pitches are: normal 12 characters per inch(cpi) giving 80 characters per line; expanded six cpi giving 40 characters per line; compressed 21.3 cpi giving 142 characters per line; and 10.7 cpi giving 71 characters per line.

Each of these modes can be bold, underlined or both. Unlike dot-matrix printers that take multiple passes of the print head to print bold or underlined, the Think-Jet can do it in one, keeping its 150 characters per second print speed. You can also set the line spacing and the number of lines of text on each page.

A number of optional peripherals are available for the system including hard disks, laser printers, and plotters. The Think-Jet can do it in one, keeping its 150 characters per second print speed. You can also set the line spacing and the number of lines of text on each page.

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System software

Two levels of system software are supplied with the Integral - the underlying Unix environment and, on top of this, HP's own user-friendly Personal Application Manager (PAM). Formatting the output from these and other applications is a program called HP Windows. All three are all in ROM, including Unix.

The Unix supplied is an AT&T Bell Laboratories System III-compatible version called HP-UX 2.1, which is referred to in HP's literature as a 'vanilla' Unix environment. While the multi-user features of Unix are obviously lost on this machine, the multi-tasking features are not.

It is quite possible to be printing from one application while monitoring an instrument and updating a spreadsheet. I found no limit to the number of applications you can have running at one time, although the machine gets noticeably slower after about five or six. Even given all this, Unix does seem to be a case of overkill in a single-user micro. There is no way you can directly interact with the Unix ROM; to enter Unix commands, you need to run the HP-UX commands disk which gives you 32 standard Unix commands including

'From the nature of the manuals and software developed, it is obvious that HP also sees the machine selling to business and first-time users.'

the Berkley enhancement 'csh', a Unix C Shell.

There are three other system software disks included: a utilities disk for performing standard system functions and system customisation; a diagnostic disk that tests all system components and reports any faults; and a system programming disk with the HP graphics language (HPLG), window and serial port drivers, and real-time extensions.

For users who use a mainframe system, the Integral can act as an intelligent terminal. You could then write source code on the mainframe, and download to the Integral to compile and run or vice versa. The Unix on the Integral is very flexible, as it can dynamically update itself through a RAM jump table. This gives the ability to emulate Xenix, System V and other Unix derivatives.

As a single user, it is rare that you will need to deal with Unix directly. All file manipulation and applications-running can be done from the Personal Application Manager (PAM), which is fundamentally the same front-end as found on the HP-150 but with some additions to incorporate the multi-tasking nature of the Integral and the operation within the window manager.

There is also a version called HP-UX 3.1, which gives an additional 'csh' (see below) and all the most significant enhancements to PAM on the Integral over the HP is that all the software is in ROM, making it much faster and less cumbersome to use.

Upon the machine being switched on, PAM reads the disk drive, looks for installed applications and displays the names onscreen. The PAM window is divided into two sections. The upper portion, the command area, is where you issue commands and receive feedback from PAM. The lower portion, the folder area, displays the name of applications and data files. At the bottom of the screen is a user menu containing eight frequently used file operations.

A full description of PAM was featured in PCW's review of the HP-150 (May 1984), so I'll just concentrate on those features specific to the Integral.

PAM on the Integral supports pipelining: that is, two or more programs can be connected, whereby the output from one acts as the input to another while running concurrently. This means you could have program A obtaining data from the user, which would be passed via the first pipe to program B where it would be checked for validity. The validated data could then be passed by the second pipe to program C for formatting into a report. This would be specified to PAM as: program-A / program-B / program-C.

Similarly, there are times when it is necessary to specify purely sequential processing, such as making a backup of a disk. A program can be set to run by itself only by adding a semicolon to the end of the program name: that is, backup;.

Also in ROM is HP Windows; a window, graphics, mouse and function key interface. Although not of the same quality as that of the Macintosh or Windows does provide a natural environment for multi-tasking. Windows allows you to place, stretch, hide and shuffle multiple windows, and is much easier to use when operating with a mouse. The top window is the only one with which you can interface directly. Each window is in fact treated as a separate 9600 baud terminal with 80 columns and 20 lines, and uses the

Benchmarks Hewlett Packard Integral PC

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All timings are for use only. For a full listing of the Benchmark programs, see page 185, January issue. Machine loaned by Proteck.
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Applications software

A number of software packages are now available for the Integral. These include Microsoft's Multiplan, Ashton-Tate's dBase II, HP's own Memomaker and Visicorp's TK!Solver. On the software development front there are a number of Unix development tools, the C programming language and Basic. The Basic is HP's Technical Basic which is a version of ANSI Basic with extensions for maths, graphics and instrument I/O. Basic programs written on the HP 85/86 and on series 200 and 500 machines will immediately run on the Integral. Applications written in C in 500 machines will immediately run on the HP 85/86 and on series 200 and 500 machines will immediately run on the Integral. But having said that, the Integral would be capable of monitoring far more complex experiments due to its multi-tasking nature.

More software is being developed, both by HP's own software division and by independent vendors. It is unlikely, however, that the machine will have as wide a range, or as competitive prices, as the IBM PC.

Six disks are bundled with the Integral: a tutor, a utilities disk, HP-UX commands, standard applications, diagnostics and a system disk. All except the standard applications are described in this review; standard applications furnish you with two editors (font and text), three games and several alternative fonts.

Documentation

The Integral is supplied with two A5 manuals - a user guide and a comprehensive guide - and a tutorial on disk.

Both manuals are clearly written and well indexed. The user guide is a step-by-step guide to using the Integral, the comprehensive guide gives more information on each aspect of the machine. I found that the comprehensive guide didn't go far enough in explaining the technicalities of the system, and should have been supplemented with a reference manual.

Beginners would be advised to forget the documentation and plug in the tutorial disk. This tutorial covers everything in the user guide and takes an estimated eight hours to fully absorb. It is broken up into eight lessons with each lesson subsequently broken into smaller subjects include file organisation, use of windows, printing and creating files. Generally it's very well done, but it has a rather American 'Isn't this amazing' style. The Integral's documentation also includes a cartoon booklet showing you how to set up and start, and also how to pack the machine away for transportation.

Prices

The Integral Personal Computer follows HP's tradition of high quality and high price: it costs £8450. The optional mouse costs £152, and the Think-Jet printer on its own costs £550 with an HP interface or a Centronics interface.

Conclusion

I started this Benchtest with considerable doubts about the viability of a machine that uses Unix in ROM and which is designed purely for a single user. However, HP has created a machine that makes an awful lot of computer power easy to use. The windowing software makes multi-tasking a natural activity with no worries about task priorities, foreground/background tasks and scheduling. One week of using this machine and then returning to MS-DOS on an IBM PC really makes me realise the power of Unix.

As for the possible market for the machine, it is hard to tell who will buy it. Certainly, computer scientists who use Unix now will appreciate the benefit of a complete, luagable Unix system. Similarly, scientists using HP's existing scientific computers will find it a logical upgrade. The multi-tasking facilities may well draw other users who have outgrown operating systems such as MS-DOS.

From the nature of the manuals and software developed, it is obvious that HP also sees the machine selling to business and first-time users. But with it's high price and limited and expensive software, I don't foresee many sales in this area. It may sell to those who want to find a way of switching to Unix at a reasonable price, or those who purely want to cast a vote against the IBM PC.

If nothing else, the Integral PC must be admired for its all-in-one-box approach, the state-of-the-art technology, easy-to-use multi-tasking, high build quality, and the ingenuity that went into making Unix a ROM-based operating system.
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Am I alone in feeling humbled, frustrated, humiliated even, by the enormous advances which have been made in computer games recently? Ten years ago I could sit down to a game of chess with any computer in the country, confident that it couldn't hold out for more than 10 minutes. But now I regularly get th rashed, not only at chess but at draughts, reversi, backgammon, go-moku — even Scrabble.

Is this really what computers were meant to do? Is mankind really destined to pour hours of concentrated effort into a sophisticated program just to emerge the loser? Surely, with all the number-crunching power of a modern machine, there must be a way of letting the computer do all the hard work so that we can improve our game.

Many's the time I've pondered this point as I sat brooding over a hand of cribbage — a game where there are many decisions to be made solely on probabilistic grounds. Could I program a computer, not simply to play cribbage itself, but to devise a strategy to improve my skill in ordinary face-to-face play?

The problem, of course, is lack of motivation: cribbage is a happy-go-lucky, time-wasting game, played for fun, not for blood. Writing thousands of lines of code to devise a world-beating strategy for cribbage would be like putting in hours of secret practice in order to beat your children at snap.

Last year, while browsing at a news-stand, I picked up a booklet which contained the quote: 'Of all the casino games, blackjack is the one game where... you can actually turn the advantage in your favour by as much as 5%,' and immediately I knew that in blackjack I had found a game worth studying — and not just from the financial angle.

Blackjack is perfect for the kind of approach I had in mind. It is a 'one-sided' game, in the sense that the player plays against a banker who makes no independent decisions. There are situations which repeatedly occur in which the correct decision is far from obvious. There is only a limited choice of options at any given stage in the game, and because a pack of cards can be simulated using a random number generator, the correct strategy for any given situation is easy to determine with a computer. Ready to make my fortune, I bought some more books on the subject and sat down at my micro.

For those of you who have never been into a casino, let me summarise the British version of the rules of the game. Blackjack is a simple version of the card game known as 21 or pontoon, with a few changes to reduce the odds in favour of the bank. Each player places a bet, which can be any amount from the table minimum (typically £3) up to the maximum (typically £200), whereupon the dealer gives two cards to each player and one to himself. The players in turn then ask for as many extra cards as they wish, one at a time, until they either choose to stick with the hand they have, or the total of their cards exceeds 21 (picture cards counting as 10, aces as one or 11), in which case they are said to have 'busted' and they immediately lose their bet.

When all the players have either stuck or gone bust, the dealer plays his own hand. He plays in exactly the same way as the players except that (and this is the first main difference between pontoon and blackjack) the dealer must keep taking extra cards until his hand totals 17 or more, and then he must stick. There is therefore no skill in the game for the dealer: his actions are determined entirely by fixed rules.

If the dealer busts, he loses and pays all the players who have not themselves busted. If the dealer does not bust, he pays all the players with a higher total than his, and collects from those with a lower total. If there is a tie, no money changes hands — another difference from pontoon, where the dealer always wins tied hands.

As in pontoon, if you are dealt two cards of the same value, you can split the pair by doubling your bet and getting a new card on each of the originals; this rule creates more headaches when programming than any other rule of the game. You also have the option of doubling down, which means doubling your bet and receiving exactly one more card. There is no five-card trick in blackjack.

In blackjack, though, the odds are constantly changing. If you are dealt two aces on the first hand, the chances of you getting an ace on your second hand are smaller than they were previously because there are fewer aces in the pack. This is the basis of all winning systems. By watching the cards which have been played, you can get some measure of the odds against you. When your expected profit on a hand is negative, you bet the minimum; when the odds swing in your favour, you bet high.

A winning streak

The first player to make a winning system popular was Edward O Thorp in his book Beat the Dealer, first published in the early 1960s. Thorp's system caused such a stir in Las Vegas that the casinos changed the rules — only to change them back again when players refused to play under the new rules! Other authors, programmers and mathematicians were quick to refine Thorp's strategy, and Las Vegas and the other gambling centres of the world were soon flooded with winning systems and skillful players (known as 'counters') who could use them. Before long it was impossible to use the strategies outlined in Beat the Dealer: every casino trained its personnel to "count" hands — another rule of the game. The players were soon banned from the blackjack tables.

New strategies were devised which kept the bet range down in order to conceal the fact that a system was being used. When I decided to investigate blackjack there were several books available, all of them proclaiming their system as 'the best', 'the most effective', 'the least detectable under all playing conditions', and, invariably, 'computer-proven to be the most workable blackjack system available today'. But how to decide which to use? And just how effective are these systems anyway?

I started out by writing a 1500-line interactive program which took the part of the dealer while I played the game. Such a program would be fairly easy to test, fun to play around with, easy to modify into the number-cruncher which would do my analysis, and be useful for practice when I finally had my system designed.

A rags-to-riches story could be yours — Ken Barker applies random number generation to the problem of winning a fortune from casino blackjack.
I wrote it in Pascal, designed from the top down according to the best traditions of structured programming. I did this more for reasons of convenience than anything else, but was pleased to see structured programming vindicated. The program was as easy to test and debug as I had hoped, and I soon progressed to a version which took the part of both the player and the dealer, and which I could leave running over-night to produce statistically significant results.

The biggest problem was the difficulty in debugging a program which includes a pseudo random number generator. Most generators have a period of $2^{16}$ (that is, after generating $2^{16}$ numbers, the sequence of numbers repeats itself), as I intended to play several million hands of blackjack each night, I had to include a generator of my own.

Most random number generators are multiplicative: that is, each number is generated by multiplying the previous number by some suitable constant, adding another constant, and taking the remainder when divided by a third, fairly large constant, thus:

$$X_{n+1} = (aX_n + c) \mod m$$

As each number depends only on the previous number, and since there are only $m$ possible values for $X$, the sequence must start to repeat itself in less than $m$ numbers.

I decided to use the additive random number generator of Mitchell and Moore. This works by adding two previous numbers from the sequence together according to the formula

$$X_n = (X_{n-24} + X_{n-55}) \mod m$$

where the first 55 values are assigned arbitrarily, and the sequence is taken to be random from, say, $X_{50000}$.

As each number depends not just on the previous number but on the previous 55 numbers, it can be shown that the sequence has a period of at least $2^{55} - 1$ which is approximately $10^{16}$ — far more than I was ever likely to need.

An added bonus of writing my own code for the generator, rather than relying on the system's, was that I could
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write it so that it needed a 'seed' before it would run. This meant that on successive nights I could use different random numbers to simulate the shuffled pack of cards; it was simply a question of using a different seed when the program was initialised.

But there were problems which I was not expecting. The mathematician Von Neumann said that anyone who considers arithmetical methods of producing random digits is in a state of sin; after wasting several hours attempting to do just that, I was starting to believe him.

Normally, when you debug a program, although the bug may take weeks, months, or even years to emerge, when it is finally spotted you can usually be certain that the program isn't running as it should, and the errors are repeatable. With random numbers, I discovered, there is such a thing as a probabilistic bug!

**Debugging the program**

When I first ran my program, the results appeared a little biased: the machine seemed to be dealing more picture cards than it ought to. I repeated the run each night for several nights, and found that sometimes the proportion of picture cards was higher than it should be, and sometimes it was lower — but there seemed to be rather more nights when there were too many picture cards than when there were too few. I carefully examined the code, but could find no coding errors. Eventually, I decided that I would have to analyse the results statistically.

I borrowed a textbook on probability which told me more than I wanted to know about chi-squared tests and other statistical tests to determine just how likely it is that the results of a random test really did occur by chance. After an hour's calculation I had found that the probability of my results could have occurred by chance, but the probability of this happening was only one chance in 20 — so it was 95 per cent certain that my program had a bug, but there was a five per cent chance that I had just been unlucky.

I had already run the program every night for a week, and was getting impatient to start playing in a casino — winning the vast fortune the books had promised me. Still, I reasoned, better to get the maths sorted out first and be sure of what you're doing.

A second week of calculation followed, with the machine buzzing and whirring all night, and the results this time still showed a slight bias towards picture cards but not as much as previously. I repeated the chi-squared tests and even after allowing for the previous run there was still a bug in the program, with 95 per cent probability.

I still don't know whether I was just unlucky or whether there really was a bug, because at this point I lost patience. I gave up on the code I had written and started with new code. It was still based on the Mitchell-Moore algorithm, but I structured the program differently, styling it so that I would be able to carry out the statistical tests faster. 10 test runs of the new routines went through the machine on the first evening. Nine of them gave results which were exceptionally close to the theoretical values, but to my deep dismay, test run number seven gave a result so unlikely it could only have occurred by chance once in every ten thousand runs.

After another thousand runs, all of which gave values exactly as the chi-squared tests said they should, I was satisfied that results as amazing as run number seven would only occur once every ten thousand runs, and it was just bad luck that I had turned up such a run so near the beginning of my tests.

The books all agreed that with a perfect playing strategy, the odds against you are about 0.67 per cent. As a final test of my program, I set it playing, using the strategy it had calculated for itself. After five days of machine time, the machine had played about six and a half million hands and the average loss per hand was 0.65 per cent, well within an acceptable margin of error.
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156 PCW JUNE 1985
The end was in sight. I had worked out the correct way to play the cards, and now all that was left was to determine how to decide when the pack is ‘good’ and thus when I should increase my bet, and when the pack is ‘bad’ so that the bet should be kept to a minimum. This proved to be the easiest and most interesting part of the whole experiment.

No-one can memorise exactly which cards have been played and simultaneously calculate how they affect the odds in your favour in a game of blackjack, so all winning systems use a simplified method which consists of assigning numerical values to each of the cards, positive if the card is good for the bank, and negative if the card is good for the player. By keeping a running total of all the cards played, the player can determine when the chance of winning the next hand is greater than zero, and thus when to increase his bet.

The question is: what are the best values to assign to the cards? Rather than let the computer attempt to find a system, I compared six different popular systems with one I created myself based on the knowledge I had acquired from my study of the game.

<table>
<thead>
<tr>
<th>Number of hands dealt</th>
<th>651874</th>
</tr>
</thead>
<tbody>
<tr>
<td>Hands dealt from 'good' decks</td>
<td>1034811</td>
</tr>
<tr>
<td>Hands dealt from 'bad' decks</td>
<td>5483931</td>
</tr>
<tr>
<td>Total loss (betting £1 per hand)</td>
<td>£36,672</td>
</tr>
<tr>
<td>Loss on 'bad' decks</td>
<td>£50,737</td>
</tr>
<tr>
<td>Profit on 'good' decks</td>
<td>£14,065</td>
</tr>
<tr>
<td>Average loss per hand</td>
<td>0.56 per cent = 0.56 pence per hand</td>
</tr>
</tbody>
</table>

**Conclusion**

And now the most important questions: how much can a card-counter expect to win? And why, if I have got such a great system, am I telling you all about it rather than going into a casino and making my fortune?

The answer to the second question is contained in the answer to the first. As I have explained, the amount you expect to win depends on the ratio of your maximum to minimum bet. If the ratio is too small, you won’t win. If it’s too big, your fortune will be (£3.6 per cent quoted in the article assumes a fixed betting spread of 5:1) you can expect a net profit of around 90p — and that’s before tax!

For those of you who want to write a program to play blackjack, either to play the game against the machine as dealer or to check my results, here are a couple of tips to point you in the right direction.

Firstly, make sure you thoroughly understand all the rules you want to include, together with their implications, before you start to program. If you want to use the rules played in the UK, the only book I have discovered which explains them correctly is A Book on Casino Blackjack by C. I. Tulcea. Incidentally, this is one book whose results agree very closely with mine — of all the books I’ve mentioned, this is the only one I would recommend for serious study.

Secondly, I strongly recommend a top-down approach to writing the program. Start by breaking the main task into a few fairly big sub-tasks, each of which will be split into several smaller sub-tasks.

If you do this thoughtfully, the program can be written in several stages, with each stage being thoroughly tested before it is incorporated into the code. A flow diagram illustrates this approach (Fig 1).

Finally, despite all my testing, there’s still the possibility of an error in my results. If you do write a blackjack program which gives results substantially different from mine, or if you can think of a new tactic to divert the casino from spotting a counter at work, then do let me know.

**Fig 2 Assessment of strategy**

<table>
<thead>
<tr>
<th>Profit with betting spread of 5:1</th>
<th>0.3 per cent = 0.3 pence per hand</th>
</tr>
</thead>
<tbody>
<tr>
<td>(The average loss of 0.67 per cent quoted in the article assumes a fixed playing strategy. By using a different strategy for good and bad decks, the loss can be reduced to 0.56 per cent.)</td>
<td></td>
</tr>
</tbody>
</table>

**JUNE 1985 PCW 157**
Telesketch

The Telesketch is a combination of communications terminal and stand-alone micro, but does the UK market have room for its impressive specification? Stephen Applebaum takes a look.

The Telesketch is a machine with an identity crisis. On the one hand it is a communications terminal, while on the other it is a stand-alone computer with powerful graphics capabilities. The only way I can describe the Telesketch is as a kind of overpriced One Per Desk. In fact, the basic machine could cost nearly £800 more than the OPD, having a provisional price of somewhere between £1,800 and £2,000.

Hardware

I say the Telesketch is overpriced because unlike the OPD, and even some smaller personal micros such as the Amstrad, it does not come with any kind of storage device fitted as standard. Not even a mere cassette recorder. However, that aside, what you do get is a Motorola 6809E-based machine with a 512 x 384 pixel green-screen monitor, 64k of dynamic RAM, 16k of static RAM (expandable to 32k), 32k ROM (expandable to 128k), a Centronics interface, modem and telephone handset, and a very accurate light pen, all set into a compact 9ins x 10ins x 15ins case. For very accurate light pen, all set into a very ugly, short length of wire.

Although the review model was fitted with all its graphics and communications software, it lacked even the slightest hint of a programming language. I was assured that if and when the machine goes on sale here in the UK, it will be fitted with either Basic or Forth (depending on the user's preference), plus a spreadsheet, as standard. Not externally the Telesketch is bizarre, looking like something out of an old sci-fi movie. In a groove, on top of the main console, sits the telephone handset, while the light pen sticks out of a receptacle in front of the screen. Also on the front is a small hole which leads to a microphone, enabling the machine to be used as one would an intercom, freeing the hands for making notes or lifting the odd cup of coffee.

On the rear of the unit are several interfaces and minor controls. Working from the left there is a brightness control, an expansion bus to which an interface box with a Centronics interface can be attached, a hand-set plug, a light pen socket, phone line plug and reset switch.

Unscrewing the Telesketch's bottom and lifting off the top uncovers a large PCB packed chock-a-block with chips. The RAM and ROM were immediately evident, as was an interesting, but obscure, custom chip. Towards the rear of the machine a mass of wire runs to a power supply and speaker, as well as running below the board to the monitor.

In use

Getting started with Telesketch is quite simple: you plug the unit into a telephone socket (like any hard-wired modem), plug into the mains and switch on.

Immediately after power-up, Telesketch goes into 'idle' mode. Idle, in this case, means that it can transmit and receive files to and from another Telesketch without any intervention from the user. By switching the unit into Auto-on' mode, the user can 'program' the machine to send a file at a preset time. This is done by storing a file in the system's catalogue, along with a time at which it is to be transmitted. A file need not consist only of text but can also be graphics, or a mixture of the two.

Lifting the light pen or hand-set switches the system into 'phone' mode. The screen changes to display a telephone touch-pad, volume control for the speaker, a directory of telephone numbers, a 'soft' keyboard for data entry using the light pen, and a menu along the bottom of the screen.

When in phone mode, Telesketch can be used in the same way as a normal phone with the additional facility of being able to send both graphics and text using a 'send' option. Unlike a normal phone, a number can be dialled onscreen using the touch-pad and light pen, or via the hand-set. To save time, numbers can be entered into the machine's telephone directory from the soft keyboard. Up to 40 numbers can be stored in the machine's battery-backed static RAM, being retained even when the machine is switched off. A number stored in this way can be automatically dialled by touching the appropriate box in the directory. If a number is engaged, a retry option enables Telesketch to redial the number up to 16 times at intervals of 30 seconds.

As mentioned, Telesketch features an onboard modem. By dialling up a public database and switching to terminal mode when the tone is heard, Telesketch can be used just like any other telephone and modem.

Both Bell 202 and CCITT V23 transmission requirements are supported, so bulletin boards cannot only be dialled within Europe, but in the US too. Both 300 and 1200 baud are supported by the modem, the latter not only being useful for logging onto boards such as Prestel, but also for talking to other Telesketches.

At the time of publication the Telesketch had not received BT approval, although there were no foreseeable problems as to why it should not.

Operation modes

The menu at the bottom of the screen in phone mode gives access to five modes of operation: phone, draw, text, file and terminal.

In draw mode you can create pictures to send to other Telesketch users. The obvious machine to compare the Telesketch's graphics facilities with would be the Macintosh, as they are both in the same price bracket. However, close inspection shows that the two are worlds apart, each being equipped for very different uses. Whereas the Mac gives the 'arty' user full range with its different textures, paint sprays and so on, most of Telesketch's tools are based on simple mathematical figures, such as the square and the circle, and are orientated to the technical rather than the home/business market.

Just as in phone mode, all the various
drawing tools are selected from a menu along the bottom of the screen. Where-as Macintosh users have a mouse to control the cursor, the Telesketch uses one of the most accurate light pens on the market, resolving to plus or minus half a pixel. And when you consider that graphics can be drawn straight onto the screen with a greater degree of accuracy, it is a wonder how the mouse has become so successful.

True, we've all heard the reasons given by the big guns, such as Apple and Microsoft, as to why they have chosen to adopt the mouse rather than a light pen; the most obvious one being that it is more comfortable to use. But even this is overcome by the Telesketch's screen size. Every corner of the screen can be reached with the elbow resting on the desk, so there is little chance of contracting pins and needles when you make a mistake, single pixels or whole blocks can be removed with the aid of some near erasing functions.

The fifth and final mode, 'terminal', literally turns the Telesketch into a stand-alone computer, utilising either Basic or Forth as its language. Unfortunately, terminal mode was not fully implemented on the evaluation model, although the functions available are no less than you would expect to find on a machine in this price bracket. One very Mac-ish feature is the inclusion of an onscreen calculator, which can be operated using the light pen. There is also a direct connection mode which allows the Telesketch to be linked to a mainframe via a bi-directional RS232 interface, some powerful editing functions and a terminal mode which uses the built-in modem.

Conclusion

As it stands, the Telesketch is an excellent little machine although it is overpriced, even with its impressive specification. Several enhancements, including floppy disk operation software (the hardware is already fitted), bubble-pack software (the hardware is already present), a 640 x 480-resolution monitor, colour, a video digitiser, and various ROM-based packages, are planned. But until these are available, the Telesketch could have a very limited market in the UK.

Anyone who is interested in becoming a Telesketch dealer/distributor should contact Andrew Sheldon on (06928) 2468.
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F Plus low cost dot matrix printer with 105 cps print speed, is compatible with Epson FX 80; and with its unique paper handling and stacking system the Riteman F Plus uses the minimum of space in operation.

**Riteman**
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**Riteman**
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**Riteman**
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£399 TURNS YOUR BRAINBOX INTO A REAL CHATTERBOX!

Computers are like people. They can learn from each other. But first they have to communicate. If your computer keeps itself to itself, why not introduce it to the Chit-Chat Communications Pack from Sagesoft?

Chit-Chat is a versatile data communications program that opens up a whole new range of possibilities. Data can easily be transferred, even between incompatible machines, either by direct cable connection, or by telephone, using a modem.

Chit-Chat also gives you access to electronic mail systems such as Telecom Gold, Easylink, and One-to-One plus viewdata services like Prestel. The program is simple to understand, easy to learn and use, and is currently available on IBM PC and compatibles, Apricot, Wang PC and Sharp 5600, with many more to follow.

The Chit-Chat Communications Pack at only £399 + VAT, includes the Chit-Chat program, a state-of-the-art modem, specially made to Sagesoft specifications by Thorn-EMI Datatech. No knobs or switches, just sleek good looks and simple, error-free operation. Autodial and autoanswer facilities are incorporated and the unit is entirely software controlled. An RS232 cable and power pack are included in the package.

Chit-Chat software is also available without hardware.
Within the close-knit tribe of Cambridge computer entrepreneurs, the name of Martin Vlieland-Boddy continually occurs. Joint founder of Torch only a few years ago, he fell out with the financiers and left to set up Data Technologies Ltd, a small design and development company, whose first significant product was the Graduate. Data Technologies first advertised it a year ago, then — silence! No product appeared on dealers' shelves.

Delay-shocked users of BBC Micros had already been rescued once by Torch, whose Z80 second processor reached the showrooms long before its 'official' Acorn rival. Once again, Torch played the knight in shining armour.

The Torch range of micros begins with a small Z80 board which fits inside a standard BBC computer, giving CP/M capability and 64k of memory. It ends with a stylish business machine that hides enormous power: a massive 20Mbyte hard disk, coupled with a Motorola 68000 processor capable of running substantial multi-user systems; multi-tasking Unix and other high-power languages; and up to 1Mbyte of RAM.

However, there is still a lack (at least in the UK) of business applications software on Unix. Torch has hitherto deftly avoided challenging the giants in the MS-DOS arena. This policy has kept the company small but healthy. It has also left a noticeable gap in the product range: none of its products could run the 'sexy' executive software that has sprung up around the IBM PC — programs like Lotus, Framework, Symphony and dBaseII. It was into this cavernous hole that the Graduate, with an MS-DOS operating system (so close to IBM's PC-DOS as to be virtually indistinguishable), and with quantities of random memory or memory expansion slots, fitted neatly.

Then Torch too misjudged how long it takes to convert a good design into stacks of boxes on dealers' shelves. It allowed advertising to continue and soon had a flood of orders — but no Graduates. It is now available without delay and has 256k of RAM, two 320k (formatted) disk drives, no variations and, bundled with an excellent suite of integrated Psion Xchange software, it sells at £999.99 plus VAT.

**Hardware**

The Graduate is a 6in-high steel box, 10ins wide and 16ins deep, in the front of which are dual Cannon disk drives. It is solidly constructed and pleasantly finished in two-tone hammer grey, and the top cover easily removes to permit service access. Inside are the disk drives. In operation these made a slight clanking sound. On one occasion a disk did not eject, but proved easy to ease out with fingers. Torch tells me that present production machines are using quieter, Epson disk drives. There is also a separate power supply (no more problems with the BBC overheating) and an acceptably silent cooling fan. A single, enormous, motherboard bears the 8088 16-bit processor running at 5MHz, and an array of RAM chips (the 256k can increase, with a standard expansion board, to 640k — adverts quoting 1.2Mbytes were in error); and two welcoming expansion slots. While this is less than the five on the IBM PC itself, Torch points out that, unlike the PC, you do not need to tie them up with colour graphics or printer ports: these are all provided by the BBC.

Access to the motherboard is restricted by the disks above it, but would only be required for repairs. The expansion slots are readily accessible. A good feature is that the unit will operate as well on its side (with the disk
when which means you are down to virtually the bottom three as a 'status area', the top five lines as a 'control area' and Xchange suite, for example, likes to use that repeat either all or part of the last cursor, so useful for copying text from directory across the screen width and DIR for directory (equivalent to the DOS so, although many, such as COPY this problem has been overcome.

box and having to come across the screen scrolling is due to the screen and eventually signals an error mes-

sions of the keyboard and larger restric-

ions on the graphics. The former are

easily overcome by simple combina-

tions of keys with SHIFT and CONTROL, and are therefore insignificant. The screen was quite another matter.

The worst loss was of colour for serious applications software. The Graduate inherits the BBC Micro's inability to provide more than black and white in 80-column mode. In the past this was sufficient: serious business users stuck to monochrome because colour screens were too blurred. Although the IBM PC offers 16 colours in 80-column mode, only four of them can be onscreen at any time and users have accepted this. Now, with high-resolution screens at modest cost, all the former likely to go out and buy an IBM clone, such as the Ferranti Advance, which will apparently run anything which runs on the IBM PC, even the screen-related programs such as Flight Simulator. But the Acorn model comes with a 6845 video generator in the memory of the 8088 chip, cannot be run.

But for serious business use, on a monochrome screen, I found little restriction. As well as Perfect II and Xchange is the most likely customer. For him there are three alternatives:

- To buy the Acorn Z80 package, with its 6845 video generator chip inside the BBC Micro. The IBM PC uses an identical chip. Its operation is control-

led by an address register and a data register in the computer's main mem-

ory. However, with the Graduate sys-

tem, the memory for the BBC's 6502 processor is quite separate from the memory of the 8086 second processor that makes it 'IBM-ish'. Programs such as MS-DOS MS-DOS operating system from disk. If no disk is present it looks down the 1MHz bus, becomes confused, waits and eventually signals an error mes-

sage. Put in the right disk and it boots.

MS-DOS forthwith. Press the BREAK key and it automatically re-boots. Jerky screen scrolling is due to the screen memory all being held in the Graduate box and having to come across the 1MHz bus; however, Torch informs me that this problem has been overcome.

The commands are standard MS-

DOS so, although many, such as COPY and DEL, are familiar, others will be a little strange to BBC users. For example,

DIR for directory (equivalent to the BBC's CAT), while DIR/W spreads the directory across the screen width and stops it scrolling. BBC users will miss the Beeb's twin (text and graphics) cursor, so useful for copying text from higher up the screen. MS-DOS has only one cursor but offers instead soft keys that repeat either all or part of the last command typed in, which I found most inferior.

But what I grieved for most of all was the BBC's 32-line deep screen. MS-DOS uses the pitiful IBM standard of only 25 lines and, with some software, even all this is not available. Psion's Xchange suite, for example, likes to use the top five lines as a 'control area' and the bottom three as a 'status area', which means you are down to virtually half a screen for text—quite inadequate when rapidly scrolling through a spreadsheet or trying to edit text. Using Perfect Writer's split screen, an invalu-

able feature, I was left with text areas no more than 10 lines deep. Very restrictive.

My other grouse is the lack of speed. It is not just the Graduate: a PC or a Compag would be the same. MS-DOS on floppy disks is an awfully slow system. First there is the dreadful disk shuffling. Even the simplest command, such as COPY (a file from one disk to another) requires that MS-DOS has been loaded. I have become used to Torch's Z80 second processor, which employs a CP/M lookalike known as CPN. This holds the most vital com-

mands in ROM so they are there at switch-on, even if no disks are in use. It also squeezes 400k from a double-sided floppy so I grieved for the loss of both time and disk capacity. In practice, to save 'shuffling time', you would write an MS-DOS batch file to load automatic-

ally and also copy the essential file (called COMMAND.COM) onto virtually every disk in use, which would im-

mediately absorb 16 or more Kbytes of the (already modest) 360k capacity disks.
John Dallman introduces the BCPL language, and gives an overview of its basic contents and usage with the help of comparison Benchmark results for the BBC and QL.

The imminent arrival on the QL of BCPL makes this an ideal time to reassess Acorn’s BBC implementation — and indeed to introduce any unfamiliar readers to the power of one of the first portable programming languages.

BCPL is intended for use in writing ‘systems’ programs such as assemblers, compilers and operating systems. It was one of the first languages designed for this, and the better-known C language was developed from it.

BCPL is similar to C although much simpler, and forms a good introduction to it while also being rather easier to implement on a micro. Versions are currently available for the BBC Micro, the QL, and for CP/M-80, as well as many mini and mainframe computers.

BCPL is highly portable, and programs can generally be run almost unchanged on different machines.

Of the languages widely known among micro users, BCPL most closely resembles Pascal as a structured language used via a compiler rather than an interpreter. It differs, however, from Pascal in one fundamental respect: where Pascal has several ‘types’ of data (for example, integer numbers, real (floating point) numbers, Booleans (logical values) and character strings) and prevents their mixing, BCPL has only one data type, the word. This is conceptually defined as simply a group of bits, of a size defined by the computer in use. In practice, it occupies several adjacent bytes of memory, and can be considered as a binary number.

Words usually occupy 16, 24 or 32 bits, depending on the computer in use. The contents of a word can be considered as an integer, as a logical value, or as a ‘pointer’. As a pointer, the word holds the address of another word or a group of words (a vector). As a pointer can point to other pointers, this allows grouping of data in a manner very similar to the arrays used in other languages. While the contents of a word can take many meanings, these exist only in the mind of the programmer, and the language does not enforce them or even know of their existence.

This almost gives the power of assembly language while retaining the virtues of high-level code.

Programming

A BCPL program consists of a set of procedures, and starts executing at the procedure START. A very simple BCPL program is therefore:

```
LET start () BE
$!
LET a,b,c = 3,4,?
WRITES("Sum of 3 & 4 is ", a + b)
LET a,b,c = 3,4,?
$!
```

Variables and procedures are both declared with LET, and variables may be given initial values (here, a is given the value 3 and b is 4), or left undefined as c is in its declaration here. The standard library procedures WRITES and WRITEN are used to output strings and numbers. Note that ‘:=’ is used for assigning a value to c, as opposed to the ‘=’ of Basic. The section brackets ‘$!’ and ‘$!’ are used, like ‘BEGIN’ and ‘END’ in Pascal, to group commands together.

As well as normal arithmetic, BCPL provides remainder and shift operations such as those found in assembly language. Floating point numbers and operations are not part of the basic language, but are provided as groups of library procedures. BCPL is not intended for number-crunching, and these operations are not usually used in systems programming.

A vector of words can be declared as a variable:

```
LET atoz = VEC 26
```

or, for large vectors, by a library procedure, GETVEC. This requests an area of memory from a memory management system:

```
LET atoz = GETVEC(256)
```

The variables ‘atoz’ and ‘allchars’ in these examples hold the address in memory of the first word in the vector; the individual words are addressed by the indirection operator ‘!’.

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$!
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Variables and procedures are both declared with LET, and variables may be given initial values (here, a is given the value 3 and b is 4), or left undefined as c is in its declaration here. The standard library procedures WRITES and WRITEN are used to output strings and numbers. Note that ‘:=’ is used for assigning a value to c, as opposed to the ‘=’ of Basic. The section brackets ‘$!’ and ‘$!’ are used, like ‘BEGIN’ and ‘END’ in Pascal, to group commands together.

As well as normal arithmetic, BCPL provides remainder and shift operations such as those found in assembly language. Floating point numbers and operations are not part of the basic language, but are provided as groups of library procedures. BCPL is not intended for number-crunching, and these operations are not usually used in systems programming.

A vector of words can be declared as a variable:

```
LET atoz = VEC 26
```

or, for large vectors, by a library procedure, GETVEC. This requests an area of memory from a memory management system:

```
LET atoz = GETVEC(256)
```

The variables ‘atoz’ and ‘allchars’ in these examples hold the address in memory of the first word in the vector; the individual words are addressed by the indirection operator ‘!’.

```
LET start () BE
$!
LET a,b,c = 3,4,?
WRITES("Sum of 3 & 4 is ", a + b)
LET a,b,c = 3,4,?
$!
```

Variables and procedures are both declared with LET, and variables may be given initial values (here, a is given the value 3 and b is 4), or left undefined as c is in its declaration here. The standard library procedures WRITES and WRITEN are used to output strings and numbers. Note that ‘:=’ is used for assigning a value to c, as opposed to the ‘=’ of Basic. The section brackets ‘$!’ and ‘$!’ are used, like ‘BEGIN’ and ‘END’ in Pascal, to group commands together.

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```
LET atoz = VEC 26
```

or, for large vectors, by a library procedure, GETVEC. This requests an area of memory from a memory management system:

```
LET atoz = GETVEC(256)
```
File a.nlm:
SECTION "MULTIFIER" // Benchmark 1
GET "TSTHDR" // Declare library
LET START: BE
#1
LET a = ?
ARCH('S')
FOR count: 1 TO 10000
DO
#1
ARCH('E')
ARCH('N')

Benchmark 1

File a.nlm:
SECTION "FOR.LOOP" // Benchmark 2
GET "TSTHDR" // Declare library
LET START: BE
#1
LET a = ?
ARCH('S')
FOR count: 1 TO 10000
DO
#1
ARCH('E')
ARCH('N')

Benchmark 2

File a.nlm:
SECTION "WHILE.LOOP" // Benchmark 3
GET "TSTHDR" // Declare library
LET START: BE
#1
LET a = ?
ARCH('S')
FOR count: 1 TO 10000
DO
#1
ARCH('E')
ARCH('N')

Benchmark 3

File a.nlm:
SECTION "REPEAT.LOOP" // Benchmark 4
GET "TSTHDR" // Declare library
LET START: BE
#1
LET a = ?
ARCH('S')
FOR count: 1 TO 10000
DO
#1
ARCH('E')
ARCH('N')

Benchmark 4

would recognise lower-case ASCII characters, convert them to upper case, and keep a count of the number converted.

BCPL also provides a range of structured loop forms which are best illustrated by the Benchmark examples, and a CASE statement.

Character strings are stored in a special fashion in BCPL. They are packed into words, as many bytes in a word as will fit. The words form a vector. The zero'th byte in the string holds the length of the string, and they are therefore normally at most 255 characters long. A variable may be attached to a string:

string.name := "I'm a string" and holds the address of the first word of the vector holding the string. Strings are manipulated either by procedures, usually called GETBYTE and PUTBYTE, or by the '%c' operator. This is just like the '/' operator, but accesses a vector in terms of bytes rather than words. For example:

ch := "another string" %4
puts the ASCII value of 't' into the variable ch, as would:

ch := string.var %4

the two pieces of code having exactly the same effect.

Procedures are called by name, followed by a list of parameters in brackets. Like BBC Basic, copies of the values of parameters are passed, but there is no check on the number of parameters passed. Vectors can be passed simply by passing their address, and the address of a simple variable can be passed using the '@' operator which returns the address of its operand. Therefore:

a := 44

puts 44 into b by using the address in a. Procedures may be called recursively, and functions may be created.

Input and output in BCPL are achieved through procedures which manipulate I/O channels (called streams) in a manner similar to most micros. There is at any time a single input and single output stream in use, although many streams may be used by a program one at a time. Random access filing is not part of the standard language, but a standard form exists for a set of procedures to provide it.

In use
An important concept in the design of BCPL is a mechanism for linking together sections of a program compiled in several pieces. This is done by means of the 'global vector', a vector provided by the language system rather than being created by the programmer.

This vector holds the start addresses of procedures that have been made global. This is done by declaring the name of the procedure and allocating it a word of the global vector to hold it's address, thus:

File a.nlm:
SECTION "NO.PARAMETERS" // Benchmark 5
GET "TSTHDR" // Declare library
LET proc(): BE
#1
RETURN
#
LET START: BE
#1
LET a = ?
ARCH('S')
FOR count: 1 TO 10000
DO
#1
ARCH('E')
ARCH('N')

Benchmark 5

File a.nlm:
SECTION "ONE.PARAMETER" // Benchmark 6
GET "TSTHDR" // Declare library
LET proc(param): BE
#1
RETURN
#
LET START: BE
#1
LET a = ?
ARCH('S')
FOR count: 1 TO 10000
DO
#1
ARCH('E')
ARCH('N')

Benchmark 6

File a.nlm:
SECTION "MANY.PARAMETERS" // Benchmark 7
GET "TSTHDR" // Declare library
LET proc(a,b,c,d,e,f,g,h,i,j): BE
#1
RETURN
#
LET START: BE
#1
LET a = ?
ARCH('S')
FOR count: 1 TO 10000
DO
#1
ARCH('E')
ARCH('N')

Benchmark 7

File a.nlm:
SECTION "CONS.TO.STACK" // Benchmark 8
GET "TSTHDR" // Declare library
LET START: BE
#1
LET a,b = ?
ARCH('S')
FOR count: 1 TO 10000
DO
#1
ARCH('E')
ARCH('N')

Benchmark 8

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SCREENTEST

GLOBAL $(this.procedure: 100)$ allocates word 100 of the global vector to hold the address of the procedure 'this.procedure'. Procedures from the library supplied with the language are allocated specific words within the global vector, so that the program only has to know which word they are allocated to rather than containing the source code of all the library procedures it needs.

The global declarations required in a program are normally put into a header file, which can be included by the compiler, with the 'GET' directive. The way in which a program indicates which library procedures it needs, and which other sections of the program are required, is dependent on the implementation. The language defines a way of giving a section of program a name with the SECTION directive as illustrated in the Benchmark programs, so that it can be selected from a library itself.

The language is intended to be portable, and this is made easier by the provision of a standard compiler. This is written in BCPL and produces an intermediate code called O-code. To move the language to a new machine from one on which it is already available, it is only necessary to write a back-end for the compiler to generate the appropriate machine code from the O-code, in BCPL. The compiler can then compile a version of itself to run on the new machine. (This route was followed by the implementors of both systems reviewed here).

Benchmarks

The Benchmark suite featured here was designed to test the major constructs of the language in a similar way to the Basic (January 1985) and Pascal (December 1984) Benchmarks used by PCW. Like the Pascal Benchmarks, they are for 10000 loops. The raw Benchmark figures are strongly influenced by the time for the FOR loop construct, which is a legacy of the original Basic Benchmarks. In both BCPL and Pascal the other loops are used at least as frequently, and more meaningful results can be obtained by subtracting the MAGNIFIER or FOR.LOOP times from other Benchmark values.

In comparing the BBC and QL Benchmark results (Fig 1), it should be noted that the BBC not only has a far less powerful CPU but is running an inter-
pretre, while the QL is running 68008 machine code directly. The BBC’s interpreted language is Cintcode, the machine code of an imaginary 16-bit processor optimised for running BCPL, and is similar in essence to Pascal
p-Code as used in the UCSD p-System.
The QL is, accordingly, considerably faster, notably in looping and con-
titional tests. The advantage is less
marked in data moves and procedure
calls, and surprisingly small in arithme-
tic. These Benchmarks can be affected

by the compiler’s ability in optimising, but in the STACK.ARITHMETIC Ben-
chmark, which is most resistant to this, the QL is only 2.5 times faster. Admit-
tedly it is doing 32-bit arithmetic, but
there are hardware multiply and divide
instructions on the 68008 which should
more than restore that disadvantage.

Accessing program sizes is rather
difficult, given the different operating
systems on the two machines. Differ-
ences, rather than absolute sizes, are
again more useful. Cintcode is intrinsi-
cally more compact than the 68008
instruction set as all the operation
codes are one, rather than two, bytes
long, and only 16-bit rather than 32-bit
addresses and embedded within the
code. The code sizes given exclude
procedure libraries required to run the
program.

Both compilers include the names of
sections and of each procedure in the
final code as text strings (10 bytes on
the BBC, eight on the QL) for use in
debugging. If space is short, they can be
compiled out on the BBC.

No figures have been given for
compilation times as these depend on the
filing system in use. Compiling
between Microdrives is very slow, but
disks or RAM expansion will improve it.
The BBC has no standard disk drive,
and there was no point in giving times for
my own rather slow system.

Implementations

Acornsoft BCPL
This was created by Richards Computer
Products Ltd for Acornsoft, and is
marketed as a BBClanguage ROM and a
utility disk. The language ROM contains
the Cintcode interpreter and a pro-
cedure library, while the disk holds the
BCPL compiler, two editors, further
libraries, debugging utilities, an

assembly and example programs. A
front-end environment from which
programs may be run and operating
system commands used is provided,
along with some utility commands, by
the language ROM.

The linkage of programs from separ-
ately compiled sections is rather un-
usual. Cintcode is stored in a relocat-
able form, and is located by the
language ROM (and linked to the global
vector) when a program is loaded.
Consequently, sections are ‘linked’ by
the user who is copying them into the
same file without internal changes
being made in them. If a few sections
are to be extracted from a large library,
the NEEDS compiler directive can be
used to mark the required sections in
the source file, and a utility program
(NEEDCIN) supplied with the system
can be used to automatically extract
them. There is no need to do this for
procedures in the language ROM’s
library as they are automatically avail-
able as needed.

As programs are stored in relocatable
form, several can be stored in memory
at once at different addresses. The
BCPL language ROM provides a mem-
ory management system that allows
this and, in addition, the use of RAM
for ‘store files’, forming a very small silicon
disk. This is invaluable when used with
the batch file system supplied with the
language, which allows compilations
and program building to be reduced to
single commands.

An assembler, written in BCPL, is
provided to allow assembler sub-
rectories to be easily included where
Cintcode is not fast enough. Assembler
routines can appear to be BCPL proce-
dures, therefore easing integration.

The debugging utilities supplied are
very complete, providing all the facili-
ties of a first-class machine code
monitor, together with tracing and
statistics collection for program opti-
misation. Facilities are also provided
for examining the memory manage-
ment and I/O systems provided by the
BCPL ROM. The Cintcode interpreter
incorporates ‘hooks’ for these facilities,
and includes low-level error detection
for program corruptions, or calls to
non-existent procedures.

Several add-on packages are avail-
able for this implementation. They include
a stand-alone system, which
provides the Cintcode interpreter and
libraries to allow programs to run
without the BCPL ROM. This provides
facilities for packaging BCPL programs
as language and utility ROMs, as well as
disk or cassette-based programs. A
floating point procedure set and ran-
don access filing procedures are also
available.

The system works with the 6502
second processor, taking advantage of
the additional memory. Disks or Econet
are required to use the system effec-

tive.

‘BCPL is intended for use in
writing ‘systems’ programs
such as assemblers,
compilers and operating
systems. It was one of the first
languages designed
for this and the better
known C language was
developed from it.’

Benchmark

Benchmark 17

<table>
<thead>
<tr>
<th>Benchmark</th>
<th>Time (sec)</th>
<th>Code (bytes)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Magnifier</td>
<td>BBC: 5.1</td>
<td>QL: 0.4</td>
</tr>
<tr>
<td>For loop</td>
<td>BBC: 54.7</td>
<td>QL: 62</td>
</tr>
<tr>
<td>While loop</td>
<td>BBC: 44.7</td>
<td>QL: 70</td>
</tr>
<tr>
<td>Repeat loop</td>
<td>BBC: 39.3</td>
<td>QL: 70</td>
</tr>
<tr>
<td>No parameters</td>
<td>BBC: 8.5</td>
<td>QL: 76</td>
</tr>
<tr>
<td>One parameter</td>
<td>BBC: 9.1</td>
<td>QL: 132</td>
</tr>
<tr>
<td>Many parameters</td>
<td>BBC: 14.7</td>
<td>QL: 88</td>
</tr>
<tr>
<td>Const to stack</td>
<td>BBC: 6.3</td>
<td>QL: 64</td>
</tr>
<tr>
<td>Stack to stack</td>
<td>BBC: 7.3</td>
<td>QL: 66</td>
</tr>
<tr>
<td>Const to stack vector</td>
<td>BBC: 61.6</td>
<td>QL: 84</td>
</tr>
<tr>
<td>Const to heap vector</td>
<td>BBC: 64.7</td>
<td>QL: 156</td>
</tr>
<tr>
<td>If true</td>
<td>BBC: 72.3</td>
<td>QL: 68</td>
</tr>
<tr>
<td>If false</td>
<td>BBC: 64.6</td>
<td>QL: 78</td>
</tr>
<tr>
<td>Test true</td>
<td>BBC: 80.2</td>
<td>QL: 82</td>
</tr>
<tr>
<td>Test mixed</td>
<td>BBC: 76.9</td>
<td>QL: 82</td>
</tr>
<tr>
<td>Stack arithmetic</td>
<td>BBC: 18.2</td>
<td>QL: 70</td>
</tr>
<tr>
<td>Const arithmetic</td>
<td>BBC: 17.4</td>
<td>QL: 70</td>
</tr>
</tbody>
</table>

Mean: 40.0 4.2

Times are means of 10 runs, timed by stopwatch

BBC: standard BBC B, code sizes are disk file sizes. Acornsoft/RCP BCPL, 16-bit word, compiler version 2.2, ROM version 7.0.

QL: Sinclair QL, code sizes are as reported by linker as QDOS will not give accurate file sizes. Metacomco BCPL, 32-bit word, pre-release version.

Fig 1 Comparison BCPL Benchmark results for the BBC and the QL.
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tively unlike the QL.

The documentation supplied does not teach BCPL, but it describes the system supplied very thoroughly and legibly. Some unusual library procedures provided with the system include: MOVE, a fast memory block move; RDARGS, a command-line interpreter; and calls to the memory management system to enable programs to use store files easily. Multi-tasking is not provided, but the BCPL extension for 'coroutines' is. This allows a program to readily swap between two tasks. A Cintcode BCPL is also available from Richards Computer Products for CP/M systems. Compiled Cintcode programs are interchangeable between the two systems, provided only the library procedures available on both are used.

Metacomco BCPL for the QL
This is very similar to the BBC implementation, within the constraints of the two machines. The portable BCPL compiler was the starting point for both systems, and the same screen editor is provided with both packages. The editor is written in BCPL; it is intended for use in programming rather than word processing, and is excellent for the job. It has recently been adopted by Sinclair as the standard QL editor for software development.

Unlike Acornsoft BCPL, which provides a programming environment, this implementation works within the machine operating system, QDOS, generating 68008 machine code programs in a form that can use QDOS multi-tasking properly. This is a very simple way of exploiting the power of the QL in a way that QL SuperBasic fails to do. The usefulness of the system is well-illustrated by the fact that Metacomco’s assembler, Lisp and Pascal packages have been written with it.

The package is supplied on Microdrive, containing the compiler, editor and a linker. This is much more of a bare-bones implementation than the BBC implementation, and lacks the other system’s plethora of utilities. The one important lack is debugging facilities, although of course any QL debugger may be used on the machine code produced by the system. It seems intended as a part of a software production system, rather than a system on its own.

It is compatible with the Metacomco assembler, and linking code produced by the two is simple. A notable advantage over the use of assembler within the QL system is that BCPL routines, notably the input and output procedures, may be called from within the code written in assembly language.

Memory management is provided by QDOS, which allows SuperBasic programs to co-exist with BCPL code, and to be executed as a batch command system.

The draft documentation I’ve seen is not as massive as that on the Acorn system, but perfectly adequate. The library includes floating point and random access filing extensions, rather than these being provided as add-ons at extra cost.

Conclusion

Simply comparing the two language packages is impossible, as the machines they run on are so different. Both form very powerful development systems for systems software, and seem quite robust.

The packages have considerable potential to be used together, with program modules being written on a BBC machine, and tested there, being able to use disk, as opposed to Microdrive, storage and the Cintcode debugger. When operational, they can be transferred to a QL by the RS232 serial link and re-compiled there. Some work needs to be done building compatible graphics libraries for the two machines, but procedures to access the operating system functions are adequate in both systems to do this.

BCPL products

Books
The definitive book on BCPL is BCPL — the language and its compiler, by Martin Richards and Colin Whitby-Stevens, published by Cambridge University Press. It is also accessible to anyone with a basic knowledge of programming, and is highly recommended. Acornsoft is to produce an introductory book, Beginning BCPL on the BBC Microcomputer.

Software
For the BBC/Acorn from Acornsoft, (0272) 216039: BCPL language system, (ROM, disk and manual), £59.80; manually separate, £15.00; BCPL stand-alone system (allows programs to run without ROM), £49.90; BCPL calculations pack (high-precision floating and fixed point maths), £19.90.

For the Sinclair QL from Metacomco, (0272) 428781: BCPL language system (Microdrive cartridge and manual), £59.90.

Thanks to Richards Computer Products Ltd and Metacomco Ltd for their help and advice with the writing of this article.
There’s more than one way to interface a BBC Micro and an Apple, but in this method only one piece of additional hardware is needed — a connecting lead. Gavin Haines explains.

If you already own one micro, you need a good excuse to buy another. When the Apple first appeared it only had a 40-column screen and no lower case. The BBC Micro by contrast has 80 columns, upper and lower case, as well as high-resolution graphics.

You can buy an additional graphics processor and 80-column boards for the Apple, but these can easily cost as much as a BBC Micro. Why not buy a BBC Micro and use it as a graphics and 80-column terminal? Your Apple can also be your BBC Micro’s second processor.

There isn’t anything new in the idea of the second processor: there are numerous additional circuit boards available for machines such as the Apple and IBM PC. On the BBC Micro, the second processors come in a separate box. The only disadvantage of owning a ‘second micro’ as opposed to a ‘second processor’ is that you will have two keyboards, which is a more visible extravagance and is harder to justify than a plug-in circuit board.

When you have accepted that the idea of owning two machines is not so bad, possibilities begin to suggest themselves. As the BBC Micro and the Apple are both 6502 machines, you immediately have cross-assembler facilities. With the DOS toolkit assembler, for example, you can create a source file of 1000 to 1500 fully-commented lines. This is about 30k, compared to 32k total RAM on the BBC Micro.

You can implement multi-tasking: while your assembler listing is being printed, you can continue working on the other machine. Another bonus is that BBC programs can be saved to Apple disks. (These considerations could apply to any two machines.)

Interfacing options

When you have your BBC Micro, how do you go about hooking it up to the Apple? There are several alternatives. The easiest (and most expensive) option is to buy a network adaptor for each machine. The software is already written, and you have your own private network to experiment with.

The next option is to buy an RS232 communications interface card for the Apple. The BBC Micro already has an RS232 interface, so you only need additional hardware at the Apple end. However, an additional card is a further expense which uses up another slot in the Apple. How can you interface an Apple to a BBC Micro without using extra hardware?

The BBC Micro has a 6522 VIA (versatile interface adaptor) configured as a user port; the Apple has a games paddle socket. The sockets on both machines provide input and output lines at TTL (transistor-transistor logic) levels — about 5 volts. All you need to interface the two machines is a length of insulation displacement cable and software. The wiring arrangement is shown in Fig 1.

The old Apple reference manual, The Red Book, contains a program to drive a teletype via the games paddle socket. This suggests a possible solution: each computer could treat the other as if it were a printer, with similar programs at...
The Apple games paddle socket has three push-button inputs — SW0, SW1 and SW2 (see Fig 1). When you press the button on your paddle, the line goes high. There are four games controller inputs called GC0, GC1, GC2 and GC3; these are used to measure changes in voltage when you turn your paddle, and can be dismissed from consideration as data inputs. Next, there are four output ‘annunciators’ — AN0, AN1, AN2 and AN3. So, there is the possibility of using four outputs and three inputs.

Most interface circuits work at a fixed baud rate, with zeros and ones transmitted at certain voltages. Such interfaces are easily implemented with a few ICs (integrated circuits), but if your skills are more in the software direction you can create an interface which does not cost anything.

If you hold an Apple games paddle in each hand, you can transmit bytes to the machine by depressing the buttons in a certain sequence — get the other machine to do the button-pushing and you've got your interface. You could, of course, use any transmission code, but it makes sense to use ASCII. It's possible to transmit text files with a seven-bit code, but it's wiser to use eight bits.

You can transmit data from the Apple by toggling the annunciators. However, at this point you can run into difficulties. Firstly, the information given in the Apple II reference manual is incorrect. This is the actual position:

<table>
<thead>
<tr>
<th>Annunciators</th>
<th>Decimal</th>
<th>Hex</th>
</tr>
</thead>
<tbody>
<tr>
<td>AN0 OFF</td>
<td>49241</td>
<td>C059</td>
</tr>
<tr>
<td>ON</td>
<td>49240</td>
<td>C058</td>
</tr>
<tr>
<td>AN1 OFF</td>
<td>49243</td>
<td>C05B</td>
</tr>
<tr>
<td>ON</td>
<td>49242</td>
<td>C05A</td>
</tr>
<tr>
<td>AN2 OFF</td>
<td>49245</td>
<td>C05D</td>
</tr>
<tr>
<td>ON</td>
<td>49244</td>
<td>C05C</td>
</tr>
<tr>
<td>AN3 OFF</td>
<td>49247</td>
<td>C05F</td>
</tr>
<tr>
<td>ON</td>
<td>49246</td>
<td>C05E</td>
</tr>
</tbody>
</table>

Inputs

<table>
<thead>
<tr>
<th>PB0</th>
<th>49249</th>
<th>C061</th>
</tr>
</thead>
<tbody>
<tr>
<td>PB1</td>
<td>42950</td>
<td>C062</td>
</tr>
</tbody>
</table>

You can change the setting of the annunciator soft switches by executing any instruction which merely reads these locations. This has several consequences, the main one being that it is possible to determine the setting of a given line by software. You can only keep a record of the state of the switch somewhere else in the program.

There is another snare with the 6502 itself. An indexed instruction which crosses a page boundary generates a false read. Unlike the writers of BBC Basic, the authors of Applesoft (Apple Floating Point) Basic used many indexed loops. Also, there are some instances where a page boundary is crossed; the most annoying occurs with the CHR$ function, as it generates a false read in the region C000-CFFF (hex). This is the area of the Apple’s memory-mapped I/O.

The false read can toggle the annunciators and mess up your interface, so you must be prepared for everything to go dead once in a while.

There are three answers to this. The first is to include error checking and error recovery software, the second is to put up with it. The third is to fit a CMOS 6502 (which does not have this problem) to your Apple. The Rockwell 2MHz version does work, at least in the Apple: it doesn't work in some BBC Micros. The Acorn 6502 second processor is fitted with the GTE 3MHz version.

At the BBC end of the interface, the Model B is fitted with a 6522 VIA. This contains 16-bit interval timers, serial to parallel shift registers, and it can also be programmed to cause an interrupt. But, since there is no equivalent hardware at the Apple end, you don't need to use all these facilities.

The VIA B (that is, the user VIA) is used to provide the BBC Micro user port. There are eight data lines, PB0 to PB7, and two handshake lines, CB1 and CB2. As the Apple does not have facilities for handling interrupts, CB1 and CB2, the
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The easiest solution is to initialise both programs do not use them. How do you get the interface to work?

In use

In use

The easiest solution is to initialise both the Apple and the BBC Micro to a known state, and then send a signal byte — all ones, all zeros. Once the other machine knows which bit is the first bit of the first byte, the other bytes follow in sequence. But if something goes wrong in this process, you get gibberish on the screen. To keep it simple, the software assumes that the BBC Micro is calling the Apple, and you have to run the BBC program first.

The BBC Micro user port is located at &FE60. The data direction register (DDR) is at &FE62. To designate a line as an output, you store a corresponding 1 in the DDR (there is an example in the user guide, pages 468-9). But like the Apple reference manual, the BBC Micro user guide is slightly misleading. It implies that all code routines must be written so that they will work over the 'tube', but using OSBYTE routines to write to SHEILA as the user guide suggests is very complicated, and execution time is considerably increased. Furthermore, a program which is running in the second processor cannot service interrupts generated by devices connected to the BBC Micro, and OS calls inside an event are not permitted. Programming across the tube is difficult, as Acorn found out.

In short, you may decide that it's more trouble than it's worth to make your software tube-compatible. Even if you have got a second processor, you can always switch it off and revert to using the BBC Micro as a 32K machine for user-interfacing applications.

The BBC Micro has a series of vectors in pairs which act like a signal box. A railway has basically two tracks, the up line and the down line, input and output. The signalman can arrange for a train arriving on any line to arrive at any platform by changing the vectors. By intercepting the output stream, OSWRCH, you can easily make data go to another machine.

Having trapped the output vector, all characters will pass through your machine code routine; you then serialise each byte and transmit it. Line PB7 is directly testable with the negative flag (line PB6 can also be directly tested with the V flag).

The interface uses just five wires: two clock lines, two data lines, and a common return. Every time one machine wants to send a bit, it changes the state of the clock line. The other machine then changes its clock line in response, and so on.

To implement the interface, you would make up a lead as shown in Fig 1. The BBC program (Fig 3) can be entered directly. You can enter the Apple program as shown (Fig 2) if you have an assembler, otherwise you will have to enter the hex data into the monitor. For example:

CALL-151 <cr>
300:20 58 FC
303:AD 61 C0, and so on.

The Big Mac assembler is a worthwhile investment. The BBC program has been written to receive and transmit data; the Apple machine language routine will only receive data. (Unfortunately, the complete package is too
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This article features the BBC and Apple micros, but the idea could be adapted for any two machines not fitted with RS232 hardware.

CMOS 6502 and the manual are available from RCS Microsystems Ltd, 141 Uxbridge Rd, Hampton Hill, Middlesex Tel: (01) 979 2204.
IN BUSINESS

Spellbound

Tom Vernon takes a break from recording TV and radio programmes to describe macro programming, the built-in ability to customise applications packages, using Spellbinder as an example.

Buying a word processor is buying someone else's way of thinking. It is like choosing a companion. As a writer, I spend more hours with the authors of Spellbinder than with any human being. I know Bintz and Gee (the said authors) quite well by now. Bintz was a Spellbinder than with any human spend more hours with the authors of which they thought well in the first place, and CP/M and MS-DOS.

I can cohabit with Bintz and Gee — at least in binary spirit — partly because they thought well in the first place, and partly because they sometimes let me hold the baby. Their program is itself partly programmable — the aspect which I will concentrate on in this article.

It makes sense to build flexibility into a package. Micro software writers rarely know the user, however well they understand the functions they are programming. Packages which are democratic in this way last better in a rapidly-changing marketplace. Davis, California. They had a small instrument company that used microprocessors, and needed an editor for the programming. Like the used microprocessors, and needed an editor for the programming. Like the Apple empire, Spellbinder grew up in a garage — developed first as a ROM for the Z80 Exidy Sorceror, and later for CP/M and MS-DOS.

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But a professional-quality word processor needs a programmable element as much as any other database. Writing is the quirkiest, widest-ranging form of information: it is by humanity, for humanity — and only its simplest aspects are easy for machines. (The database to hold the elements of Shakespeare has yet to be created.)

Flexibility

Spellbinder's flexibility comes from three sources, apart from its macros: modes, tables, and use of function keys. It has two modes of working, Edit and Command, which treat text in different ways. Edit mode thinks in text units which may be either Word, Sentence, Paragraph or Character. (The Character unit allows you to underline or otherwise enhance spaces, which can be useful not only for printing, but also for drawing a band of reverse video to catch the eye in screen displays.) Command mode thinks in terms of screen lines, which are quick for deletion, movement by chunks, and for tucking text away in the temporary 'hold' buffer which is used for 'cut and paste' operations.

Until the latest version, users have not been able to work in screen lines while editing, which is irritating.

Spellbinder has always offered tables which allow the user to control printing extremely minutely (up to 1/36 in on the Santec (Sanders) printer or a laser printer). The latest version, 5.30, has extended this principle to the point of embodying an extraordinary range of operating and configuring functions in decimal tables (relatively accessible, though not easy to figure out even with the help of The Technical and Macro Manual — a slim volume at a not-so-slim £50). The command PSn ('n' being from 1 to 14 and 128 to 137) displays the tables for alteration — at your peril — and PS puts them back. Use a copy of Spellbinder for experimenting.

Spellbinder's function keys are dynamic: that is, they change their function according to the type of operation in progress, in effect forming a command tree made out of a series of menus and sub-menus, with the changing key legends shown at the bottom of the screen. On the Sirius, seven function keys perform about 50 tasks relating to printing, disk access, formatting, searching, general editing, and global operations to deal with large files, which have to be progressively fed into memory and out again as you work on them.

Although ideal for novices, however, function keys are rather slower than the single-letter commands available from the keyboard, particularly as these can be strung together as autocommmands. E/UT/F368, for example, will instantly take you to line 368 from anywhere in the text, having first dumped (Unheld) the contents of the hold buffer at the End. Top/Forward is the quick way of moving the cursor to where you want to go.

Getting into the habit of using multiple commands lines by slashes can be a great timesaver, particularly for simple repetition ("25 s/HESELTINE / will produce 25 repetitions of HESEL- TINE, for example, or "5 PA/FF/" will Print All of a file five times from the Top with a Form Feed at the end of each one).

Soon, however, you will find that some commands tiresomely insist on your intervention. You cannot save time reading in one file after another from disk with a command like RO/ Heselfil.Brk/R/RD (Read Open/Filename/Read/Read Done), and nothing extra happens after a search command. The trick here is to type in the command at the end of whatever text you have in memory, put the cursor at the front and issue the commands AT (whereupon it will disappear) followed by A (to set it going).

Why not extend it? Add other lines, as in Fig 1. You have written your first macro.

Macros

The Macro Programming Language (MPL) creates add-on programs that you can call up to work on the text in memory or on disk. Spellbinder is almost unique among word processors in providing them (although the Sirius Programmer's Toolkit contains PMATE, an editor entirely made up of much less friendly macros, and Word Perfect also has such a language).

Macros provide most of the features of Spellbinder which justify its claim to also be an 'office management system' — it must have been one of the earliest of all integrated packages! These features include: mailmerge; special
printing functions such as two-column print, label and batch printing; standard form preparation and form filling; boiler-plate standard letters; calculation facilities which work from text or keyboard; sorting and keeping of lists as a simple database; column-moving; entry of standard phrases at a single keystroke. Version 5.30 adds macros for footnoting and referencing, and tidying widows and orphans (stray lines of print isolated at the top or bottom of a page).

None of these macros, particularly the database, is going to break any thing to do, for example (which I then start with an automatic list of urgent things). You the chance of introducing sign-on and ends through macros, which gives available can be called up on a function key which can also start them going again from the right point if they are interrupted); and Spellbinder begins and ends through macros, which gives you the chance of introducing sign-on and sign-off messages or facilities. I start with an automatic list of urgent things to do, for example (which I then ignore, of course).

Macros are fun to write. The language has its limitations — no PEEKing, rather limited math, and it isn’t practical to ask for continual screen rewriting (for example, showing the cursor moving one character at a time). But generally the language is easy and pleasant to use — and sometimes surprisingly powerful, since it calls upon most of the Spellbinder commands in addition to normal programming steps. It is easy to understand because processes going on in lines of text are concrete: the cursor moves comprehensively around in a 26k block of text, altering it, searching it, shifting chunks of it, and formatting it.

Macros may be Heath Robinson programming — that is part of their charm — but they also have the advantage of being outstandingly portable. They are created as ASCII text files and stay that way, so they are easily transferred and run on any machine with Spellbinder. You can even write macros on another word processor: I regularly create them on Microwriter, for example.

Fig 2 is the macro I constantly use. It provides hold, movement and deletion facilities on the basis of cursor position, which is registered at the first press of the macro key that immediately dumps you back into edit. At the second press of the key, the macro registers the new cursor position and gives you the choice of deleting or holding everything between old cursor and new cursor, or of returning to the original place. Deleting backwards is not otherwise possible in Spellbinder, and you normally have to decide the end of your hold or deletion in advance. The macro also bypasses the safety procedures which ask you to confirm that loss of too much text is OK.

The macro starts by assigning a string variable used for later comparison. MPL has only 10 integer and seven fixed-point variables (%I to %6 and %a to %g) but up to 26 13-character string variables, so it is often economical to use string variables as flags. (Maximum string size is set with an instruction like :SS 13 159 13, although it may be temporarily fixed with :SF and padded)

```
CURSOR.COM IFNM
:MB = "Hold"
:in "AA/RETURN CURSOR AND INTER-CURSORS HOLD, DELETE - WARN AT 7 LINES (No./Ret) *%B"
:on %I / 1+1
:MB = %B
:MB = %A
:icp
:see 10
:pr "%3/" CURSOR NOTED */ NOTE FIRST CURSOR POSITION
:%0 = %2 ; column number
:%2 = %3
:row number
:icp
:see 16
:Exit to Edit Mode, with restart at line 16
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Line numbers are implicit: MPL lines begin with a colon whereas word processor command lines have none. MPL treats everything after a semicolon as a comment: in pre-version 5.30, it requires ingenuity to use a plain semicolon in a macro. You can move the cursor along until the ASCII value underneath it is returned as 59 (Fig 3).

Another way is to search for a semicolon using 'st':/ which has an enhanced semicolon that the macro will not object to, and an asterisk for non-specific search so that it is likely to end up at an unenhanced semicolon instead.

The branch routines work by testing a value against 0. If it evaluates as less than 0, the macro jumps to the line number next to the left-hand slash; if 0, the middle line number; if greater than 0, the right-hand one. String comparisons are evaluated by ASCII code in the same way, although the syntax uses a question mark for comparison but simply puts them together (for example,:on%A%B:/). Strings are combined with the form :%C = %D%A%;

Maths is limited to plus and minus and what you can do with them, although the calculator macro supplied with Spellbinder does quite well.

That is most of what is needed for a first understanding of the language, although there are also String Enhance and Read Key (for ASCII number) macro instructions, interrogators for String Length, and read or write file ($0 or $1) open or close. Input and Print work in much the same way as their Basic equivalents.

MPL is properly covered in the Macro and Technical Manual, which is well-written but expensive.

Since this macro in effect institutes a command branch at the second press of the CONTINUE key, there is no reason why other keys should not be used to perform other simple operations. But bear in mind, however, that the whole point of a macro addition like this is simplicity and efficiency. Beware of re-inventing an asymmetrical wheel. I was halfway through a macro for film budgets when I suddenly realised that I was writing a spreadsheet, and that I would be better off using Multiplan.

There are limitations to macros. Spellbinder is no better than most other micro word processors in being able to address 28k of text in memory including the macro. Larger files have to be manipulated on and off disk, as do files to be used by other programs.

There are two types of speed in computing — the instant answer, and the process that happens automatically while you are making a cup of coffee. Complicated macros, like my punctuation checker, TV script formatter, word counter, filler for random thoughts, and comparator of similar files, definitely come into the second category. I also have a simple dot-graphics program for a daisywheel printer.

Whether or not you use relative line numbers in branching (+5 or +22) there is a good deal of line-counting writing macros, particularly when making alterations within nested loops. A macro to renumber line numbers in macros is useful, or you can write your macro in a screen line. This can be easily created, in spite of the semicolon problem, with extra indication of odd lines and tenth lines (Fig 4).

Other useful tools are macros to print ASCII values of the keys on the keyboard, to test printwheels, to make multiple searches for combinations of keys occurring within a certain distance of each other, and to convert text to other formats, such as a database. Spellbinder creates either sequential or system files, but random access files need to be filtered through Basic.

Another limitation is the presence of the soft carriage return character ASCII 14 at the end of every screen line except those terminated by a carriage return. In practice, therefore, data must be in segments with not more than 158 characters between carriage returns (159 characters is the maximum Spellbinder can cope with). This can be easily done by making alterations within nested loops. Whether or not you use relative line numbers in branching (+5 or +22) there is a good deal of line-counting writing macros, particularly when making alterations within nested loops. A macro to renumber line numbers in macros is useful, or you can write your macro in a screen line. This can be easily created, in spite of the semicolon problem, with extra indication of odd lines and tenth lines (Fig 4).

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FONT 464 is an easy-to-use program enabling you to design, edit, and save your own characters and graphics for simple use in BASIC programs. There are pre-designed fonts and sophisticated printer-driving software which allows high-resolution screen dumps and letter writing on Epson compatibles or the DMP1.

ULTRAKIT is the most powerful interactive toolkit yet for ZX BASIC. All the features you will ever need:

**AUTO BREAK COPY DELETE EDIT FIND GRAB HIDE INFORM JOIN KEY LOAD MOVE NUMBER ONERROR PUT QSSPERATE RAMTOP SUBSTITUTE TRACE UPDATE VARIABLES WARN CRUNCH CRUNCH2 REMKIL PACKER MAP UCASE LCASE CTIME ATIME ALARM PRINTER KMODE RESET and much more.**

It comes with a FREE tape header reader.

C, combines high-level structuring with direct control over the machine, all at compiled speed. Our compiler is now available from good retailers, and has proved extremely popular. It supports all statement types (plus inline code) and over 40 operators; whilst char, int, unsigned and combinations using pointers, arrays, structures, unions, functions, and typedefs are all allowed data types. External and static variables can have initializers, whilst auto variables support recursion. There are six preprocessor directives and over 60 library functions with a selective inclusion scheme.

Pascal is a valuable educational and development tool as well as running typically 40 times faster than a BASIC equivalent. Our compiler is an almost full implementation which compiles directly to machine code (no slow P-codes). Multiple file inclusion allows very large programs to be compiled.

MON QL is our latest product and our first on the QL; it was written by Andy Pennell, who has a great deal of experience on the QL. It is similar in style to the well-known MON 'front panel' in DEVPAC and includes additions like job control and multi-tasking support. It also catches system exceptions and includes fixes for QDOS.

**Product Price Table**

<table>
<thead>
<tr>
<th>Product</th>
<th>Price</th>
</tr>
</thead>
<tbody>
<tr>
<td>Pascal</td>
<td>£1.95</td>
</tr>
<tr>
<td>DEVPAC</td>
<td>£5.95</td>
</tr>
<tr>
<td>ULTRAKIT</td>
<td>£7.95</td>
</tr>
<tr>
<td>FONT 464</td>
<td>£9.95</td>
</tr>
</tbody>
</table>

All prices are for cassette versions (except CP/M and QL) and include VAT and P+P in the UK. Please contact us for export orders, disc formats or detailed technical information packs. All products are available by mail order; please send a cheque or Postal Order. Sorry, we do not accept credit cards.
other operating systems, Spellbinder can provide extra facilities such as text recovery and the ability to run other programs from within itself (apart from its own macros).

New versions

Version 5.30 of Spellbinder is a partial rewrite to make the program easier to adapt to new machines. It has a bundled spelling and grammar checker — Electric Webster — far below the standard of Spellbinder itself, and is the basis of the new Scientific Spellbinder, which contains a full set of Greek letters and scientific symbols among up to 224 different characters.

You can issue command mode commands from Edit, view disk directories selectively, and have two read files open at once. There are new macro instructions, but the greatest change is in adaptability.

Previous versions kept a proportional spacing table in quite accessible decimal/ASCII format. 5.30 has a major part of the configuration as tables which are capable of being manipulated by people who have some knowledge, but who have not yet graduated to machine code. You can redefine the way the function keys work, and the way the printer prints, the screen behaves or the keyboard works. You can see a second character set replacing the enhanced set, or control screen colour on an IBM PC.

This process is in a different league from macro-writing. The inexperienced user would be wiser to get a dealer to configure a package for special facilities and configure others cheaply. French accents, and so on, (up to 16 extra characters are readily available, with their enhanced versions.) Sierra Systems of Epsom (which supplied my (early) copy of 5.30) throw in extra characters with the package, and will configure others cheaply.

There are several desirable macro features not listed in my older manual, but most of which seem to work with version 5.20 at least. An On Error instruction (On 1) brings you back to a specified line; and String Get (s% A %61) extracts the first character in a string and converts it to an ASCII value. There is a useful technique in $4, which returns the current macro line number +2, and you can read indent values with the $5 function but change them only in 5.30 with the Set Indent instruction.

String Put (the opposite of String Get) solves the problem of the semicolon, being a means of converting an ASCII value into the character it represents. It leaves Spellbinder macros with few limitations as an easy (if leisurely) means of text-handling, notably: the fact that you cannot save a disk directory as a text file and use macros for disk housekeeping; and the size of the text buffer (a 64k text version has been seen, but not sold).

My current macro is one to create dot-graphics on a daisywheel printer. It is a ridiculous task to give to a word processor — every time I draw a cow it looks like a dachshund — but I am far from convinced that even here macros have met their match.

Thanks to Geoff Wilkinson of Sierra Systems, 6 The Greenway, Epsom, Surrey KT18 7HZ, tel: (03727) 22890, for supplying an early copy of Spellbinder 5.30 and the Technical and Macro Manual.

A Spellbinder Users' Group exists which will enable users to pool their knowledge and experience, and to seek help and advice from other users, especially on advanced applications and macro-programming. It will be a non-profit, self-help group but will be supported by the UK distributors, who have promised technical advice and assistance with publicity.

Interested readers should contact Dermod Quirke at PO Box 14, Newark, Notts NG24 4TP, or phone (0636) 77513 between 10am and 10pm for details.

Tom Vernon is a journalist and broadcaster, and is best known for his radio and TV travelogues.
The proliferation of personal computers in homes and offices over the last few years is the direct consequence of the never-ending search for increased productivity and improved communication by people around the world. Although many facilities exist today that help the user type a letter, calculate a cheque or obtain a list of groceries, few possibilities exist to enhance communications needs. Mail has been the basic means of communication of millions for more than a century. The tie-in of mail and the personal computer would seem a natural evolution, but alas that is not the case.

Electronic mail companies do exist today; their service is a highly needed one and in most cases, efficient. However, for most users electronic mail is something that resembles a mailbox. User A sends a letter to user B who, upon looking at his 'electronic' mailbox, reads the contents of the letter. Users do not know what actually takes place and how the letter goes from one place to another in the mailbox. All they have to do is dial a number, connect the personal computer to a remote computer system and send the letter after signing on. It seems that some kind of mystique prevails over the operation.

The program in Fig 3 illustrates in a pedagogical way how an electronic mail program works. Although the program is mainly intended for illustrative purposes it can be used for on-site mail, and is designed in a way that permits easy expansion.

**In use**

Type the program into an appropriate computer (an IBM PC is ideal). When the program starts it asks for the date, and a menu appears from which the user is asked to select a function. The menu accepts various entries, each corresponding to a unique action as shown in Fig 1. Since this is the first time the program is run, press the '5' key, followed by the Enter (RETURN) key. This takes you to the system set-up code which will set up the required files used by the program.

Enter the password 'peter' as in Fig 3, or the password you have chosen, and the program will ask you for the number of sectors which indicates the maximum number of lines (each up to 80 characters long) the mail database can contain at any time. Type 100 and press RETURN. Then type in the name that you would like to call the mail database, and the system file will be initialised as shown by an appropriate message on the screen.

The program will then initialise the actual mail data file in a specific way called the 'sector availability sequence' (SAS), as well as keeping you informed of the sector being initialised.

The user list or directory is set up next, which requires you to enter the mail system users' names. You can enter a name up to 30 characters long, although only the first four are significant. When the names are entered, enter the name 'END' which signifies the end of the user list; a maximum of 20 names may be entered. The program has now finished the initialisation of the required files and you are taken back to the main menu.

To send a message, press the '1' key followed by RETURN and the program will ask you for the name of the message which may have up to 30 characters of text. The screen will be cleared and the program will wait for your message entry. The message is normally composed of lines which are terminated by the RETURN key, as on a typewriter. When the message is finished, the sequence "[stream]" must be typed, which tells the program that the message entry is finished.

The user name must then be entered, which is a name that corresponds to one of the names entered in the user directory. At this point the program will return to the main menu and wait for another command.

To see the message on the user list, press the '3' key followed by RETURN and the user list will be shown. You will notice that the 'Cnt=' field of the line displaying the user's name selected shows the number '1', which means that one message is actually tagged to that user. Also, the 'Total cnt=' entry also has '1' as this is the first message.
<table>
<thead>
<tr>
<th>System file 'SYSTEM.SYS'</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Database name</strong></td>
</tr>
<tr>
<td>(8 bytes)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>User directory entry 'USER LIST'</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>User name</strong></td>
</tr>
<tr>
<td>(30 bytes)</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Mail database 'MAIL.DAT' typical sector (record)</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>Previous sector pointer</strong></td>
</tr>
<tr>
<td>(3 bytes)</td>
</tr>
</tbody>
</table>

*Fig 2 The SYSTEMS.SYS, USERLIST and MAIL.DAT files*
To read the message, press '2' after returning to the main menu: this takes you to the program part that reads messages for each user. Assuming that you are the target user, enter the user name used as the target name in the send operation, and the system will try to find the message. If you have entered the correct name, the system will ask you whether you want the message printed on a printer, at which point reply 'n' followed by RETURN. The last line on the screen (that is, the 25th line) will show the message name, while the message will be shown on screen. If the message exceeds 18 lines, the RETURN key must be pressed to continue the display. When the process is finished, the system will ask you whether you would like to accept the message or not. If you enter 'Y' the system will update the files, so for all practical purposes the message has been deleted (in reality it has not, as will be shown). Subsequent display of the user list will have a zero in the current count field although the total count field will contain a '1'.

### System file

<table>
<thead>
<tr>
<th>Name</th>
<th>Date created</th>
<th>Date last used</th>
<th>First free sector</th>
<th>Last free sector</th>
<th>Sectors used</th>
<th>Total sectors</th>
</tr>
</thead>
<tbody>
<tr>
<td>Mailbase</td>
<td>1984 08 06</td>
<td>1984 08 06</td>
<td>10</td>
<td>11</td>
<td>9</td>
<td>11</td>
</tr>
</tbody>
</table>

### User Information

<table>
<thead>
<tr>
<th>User name</th>
<th>Date created</th>
<th>Current MSG count</th>
<th>Total MSG count</th>
<th>First sector pointer</th>
<th>Last sector pointer</th>
<th>Flag</th>
</tr>
</thead>
<tbody>
<tr>
<td>Peter</td>
<td></td>
<td>1</td>
<td>11</td>
<td>1</td>
<td>5</td>
<td>0</td>
</tr>
<tr>
<td>John</td>
<td></td>
<td>1</td>
<td>6</td>
<td>9</td>
<td>1</td>
<td>0</td>
</tr>
</tbody>
</table>

### Maildatabase

- **Mailbase**
  - User: Peter
  - Current MSG count: 1
  - Total MSG count: 11
  - First sector pointer: 1
  - Last sector pointer: 5
  - Flag: 0

- **Mailbase**
  - User: John
  - Current MSG count: 1
  - Total MSG count: 6
  - First sector pointer: 9
  - Last sector pointer: 1
  - Flag: 0

### Message Table

- **Text**
  - Previous record number: 0
  - Next record number: 10

---

*Fig 3 Program which illustrates how an electronic mail program works*

*Fig 4 The mail database with two users*
The following code performs the get message function.

1. Get the message name.
2. Get the sector pointed to by the user directory entry and ask the user whether it is to be printed.
3. Get the number of sectors required for the message.
4. If the first 4 letters match, then continue, else show error.
5. If EOF(2) then go to 1580.
6. Count the number of sectors used.
7. Update the directory entry "MSG" counter.
8. If first 4 letters "MSG" match, show the message name on screen.
9. If the sector pointed to by the user directory entry and last sector field in the current message record are equal, then continue, else get the next sector pointed to by the user directory entry.
10. If sector pointed to by the user directory entry is the last sector and update the next sector number field. The messages are now linked, update the list pointers and the total sector counter.
11. Ask for the user name and look for it in the user list.
12. Get the first sector and show the message name on screen.
13. Get the number of sectors used.
14. Update the directory entry "MSG" counter.
15. If the next pointer as the new first directory entry.
16. Update the list pointers and the total sector counter.

When the program is used to initialise the database and the user is asked to enter the number of sectors required for the message remains in the system for further examination. Additional messages to the same user will be run consecutively, while messages for other users will be allocated accordingly.

Although one main file is used for the actual message information, the system always keeps track of the relation of the messages to the respective target users using pointers.

**Database design**

The correct allocation of the messages and user directory pointers relies upon the contents of three files used by the program. These files, whose structures are shown in Fig 2, are called the 'SYSTEM.SYS', the 'USERLIST' and the 'MAIL.DAT'.

The SYSTEM.SYS file is used to store the name of the mail database, the date of creation and the date of last use, the count of total sectors available for messages, the count of sectors used, and two pointers which give the number of the first and last available sector.

In order to understand what the pointers do, it is better to know what the MAIL.DAT is made of.

Fig 5 The mail database after one user has read and accepted a message
storage of messages, it creates what I call the 'sector availability sequence' (SAS) which is a way of tying sectors together so that they point to each other. The MAIL.DAT part of Fig 2 shows what a sector looks like as used for message storage. The first three bytes contain a pointer that points to the previous sector number if any or zero, if this is the first sector of the SAS or of a message.

The next 30 bytes are used to store the name of the message. Following that is the actual text, one line at a time. This is followed by a three-byte field containing the number of actual sector, and another three-byte field that contains the next sector number if any or zero, if this is the last sector of the SAS or the last sector of the message.

Upon initialisation the pointers are sequential, starting from 1 up to the number specified. As no sectors are used (that is, no messages sent), the first free sector pointer of file SYSTEM-.SYS as shown at the top of Fig 2 contains 1, while the last free sector field contains 100, this being the last sector of the SAS or the last of the message.

Upon initialisation the pointers are sequential, starting from 1 up to the number specified. As no sectors are used (that is, no messages sent), the first free sector pointer of file SYSTEM-.SYS as shown at the top of Fig 2 contains 1, while the last free sector field contains 100, this being the last sector of the SAS or the last of the message.

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<td>10</td>
<td>9</td>
<td>0</td>
</tr>
</tbody>
</table>

System file

Mail file

<table>
<thead>
<tr>
<th>Message</th>
<th>Text</th>
</tr>
</thead>
<tbody>
<tr>
<td>111 1 2 1 2 3 2 3 4 3 4 5 4 6 5 6 7 6 7 8 7 8 9 8 9 9 0 0 10 11 10 11 1</td>
<td></td>
</tr>
</tbody>
</table>

Fig 3

Fig 6 The mail database after both messages have been retrieved
sector number. Also, the total sectors used field is zero, while the total sectors available field is 100.

At this point, the system points to the part of the MAIL.DAT file that can be used for storing messages. As no messages have been entered, the file data sectors are available for text storage. The user directories are initialised by entering the user’s name and setting a usage flag to 0 instead of FF. You will notice that the user directories contain additional pointers as well as counters; these are all set to zero during initialisation.

Let’s assume that we have a database with a maximum of 11 sectors (as defined upon initialisation), and that one message containing five lines has been sent to a user called ‘peter’ and another message, four lines long, has been sent to user ‘john’. The situation is shown in Fig 4.

The bottom part shows a schematic view of the MAIL.DAT file with sectors and their pointers with the necessary number of free sectors. The first sector’s ‘previous sector pointer’ has a zero in it, meaning that this is the first sector in the message or list. Sector five has a ‘next sector pointer’ filled with zero, meaning the end of the message. As this message was sent to user ‘peter’, the first sector pointer field in the directory of ‘peter’ contains the number 1, denoting sector 1 and the first sector of the message. The last sector of this message is five and is shown as such in the directory. The same is used for the second message, except that it is four lines or sectors long and that it belongs to user ‘john’.

The main file SYSTEM.SYS has the first free sector pointing to sector 10 while the last available sector points to ‘FF’. The current counter is reset while the pointers are set to zero since no messages are in the database for the user now. The available sector count in the SYSTEM.SYS file is increased by the number of sectors contained in the message just read (that is, increased by five), while the first free sector pointer still points to sector 10 as before. However, as the program puts the sectors of the last read message to the ‘end’ of the SAS, the last free sector pointer now points to sector 5. Notice that in order to keep the SAS continuous, the pointers have been updated according to the sector ‘previous’ pointer of sector 11 showing 1 and the ‘previous sector pointer’ of sector one displaying 11. The message for user ‘john’ is not touched during this updating operation.

If ‘john’ decides to read the message as well, the pointers are further updated as shown in Fig 6. All the sectors are available, although the sequence for using the sectors in new messages changes.

Although the extensive use of pointers makes the program difficult to track, its versatility and secure database arrangement compensates for the difference. The data in the database may not only be messages, but any other form of data that must be allocated to a specific user or key. Also, the use of SAS in the database is an efficient means of allocating sectors for data, as well as ensuring that deleted or accepted data, in the case of the mail program, is still on disk.

**Conclusion**

The program does not contain any software to drive a machine’s communications ports, as it is mainly intended to illustrate the techniques involved when dealing with electronic mail database design. Such software may be placed instead of the code used to get the text from the console as well as the code used to display the text. Additionally, better user protection, password checking, and accounting code may be implemented for user versatility.

Many of the techniques shown in this program, especially in the case of the pointer handling, may be used in other forms of database types. Writing programs with pointers is not easy due to the large number of variables processed, however, the use of pointers in such applications permits extreme flexibility as well as additional protection in case of faults. This protection alone is worth the trouble — there is no worse error in a database than unexplained data loss.

Program notes: the listing in Fig 3 is for the IBM PC Basic but can easily be modified to run on other machines. The program uses random files which are available with most versions of Microsoft Basic. Please note that the LOCATE command is used on the IBM PC to place the cursor at the required row and column.

Although many facilities exist today to help the user type a letter...or obtain a list of groceries, few possibilities exist to enchain communications! sector 11: that is, there are two free sectors in the database.

How are all these pointers used? When the user wants to read a message allocated in directory ‘peter’, the system will find the first sector pointed to by the directory entry, that is ‘1’, and shows it onscreen. The ‘next sector pointer’ is used to get the next sector until it contains a zero which denotes the end of the message. If the reader of the message decides to accept it, the pointer is saved as shown in Fig 3.

The directory entry for the user ‘peter’ is set to unused by setting the flag to 'FF'.
Imagine a number of plane figures, each made up of five equal-sized squares. These are the pentominoes, 12 of which are shown in Fig 1, making up a 6 x 10 square. Now write a program to find all the possible ways of arranging these 12 pieces, then one of the remaining 11, and so on, giving

\[ 11 \times 10 \times 9 \times 8 \times 7 \times 6 \times 5 \times 4 \times 3 \times 2 \times 1, \]

written as 11! (factorial) possible solutions. This ignores the fact that each piece may be placed anywhere on the board and each may be rotated.

**Problem-solving**

Another problem with similar complexity is the Travelling Salesman Problem. Here, you are asked to plan the optimal route for a salesman who must visit a number of cities. For example, suppose you were given the map in Fig 2, with eight cities and the distances between them (Fig 3). Find the shortest possible route that passes once through all the cities and returns to the starting point. Obviously, because you have to eventually pass through all the cities, you can choose any starting point and still be sure of the shortest solution. If you now continue to measure all the possible routes and take the shortest, you're sure to get the best route. If you've done this fully, you'll have covered 7! (or 5040) different routes.

The program (Fig 4) will do all these calculations for you. Rather than having reams of output, PROPrint only outputs any information when it finds a route shorter than its previous shortest possible circuit. By covering all routes, this ensures that the final output is the shortest route.

Now imagine that there are 100 cities, instead of the eight in the example. This more likely situation gives 99 possible routes, which Fig 5 shows to be quite a few possibilities. Even the fastest computers would require days, or perhaps weeks, of computation for these larger problems. One way of avoiding this might be to always consider the nearest cities, but you'll soon discover that this does not guarantee the best solution. In fact, although other algorithms do exist for this problem, they are not much better than the method we have already used. It is thought that no efficient algorithms can ever be produced for this problem, but no-one has yet been able to prove this.

By working through the travelling salesman problem, we have been able to speculate that an optimal solution for 'a large number of cities' would take too long to compute. This is, however, a little vague, and we really need a more general method for evaluating and comparing algorithms. To do this, we imagine that a particular algorithm is supplied with more and more inputs (cities in the above example) and measure the increases between the execution times. This rate of increase can then be used as a measure of the efficiency of the algorithm.

In the case of the travelling salesman problem, the increases for n cities can be shown by the function

\[ f(n) = (n-1)! \]

Thus, 24 routes would have to be considered for five cities, 120 routes for six cities, and so on. Other problems have functions with similar growth rates, such as \( 2^n \) and \( n^n \), all of which can be said to have exponential growth rates. Other problems, where n doesn't appear as a factor of the exponent, are said to have polynomial growth rates. Typical examples of these are \( 5n, n^3, \) and so on. If n is sufficiently large, any exponential-time algorithm will take longer to compute than an algorithm with polynomial time. In most cases, only polynomial-time algorithms are considered fast enough to implement for general applications. This system of classification has the added advantage of being independent of the machine the algorithm is run on.

Another problem, closely related to the travelling salesman problem, that can again only be solved using exponential-time algorithms, is the Hamiltonian Circuit problem. Consider the graph in Fig 6. The problem is to discover a path which travels through all the nodes once, finishing at the starting node. In this particular case it is very easy: the path 1,2,3,4,5,1 will do. Now try the slightly more complex case shown in Fig 7. If you finally give up, then I must tell you that no such circuit exists. This can easily be shown by naming the three top nodes of type A, and the five bottom nodes of type B. Then you'll realise that no node is directly connected to a node of the same type, so all routes must be of the form A to B, or B to A. We need to introduce a circuit containing seven routes and finishing at a node of the same type as the start node, which is impossible. We can easily transform the Hamiltonian Circuit problem into the travelling salesman problem. First, construct a 'complete graph' by connecting each point to every other point, then assign a cost to each line (the distance between the cities). The Hamiltonian Circuit with least cost is now the solution.

Let's consider a very similar problem: that of finding a route which traverses each line (as opposed to each point) of a graph exactly once, known as an Eulerian Path. A classic problem of this type is that of the Konigsberg Bridges (Fig 8). During the 18th century, the (then German) city of Konigsberg had a park built on the banks of a river. The banks were connected to two islands and the bridges shown in the diagram. The problem here is to decide whether or not a path exists which will cross all the bridges once and only once. The problem can be reduced to the graph given in Fig 9, since the size of the islands and the bridges does not really matter.

Again, the obvious method would be to list all the possible routes, starting from each of the four locations, and see if any of them meet the requirement. This would be an exponential-time algorithm but would be sure of finding a route, if one existed. Unlike the previous problems, however, this one does have a polynomial-time solution. Euler was able to show that all graphs with the following conditions have Eulerian Paths:

(a) The graph must not be disconnected. In other words, it must be possible to travel from any point on the graph to any other point by following the lines of the graph.
(b) Either all graph points must be at the junction of an even number of lines, or exactly two points must be connected by an odd number of lines. It is clear that to have a Eulerian Path, it must be possible to reach all parts of the graph as specified in condition (a). If each point has an even number of lines, it is possible to use half of them to reach the point and the other half to leave it, thus forming a path. The exception to this is where two nodes have an odd number of lines, in which case they must be the start and end points. This explains why a graph containing a Eulerian Path must meet these requirements, but Euler was able to go further than this. He was able to prove that any graph meeting these requirements must have a Eulerian Path. Consequently, there is no solution to the Königsberg Bridge Problem. However, if you were to take any one of the bridges away, then the graph meets the requirements and you should be able to find a path. Try testing the graphs given in Fig 10, which are of the common 'draw without lifting your pen from the paper' type.

**The Turing Machine**

In the 1930s a British mathematician, AM Turing, studied these and many other algorithms. His intent was not to solve them, but to investigate which problems could be solved, and which could not. Using an imaginary computing device known as the Turing Machine, he was able to show that there are some problems for which no algorithmic solutions exist. Other problems, he was able to divide into two groups. We have already seen these: those for which polynomial-time algorithms exist; and those which can (at present) only be solved by inefficient exponential-time algorithms. However, as we have seen, it is sometimes very difficult to assign a problem to one of these groups.

The hypothetical machine which Turing devised is known as a Deterministic Turing Machine. In essence, this can be regarded as a single processor. The machine, though very simple, was able to perform any calculations currently carried out by computers. Any problem which could be implemented using a polynomial-time algorithm on the Deterministic Turing Machine could also be computed in polynomial time on a computer. In our classification of algorithms, these are said to belong to the class P (for Polynomial).

Turing then devised a slightly different machine, known as a Nondeterministic Turing Machine. This machine is quite 'clever' in that if faced with a number of possible choices, it will always choose the correct one in order to solve the problem. In some ways, this could be considered to be a machine with an infinite number of parallel processors. Whenever the machine is faced with a choice, it merely gives each possibility to a different processor.
Fig 5.99 is a big number...

the end, one of the processors must find the correct solution, if one exists. For example, our travelling salesman, starting at Aberdeen, is faced with seven possible choices (the remaining seven cities). Each possibility is given to a different processor, which is then faced with six possibilities. These are also shared out, and so on, until all the possibilities have been considered. One of these processors will clearly find the optimum route because all possible routes will be considered. The problem can be completed in polynomial time on a machine of this type; thus, these problems are classified as NP (Non-deterministic Polynomial).

Unfortunately, a machine of this type could never actually be built. Although the example with eight cities would only need 5040 parallel processors, a computer capable of handling 100 cities would require more processors than there are atoms in the universe!

Based upon this classification (shown by the Venn diagram in Fig 11), it is clear that all problems in the class P are also in the class NP. In other words, all problems which can be computed in polynomial time on a deterministic machine could also be calculated on a non-deterministic machine. However, it is not necessarily the case that NP problems are also in the class P. If this were the case, then the classes P and NP would, in fact, be the same. Unfortunately, mathematicians have so far been unable to prove this one way or the other, and it is now generally thought that the two classes are indeed different. At first sight, Euler’s Problem may have appeared to be in the class NP, but it has since been proven to be in the class P because it does have a polynomial-time solution. It may be that other problems, presently in the NP class, will also be found to lie in P.

Another subset of the NP class of problems is known as NP-Complete. It is often found that NP problems have some relationship to each other. For example, as we have seen, the travelling salesman problem could be regarded as finding the least-cost Hamiltonian Circuit on a graph where each point is connected to every other point.

Using a mathematical language known as Propositional Calculus, the mathematician SA Cook was able to describe the workings of a Non-deterministic Turing Machine. From this, mathematicians have been able to show that a number of NP problems are special in that they can all be converted to a common problem in propositional calculus. What’s more, this conversion is in polynomial time. It follows from this, that if a polynomial-time solution to any of the NP-Complete problems could be found, then it could be used to solve all NP problems.
Solutions

This theory is all very clever, but not much help to the poor computer scientists who still have to implement these problems. Consequently, many methods of finding sub-optimal solutions have been developed. These are usually of two types, both of which have the advantage of being computable by polynomial-time algorithms.

The first type are those that guarantee solutions near to the optimal in all cases. For example, the travelling salesman problem has already been demonstrated to lie in the class NP (unless you can prove differently, of course!), so a number of sub-optimal solutions are used. One technique is guaranteed to provide solutions which are no more than twice the optimum length. This process is shown in Fig 12, and consists of the following steps:

(a) Generate a Minimum Spanning Tree to connect the cities. This is done by connecting the closest cities, then the next closest, and so on, but a connection is only made if the city is not already connected to the graph.
(b) Each of these lines is then traversed in both directions to form a cyclic route.

The Minimum Spanning Tree, which is generated in polynomial time, is known to be shorter than the length of an optimum tour. This can easily be seen by finding the optimum tour (using the program in Fig 4), then omitting any one of the lines. This will form a spanning tree of shorter length, so the minimum spanning tree must be shorter than any possible tour. Consequently, traversing this tree in both directions will give a tour which is less than twice the optimum. The tour shown in Fig 12 (b) can then be further improved by taking short-cuts. This is done where cities are visited twice (that is, in both directions), where the two lines travelling in one direction can be reduced to one line which bypasses the city.

Techniques also exist which will give solutions to the majority of problems. This type of solution arises because in most practical cases the problems are not the worst cases. For example, if you were given the city layout shown in Fig 13, the shortest path is fairly obvious without having to work through the 15! possible routes. For large maps, one typical method is to divide the map into a number of territories, calculate a route for each, then join the territories. If, for example, a map contained 26 cities, an exhaustive search would be required to check 25!, or $1.55 \times 10^{25}$ (approximately) possible routes. If this map were split into the areas, as shown in Fig 14, then an exhaustive search of each area would only have to analyse $3! + 4! + 3! + 4! + 3! + 3!$, or 72 possible routes. Another algorithm is then known to connect the areas together in polynomial time.

Many other problems exist for which only NP solutions are known. How
many colours are required to colour a given map, such that no two adjacent areas have the same colour? It is fairly easy to see if a map can be coloured by one or two colours, and it was known for many years that five colours were sufficient to colour any map. However, no-one has been able to produce a map requiring more than four colours, and it was recently proven that four colours were indeed sufficient. However, choosing between three and four colours is still an NP problem. Look back to the pentominoes in Fig 1. They have been coloured using four shades, but can they be coloured using only three?

The Knapsack Problem involves placing a number of objects into a knapsack without exceeding the capacity of the knapsack. Each object has a weight and profitability; the idea being to find the best possible combination of objects which maximise the profit. The exhaustive solution would require picking each of the original objects, followed by any of the remaining objects, and so on.

Two graphs are said to be isomorphic if there exists a direct mapping between the points and lines in each graph. To see this more clearly, consider the two graphs shown in Fig 15. Although appearing dissimilar, they are isomorphic, and graph A can be transformed into graph B by changing the following points:

\[
1 = c, 2 = d, 3 = e, 4 = a, 5 = b
\]

It is possible to reduce this problem using some techniques. For example, if the graphs are isomorphic, then they must have an equal number of points and lines, and each point must have the same number of lines emanating from it. Many other techniques exist which will work with specific types of graph, but the best general solutions still take exponential time to compute. Is it clear that the three graphs shown in Fig 16 are isomorphic?

**Conclusion**

A multitude of other problems exist, but let's finish by considering a problem of particular interest to computer software designers.

Imagine a multi-tasking computer system with three independent processors, each of which is capable of handling any particular job. Imagine that the three processors are given the tasks shown in Fig 17. If, each time a processor became free, it just took the next available job in the queue, then the overall finish time would be 11 units. However, by using a system known as LPT scheduling (Longest Processing Time) the overall time can be reduced to nine time units, which in this case is also the optimum. Using the LPT rule, whenever a processor becomes free, it will always take the job with the highest processing time.

The LPT system will not always produce an optimum ordering but it can be implemented using a polynomial-time algorithm, whereas an exhaustive search would be in exponential time.

Many problems which may appear to be quite difficult can be solved using such techniques as Divide-and-Conquer, Dynamic Programming, Backtracking, and Branch-and-Bound. But some problems defy all the best efforts to find polynomial-time solutions. It is these, and especially those lying in the NP-Complete class, which pose the real questions. Is NP identical to P?
Introducing The VisiCalc Package.

Here are two powerful spreadsheet programs in one package—VisiCalc, the standard by which all other spreadsheets are judged, and VisiCalc Advanced Version, a second generation spreadsheet for advanced users. These two programs allow you to begin with a basic spreadsheet program and later move on to a more advanced spreadsheet as your business and home needs grow.

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Among the packages available on the Mac, Microsoft's Word is rare in having been available for quite a while, rather than being specially written. Yet, in some respects, Word could be said to have been waiting for just such a machine to come along — many of its features are beyond the capacity of most hardware to provide a structure which will make them as appealing as they deserve. For example, Word provides the ability to use a wide variety of fonts and font sizes, and to display these on the screen, but few systems can match this functionality.

In other ways, the Mac might have some drawbacks as a word processing system: the keyboard has a very hard feel, more like an old-fashioned terminal; the screen is rather small for comfortable word processing; and there are no special function keys other than the mouse.

Editing
When you first load a document into Word, the display shows the main Word menu names across the top, and a conventional Mac window across the screen showing horizontal and vertical scroll bars plus the name of the document being edited. No ruler is displayed unless you request it; nor are there any indicators of horizontal or vertical position such as line number. The page number is shown, but may be inaccurate unless you have recently revised the pagination.

Unlike the majority of systems on which Word is available, the Mac has only the mouse with which to move the cursor — there is no conventional arrow key pad with the system. This could mean that professional touch-typists would spend a lot of time moving their hands from keyboard to mouse and back. To get round this, Word allows you to use a system of key combinations based on the Command Option keys; Fig 1 shows the table from the Word command key summary. Despite my years of acquaintance with the alleged horrors of WordStar control keys, I found it easier and quicker to use the mouse (except for scrolling long distances), but with practice the key layout should become familiar. No stickers are provided to aid memory.

With either system, it is reasonably quick and easy to move the cursor (which Word calls the insertion position because it dictates where text will be inserted). If you prefer to overtype, you must first select the words to be overtyped, and then enter the replacement text.

This approach to text selection is used extensively to control the action of a variety of tasks — deletion, emphasis, copy, movement to another part of the document via the Clipboard, and so on; this can be done either with the command key combinations I have mentioned, or with the mouse. While I dislike the use of mice in a context where you are doing a lot of keyboard entry, it does provide a direct approach to movement, comparable with cursor controls in other environments, and it proved easier than I expected to locate.
Among the packages available on the Mac, Microsoft's Word is rare in having been available for quite a while, rather than being specially written for the Mac. Yet, in some respects, Word could be said to have been waiting for just such a machine to come along - for many of its features are beyond the capacity of most hardware to provide in a way which will make them as useful to the user as they are on the Mac. Yet, in some respects, Word could be said to have been waiting for just such a machine to come along - for many of its features are beyond the capacity of most hardware to provide in a way which will make them as useful to the user as they are on the Mac.

The one thing which did annoy me about editing with Word keys — or rather with Mackey's — was the position of the SHIFT key. Haven't we suffered long enough from IBM's idiocy in placing it in defiance of the typewriter conventions? It's not Microsoft's fault — it is something you should bear in mind when considering word processing on the Mac.

Word provides other editing features in a sensible, easily-used way. You can search for specified words or phrases, using on the Mac. Word provides a good range of text formatting options, and with the capability to use a dialogue route, you can specify formats in a variety of units — the default is inches and decimal portions thereof, but you can choose centimetres, point, or 10 or 12 pitch if you prefer. Formats can be preset before you start to type, or they can be changed later by selecting the text to be affected. Indents can be absolute, or relative to the most recent indent; you can indent just the first line of a paragraph, or have hanging indents with all but the first line indented. If you insert text into existing material, the paragraph will be realigned as you type. This is good for authors: it means that you can edit text but not so good if you are editing from a printed draft, since the reformatting throws away the visual match between the printed and displayed versions.

Rulers and formats are stored with the document, and are automatically activated as you move between different parts of the document. It isn't usually possible to tell in advance what changes will take place, though, since Word doesn't automatically display rulers or show when they change, nor are there markers such as carriage returns at the end of paragraphs automatically displayed. All these markers can be displayed if you wish — I left the ruler displayed so that I could anticipate changes of layout — but you can't really leave the display of carriage returns set, as with it comes the display of spaces that you can inspect line endings as they are displayed; Word doesn't offer any help with hyphenation, but you can insert 'soft' hyphens to split over-long words.

Tables can be implemented using tab markers set in the ruler; tab characters are actually inserted into the text, so if you want to change the format of a table, all you need to do is select it, change the tab positions, and Word will do the rest. Tabbed fields can be left or right aligned, centred, or aligned on the decimal point for numeric fields. You would be most likely to feel the drawback of the narrow screen when typing tables: you can display six
inches worth of text, so for most ordinary documents the whole line would be displayed. But for wide tables, especially those to be printed on paper inserted sideways, part of the table would extend well beyond the width of the screen.

One of Word's strongest features is its ability to display and print text in a wide variety of character sets with several different fonts for each set. These are displayed on the screen as they will print, as are emphasis (which includes bold, underlining, two forms of shadow print, and small capitals), justification, centring, and the layout features I've already mentioned. Indeed, Word is about as WYSIWYG (what you see on the screen is what you get on the printer) as it is possible to get. With such a wealth of goodies, it seems churlish to argue that you can take WYSIWYG too far, but it's true.

The trap into which Word falls is to include line spacing in its WYSIWYG approach — if you request double-spaced lines, that is what you get on the screen. Given the limitations of a screen display, there is very little text shown. I got round this by using single-spacing until my document was complete, then changing to double-spacing before pagination, but that doesn't help much if you subsequently need to make further changes.

The line-spacing features themselves are also rather patchy. If you want either single or double-spaced text, then whatever font you use, Word will adjust the line heights correctly. If you need other spacings, you are on your own — you have to adjust the line height to an appropriate unit, taking into account the font(s) you were using. It's good that this capability exists — too many packages are getting 'bossy' in this area — but the provision of one-and-a-half spacing as a third option would save a lot of grief.

Pagination may be left until print time, or explicitly requested so that you can see where page breaks will occur. Word attempts to avoid orphans by ensuring that you will not have just one line of a paragraph printed alone on a page, but this method cannot prevent headings being separated from text where a blank line intervenes. To avoid this, you can insert

mandatory page breaks, or use instructions to 'keep the next n lines together'. Page-breaks are shown on the screen with remarkably discreet equal signs in the left margin — I found them quite hard to spot at first.

You can set up running headers and footers in your text, and change them at will; these may include page numbers which are updated automatically. Word copes with changes of page formats by separating your document into 'divisions', each with its own page format-

Goodies

The basic features Word provides are quite powerful, but there isn't a spelling checker, nor are there other, more esoteric, extras such as indexing. On the other hand, you can import pictures contract work, such as conveyancing or personnel records. The ability to store such abbreviations, either for the duration of the session or permanently on disk, and to have a number of separate glossaries on disk, gives a reasonable degree of flexibility.

For repeated text of a different kind, Word has a mailmerge feature. This allows you to set up a standard document such as a letter, specify the points within it which are to vary according to the recipient, and merge this letter with a set of variables for each recipient. The information to be merged can be created within Word, or it can be brought in from outside, for instance from a file written by the File data management system reviewed on page 198 of this issue. You can include the ability to request information, such as a date, at the time the letter and data documents are merged, and you can

You can have one for the whole document, or several within a document. Provisions for formatting within a division are very flexible. They include the ability to have true footnotes, which may be printed either on the same page as the reference or at the end of the division.

Repeated text

The glossary features for handling abbreviations within documents should be adequate for most needs, where it is necessary to directly include the text in the document. For example, this feature could be used for standard specify the inclusion of other document within the template. You can also include tests to give optional inclusion of parts of the template; for example, you might have varying degrees of severity in a letter requesting payment of overdue accounts, choosing the paragraph to use with a test for the length of time the debt was owing.

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Fig 5 Paragraph formats dialogue box

Fig 6 Part of the help menu
and tables from Chart and Plan, and reports and sets of records from File. You can export text such as tables to other packages, and in File these can be incorporated as valid File records if you use the correct Word format.

In use

Word uses a combination of pull-down menus in the standard Mac mode, mouse movements, and command key sequences. In many cases, command key sequences can be used instead of menu options or mouse movements, so that touch-typists with good memories can keep their hands on the keyboard most of the time.

The marriage of hardware and software in handling character and font display is excellent. Indeed, in almost every respect except the lack of an index, Word with Mac would be an excellent combination with which to produce a book — and with a good printer, camera-ready copy could be of a very high standard. The Apple's program writer has three modes, fast draft, medium, and high-quality, and the high-quality output would probably be adequate for most requirements. It is also possible to attach a variety of high-quality output would probably be adequate for most requirements. It is also possible to attach a variety of daisywheel printers and Apple's own, but not, as yet, the IBM high-quality output would probably be adequate for most requirements. The only area in which I had potential-

ly serious problems was in the handling of work file space. The Word disk as distributed is very full; you can remove a few things like extra printer drivers, but unless you remove the Mac Finder with its attendant useful facilities, you can't get much free space on the Word disk. On a two-drive system this shouldn't matter, but Word uses the system disk for work files, even where there is a second drive and this has been selected for use. As a result, on two occasions when I tried to save my document I got a 'disk full'

message; when this happens, you have to save immediately and then quit. On one of these occasions, I lost a couple of paragraphs in the process. I also had a few difficulties setting up running headers, but that was due to my confusion over the manual rather than a software problem.

Documentation

Word comes with a three-part manual: Learning, Using, and Reference. I found the Using section the most helpful (although the tutorial part would, I think, be good for a novice); the reference section is very summary, with all the detail being contained in the Using section. However, the cross-referencing and indexing are good, so it is in the main easy to find your way around. There is also a very useful reference summary, showing all the command key sequences, including those which are alternatives to menu options; had this included the "road map" of menus which is included in the manual, it would have been even better. The onscreen help is good, and is provided in the usual Mac fashion of pull-down menus which overlay the current text. It is possible to move the help into a part of the screen where you can see it while you carry out the task — other suppliers please copy!

Conclusion

For professional word processing — by which I mean the production of long documents, tables and personalised letters, in contrast to occasional use for short letters — Word has a lot of advantages and few drawbacks. The chief of these is the lack of a spelling checker (you may also dislike the fact that it is copy-protected). For documents with a variety of character formats and fonts in particular, Word could be invaluable if your printer could cope, too. On the Mac, you would have to balance the excellent match of hardware and software as far as screen display, the neatness of the menu system and the direct pointing of the mouse is concerned, against the hard feel of the keyboard and the absence of function keys.
Kathy Lang looks at Microsoft File, a data management system for the Macintosh with a very visual approach.

In the months since the Macintosh was launched, a major criticism has been the lack of 'serious' business software. The announcement of the availability of four Microsoft packages for the Mac—File (data management), Word (word processing), Chart (business graphics) and MultiPlan (spreadsheet) could be expected to make some dent in those criticisms. I thought it would be informative to put the data management package through its paces in just the same way as I evaluate its competitors, in order to ascertain whether the accusation of 'executive toy' can be rejected once and for all. (Word is reviewed on page 194 of this issue.)

File stores each set of records in a single 'flat' file, with no direct connections between files. Each record in a file must have the same structure, but data is stored in variable length fields. (That means it only needs the amount of space needed to store the information actually present—you don't have to allow the maximum amount that might ever be needed. In fact, the news is better than that: you are not obliged to specify the field lengths at all.) Extensive use is made of the Mac's facilities for drawing on the screen, but these are exploited more by way of allowing you to alter File's initial predispositions than by the true paint-a-screen approach more common on conventional screens. Frequentely-used fields can be indexed for fast access and permanent ordering, and the index is kept up-to-date. Records can also be sorted in other ways for display or printing, although sort order is not maintained when records change, or across sessions of using File. The reporting features are good, but do not include a letter-writer — you must link to Word for that.

**Constraints**

The major constraints and functions of File are shown in Fig 1. Within the limits of the functions it provides, File's constraints are very few. The maximum size of character field is a massive 32767; since, however, a data file cannot span a disk, the practical limits on field, record and file sizes will be the size of a disk (which must have space not only for the data file, but also for associated indexes). Data validation is limited to checking the type of data entered.

**File creation and indexing**

Data files are set up by specifying their format; the minimum to be specified for each field is the name and type. (You don't need to specify length of field — File has no concept of length in the conventional sense, in that you can hold any number of characters in any field up to the maximum of 32767, and the only thing you can vary is the number of characters displayed.) Field type may be character, number, date or picture — this last is usually used as an adjunct to the more usual data types rather than to store data itself, since the pictures such fields hold have to be imported from other packages such as MacPaint or Chart, and cannot be edited within File. For date fields, there are three options: the short option uses the American numeric convention of MM/DD/YY, the other two use three-letter abbreviations for the month name. Numbers may be shown in a variety of formats, including currency, percentage and scientific notation. Fields may also be computed from the values of others, using arithmetic operators and brackets. When you have finished setting up the record format and have left File, even if you have not yet entered any information, you can't change field types or make an existing field into a computed field. You can, however, add...
or delete fields or alter their display formats, even after data has been entered, just by amending the record format.

You can, if you wish, specify a variety of display attributes for each field, as well as indicating that the field should be indexed. Initially, two record display formats are created for each data file: a List format showing one record on each line of the screen; and a Form which shows one record per screen. You may manipulate these and create others. Setting up a new data file is therefore very easy and very quick, provided you adhere to the standard approach.

### Data input and updating

Data can be entered in either the List or the Form format. In either case, data entry is very similar to that used in more conventional systems — you use the TAB key to move from one field to another, entering data as you go. If you don’t need to add data to every field, you can use the mouse to activate just those fields which you do need to enter. Finding a place to enter a new record into a large file could be rather tedious — according to the manual, you must scroll to the end of the data file. However, if you call up the Form view of a record and press BACKSPACE before anything else, you are presented with a blank record which is flagged ‘new’ in the margin. This isn’t mentioned in the manual — I found out by accident!

Where data is repeated, you can copy fields between records automatically; you can also cut or copy records into the Mac’s Clipboard, and paste them into another part of the data file. The same approach is used to transfer records between files, either within File or to other packages such as Chart.

All data amendment is done directly from the keyboard — there don’t seem to be any facilities for automatically updating records in a batch, for example to increase a group of prices by 10 percent.

### Screen display

File provides two kinds of format for displaying records on the screen when adding or amending information. The basic format is a List, with one record per line; this is used when the rather quaintly-named ‘List Helper’ is active. This is, of course, most useful for records with relatively small amounts of information, but File exploits the Mac facilities for manipulating the screen display in a way which enables you to get the most out of this approach.

The List format initially shows each field in the record, using the display length specified (or defaulted to) when the file was set up. You can modify the List by hiding individual fields in a separate area of the screen, by reducing the display of a field to just one or two characters or moving it ‘behind’ other fields, and by highlighting some fields but not others. The real power of these features, however, comes into force when you use them to manipulate the alternative display format, which shows one record per screen.
Initially, the one-per-screen form displays each field on one row, with the label preceding a box containing space for the data value. You can use the mouse to shorten or lengthen field name and value boxes, and move them around the field singly or in groups. Groups don’t need to be contiguous initially, you can select several separate boxes and group up. Field captions can be extended, and, if you have set them up in the Clipboard in advance, pictures from Chart or MacPaint can be imported to go with your field placings to aid the ultimate form-filler or just generally make the screen look more attractive.

You may have several display formats for different purposes, and each can display a different group of fields in a variety of ways. One of these formats will be saved with your data file and used whenever you request the Form view of your data, while the others need to be explicitly requested from the File pull-down menu. Switching between the Form and List views of your records can be done in several ways, mostly involving just a single key or mouse button depression. (The Form view you switch to should be the one saved with your data file. I had a problem with that — I originally saved my data with a default Form format, and subsequently modified the form and saved it with my data file. Thereafter, when I loaded the data file it came up correctly with my own Form view, but when I switched to the List form and back I always got the default format of Form.)

Fields which are not to be displayed can be ‘hidden’, but there did not seem to be a way to prevent any user modifying the form to restore these hidden fields. You could not, therefore, use that method to provide partial access to a file, requiring a mixture of secure and public information.

Printed reports
Formatted reports can be printed, or displayed onscreen in Preview mode; you can have full reports which include data field values, or just summaries which contain totals and statistics — a very useful feature. Reports are formatted using similar features to those provided for organising your own screen formats. All the fields are displayed onscreen; you select those you want to print and use the mouse to drag them to the correct positions on the report. File can provide a count of records, plus average, minimum, maximum and standard deviation of numeric fields, as well as totals, and sub-totals by items which have been specified as sortfields. Sorting can take place as part of the reporting operation. Layout features include headers and footers, and the inclusion of page numbers and current date and time.

### SCREENTEST

When you have set up a report format, you can save it alone (so that it can be used with more than one data file), with the data file, or jettison it. You can also save the complete report in a file for subsequent inclusion in, say, a Word document.

#### Selection & sorting

To find individual records or sets, you use the Find option from the Organise menu. Once checked, this displays a version of the record form onscreen, allowing you to enter values against which records are to be tested. You can test for a field being equal to or starting with a single value or with one of several values, for a field being less than, greater than or not equal to a single value, or within a range of values. Wild codes are available for both single characters and groups of characters. You can apply tests to several fields in the same selection operation, but you have no choice about how the tests are combined — every test must be passed for the record to be selected. File shows the number of records passing or failing each test, and then displays the first record of the set selected. Thereafter, until you activate the Select All Records option, all actions such as sorting operate on this subset of records.

A file can be sorted up to nine fields, in ascending or descending order. Sort order is maintained only for the current session, or until records are added or deleted; ordinarily, records are displayed in order on the first indexed field.

#### Calculation

Calculated fields are available when data is input, and you can aggregate values when reporting. Apart from these facilities, there are no special calculation facilities in File.

#### Advanced facilities

File does not provide the ability to set up permanent links between files, nor are there any programming-like features for tailoring the way the system works to particular applications.

#### Links with outside

File can read and write files in ASCII format, using a simple but fixed layout with a TAB character between each field and RETURN at the end of each record. You can import pictures from Chart and MacPaint, and spreadsheet tables from MultiPlan, and export records to these packages via the Clipboard. This is a scratchpad area which is normally entirely in memory, but which, if it gets too large, is written out partly to the system disk (although that may not help much — on my File disk, there was only 13K available). I couldn’t discover what the precise limits on the size of Clipboard are: it would, of course, depend on how much memory your Mac has, as well as how much memory File uses. (On the 512K Mac I used, 88 per cent was free when File was loaded with a single record being viewed.)

Information can be passed between Word and File either via the Clipboard, or through files. Reports can be saved in text files, for inclusion in Word documents. Records saved in the standard export format can be merged with Word template documents to give personalised letters, and tables created in Word using tabs to separate columns can be imported into File data files.

<table>
<thead>
<tr>
<th>Benchmark times recorded on a Macintosh/F</th>
<th></th>
</tr>
</thead>
<tbody>
<tr>
<td>BM1 Time to add one new record</td>
<td>1 min</td>
</tr>
<tr>
<td>BM2 Time to select record by primary key</td>
<td>4 secs</td>
</tr>
<tr>
<td>BM3 Time to select record by secondary key</td>
<td>4 secs</td>
</tr>
<tr>
<td>BM4 Time to access 20 records from 1000 sequentially on three-character field (same field as in BM2 key)</td>
<td>1 min</td>
</tr>
<tr>
<td>BM5 Time to access record using wild code</td>
<td>30 secs</td>
</tr>
<tr>
<td>BM6 Time to index 1000 records on three-character field</td>
<td>2 mins</td>
</tr>
<tr>
<td>BM7 Time to sort 1000 records on five-character field</td>
<td>2 mins 10 secs</td>
</tr>
<tr>
<td>BM8 Time to calculate on one field per record and store result in record</td>
<td>NP</td>
</tr>
<tr>
<td>BM9 Time to total three fields over 1000 records</td>
<td>2 mins 45 secs</td>
</tr>
<tr>
<td>BM10 Time to add one new field to each of 1000 records</td>
<td>Modify form</td>
</tr>
<tr>
<td>Time to import a file of 1000 records: 16 mins 15 secs</td>
<td></td>
</tr>
</tbody>
</table>

Notes: NT = Not tested  NP = Not Possible  + = including scrolling
Where two times are given, first is access to first record, second is access to each subsequent record.
User image

File exploits the Mac facilities quite thoroughly, and I've tried to describe how this is done while discussing the functions of the package. In some respects, though, this exploitation is patchy. When setting up and manipulating screen and report formats, the 'painting' features are excellent and imaginatively used: I spent hours playing with my forms and reports to get them 'just right', and thoroughly enjoyed doing so.

However, in most real applications, people spend far more time using forms than they do in designing them. When using the forms, there are fewer facilities and they tend to be more pedestrian. For example, scrolling through a set of records is an extremely common task. Doing this in List mode is quick and easy — you just use the mouse to move the scrolling arrows in the desired direction.

But in many applications, List would be used much less than Form because of the need to display a fair amount of information. In Form view, scrolling just moves around within the display of the one record. To move from one selected record to the next, the best way I could find was to select (with the mouse) the last field in the record and press the TAB key (which, within a record, advances the cursor one field), which seemed by comparison a rather clumsy operation. The difficulties I had with finding quick ways to add extra records reflect, I suspect, another aspect of the same problem — that features such as the laying out of forms and reports are more fun to design than the bread-and-butter basic record-handling features.

That said, the overall feel of the package will, I think, be attractive to people who like using icons and a mouse. But it is a mistake to think, as many do, that such an interface can do away with the need to consider your design before you start. Particularly when designing forms and report layouts, I found a quite considerable learning curve to be involved — once I appreciated the principles, I became much faster and more accurate in my work.

In some respects, the Mac — and File — approach doesn't help as must as it might. For example, there is never any indication of how wide a field is (height is indicated by a ruler in the left margin, but width is ignored). Partly for this reason, and partly because of its physical nature, I found it quite hard to use the mouse as a precision tool for siting fields. (One of the advantages of the mouse in design work such as CAD is that it allows continuous movements, rather than the discrete movements to which cursor arrow keys are limited. But in form design work, much of the movement must be discrete.)

The lack of a gearing capability when using the mouse is also a serious
drawback to someone working in a limited space — the Mac may have a small footprint, but Mac plus mouse certainly do not! These criticisms must, of course, be balanced against the superiority of the ‘draw’ approach for many aspects of manipulating elements of forms.

As to the use of pull-down menus, I found the comparison with the approach of the Perfect II suite, which I reviewed last month using an IBM PC, fascinating. For my personal tastes, pull-down menus are extremely useful, but there is little to choose between the mouse and the use of cursor keys in selecting menu items. Since in File there are many occasions when you must use the mouse (and even where you can substitute a command sequence, you cannot see the menu without moving the mouse, whereas in most systems like Perfect you can display the menu and then use a single character key to activate an option), the advantages of the mouse for issuing commands have to be highly arguable for an experienced user. This is especially true where much of the work involves entering data through the keyboard, so that using the mouse involves taking your right hand well away from the main area of action. As far as data management applications are concerned, thus far I regard the case for the mouse to be Non Proven!

Documentation

File comes with a single manual in three main sections: Learning, Using File, and Reference. The manual is typeset, and bound in a spiral inner with card outer. There are plentiful illustrations of real screens, and the outer part of each page contains captions in heavy type giving clues about the material being described. The bulk of the material is in the Using section; the Reference section is not a comprehensive coverage of all the facilities, but a summary of each option with cross-references to the Using section. This concentrates heavily on the design features, and on using File through the List view of the data. As a result there were several functions that I just couldn’t run to earth in the manual, and had to discover by much trial and error.

That said, the material which is provided is clear and well-written, although still not as well laid out as the main Macintosh manual, which I regard as a model of clarity and ease-of-use for browsers. (The index is better than File’s, too — but at least the File manual does have an index!).

The approach in the Using section is to explain each feature in turn, and then to give a set of instructions on how to do the task with some example information. This ‘Now do this’ material is in much fainter type than the rest of the manual to visually indicate that it is optional material. This idea is better in conception than in execution — I found the fainter print very hard to read.

Conclusion

File, viewed as a data management system in competition with others in its price bracket rather than just as a Mac vehicle, provides a good range of basic features. These include quite adequate sorting, reporting and screen retrieval facilities, with excellent forms design. No letter writer is included — for that you would need to use Word — nor are there any batch processing facilities. Multi-file links or programming features. Data can be easily exchanged with the other products in the Microsoft family — Word, MultiPlan and Chart — to provide as great a degree of integration as most people will need, without imposing the penalties which closer integration usually incurs.
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A display of the Learn menu functions

Learn is a mini program generator. Remember is an intermediate code compiler, and Do is a co-resident intermediate code interpreter.

To program PC Automator, you first use Learn to generate a sequence of ACL (Automator Command Language) commands. Remember then compiles these commands into an intermediate code file which can be understood by Do, which in turn executes your commands. This may sound complicated, but is, in fact, extremely straightforward.

**Learn**

Learn is probably the flashiest part of the Automator system.

You load it into the system in the usual way by typing Learn at the system prompt. Once it is loaded, Learn sits quietly in a corner of memory noting what you are doing.

Due to Learn being co-resident, to all intents and purposes the system looks like it is empty, and you can load and run applications programs in the normal way. The only way to determine that Learn is in the system is that the cursor changes from underline to block mode. It is perfectly possible to have multiple copies of Learn sitting in memory at the same time. This can be useful for teaching the system how to use Learn.

To control Learn, you can toggle a menu display on and off by using the SCROLL LOCK and space bar keys on the keyboard. The menu is displayed on top of whatever you may have on the screen at the time, and commands are issued via the function key pad.

When Learn is first loaded, the commands available are WAIT, WHENEVER, AUTO LEARN, IF, DISPLAY A BOX, EDIT and HELP.

Probably the most-used function is AUTO LEARN. This makes a note of everything you key in and stores the sequence as Automator commands. You can toggle the Learn function on and off by pressing the f3 function key.

The Automator system makes heavy use of windows to define areas where data is to be read and written. You can have up to 19 input windows and one display window per system.
Learn makes it very easy for you to manipulate windows. Using the cursor keys you can shrink, expand and move windows to your heart's content until they are the right size in the right place.

Most of the Learn functions make use of windows. WAIT allows you to define up to six windows and wait for a specified event to occur in the window before proceeding. It can also wait for a certain amount of time or until particular keys are pressed.

WHenever allows you to specify an action to be taken when a particular event occurs. For example, I often type 'DIT' when I mean 'DIR', so I could set up a WHenever command saying 'Whenever type DIT, replace it with DIR automatically'. This command is very useful, especially for handling any errors which may occur.

IF allows you to perform the IF, THEN, ELSE, ENIF operations so beloved by Basic programmers. When you hit the IF function key, you can define up to eight windows in which to define what you want the system to do if you want Automator to perform the IF statement is true, or for the ELSE part of the operation. When you have finished the definitions, you hit the ENIF key which finishes the operation.

The final building block for the Learn segment is DISPLAY A BOX: this opens a window to display a message of your choice to help the user. As you create a system, Learn will turn your actions into useful, especially for handling any errors which may occur.

The syntax of ACL is similar in many ways to that of Basic. Although it is quite a simple command language, ACL does have a reasonable set of control structures including IF, THEN, ELSE, ENIF, REPEAT UNTIL and WHENEVER...ENWHEN. As ACL doesn't use line numbers, branching is done to labels. You can either branch to subroutines (CALL and EXIT) or you can GO (to) a label.

Windows are specified by using the WINDOWS command followed by values for window number, depth, width, and the column and row positions. When I was writing ACL programs, I found it easier to use Learn to define all the window positions rather than try to work them out by hand.

Many of Automator's features are geared to allow you to alter what is displayed on the screen of your PC, or to simulate keyboard entries in order to fool an applications program.

The DISPLAY command allows you to display strings on the screen. Using a combination of this and program control structures, you can build powerful programs which allow you to intercept the output from an applications program and replace it with your own. A good example would be if you didn't like a program's help description, you could trap the output and substitute your own.

The TYPE command inserts character strings directly into the keyboard buffer. As most applications programs read keyboard input from the buffer, you can fool it into thinking that you have typed in something when, in fact, you have not. Automator has been particularly useful here. This single command can do as much as, if not more than, most SmartKey-type utility programs I have seen.

When you couple the DISPLAY and TYPE commands with the control structures available, you have an unprecedented level of control over your applications programs. For example, you could easily customise WordStar or Lotus 1-2-3 out of all recognition simply by interrupting the keyboard input and display, and making up your own Automator alternatives. The limitations tend to come from your lack of imagination, rather than from Automator itself.

Automator supports three kinds of variables — numeric, string and system. Although these are useful, for the most part they are limited in scope because of the lack of manipulation facilities built into the programming language. The exceptions are the system variables which allow you to gain information from the system.

The system variables -DAY, -MONTH, -SECS, -TIME and -YEAR allow you to access the system clock from within Automator. In addition, -CURX and -CURY allow you to read or write the cursor position. For example, A = -CURX would assign the X coordinate of the cursor to the variable A, while -CURX = 18 would move the cursor to X coordinate 18. This is helpful when you are playing with windows.

-Delay allows you to specify how fast Automator enters data into the keyboard buffer when you use the TYPE command, which is very useful because some packages such as WordStar can only accept fairly slow keyboard input. DELAY gets around this by allowing you to output characters from Automator at a rate which is acceptable to the applications program.

Using -DISPCOL you can control the colour and brightness of the display from your program. Depending on the value from 1 to 255, you can set the foreground and background colours as well as underlining, flashing, and so on.

The final system variables are -ERROR, -STACK and -TIMEOUT. -ERROR and -TIMEOUT are used in conjunction with the WAIT command in the programming language. The value of -TIMEOUT governs how long the WAIT command will wait for something to happen before it gives up in disgust and generates an error. -ERROR allows you to trap unfulfilled wait errors, and, finally, -STACK allows you to play with the contents of the system stack.

The Do module

When you have written and successfully compiled your Automator program, you can run it by passing the compiled intermediate code file to Do.

Like the Learn module, Do is co-resident with whatever application program you are using. You can always type Do in the program you are using, and so on, could compete for the same keyboard input. DELAY gets around this by allowing you to output characters from Automator at a rate which is acceptable to the applications program.

The Do module is one of the most useful pieces of IBM software I've come across in a long time. When I first saw the product, I thought it would be much like the SmartKey-type products which do little more than assign strings of characters to keys on the keyboard. Fortunately, this is not the case.

One of my major problems when reviewing Automator was that I stopped treating it as a utility and started to use it as a full-blown programming language to do things it was never designed for. It says a lot about the facilities provided that this was possible, and as long as you stay within the limitations you can do a great deal.

Beginners, especially, can produce useful applications using the Learn applications generator, while more adventurous types can dive straight into the program code. By the time you might run into a problem is if you have a number of co-resident programs in the system as well as Automator. Desk accessory programs such as Spotlight, Sidekick, and so on, could compete for the same system resources as Automator, which could have some very strange effects.

Overall, I liked Automator a great deal. It allows you to do more than just assign strings to keys, and it works in a simple and straightforward way.
Logo is becoming well known as a programming language in schools, but its success in this field has led to it being dismissed in some quarters as 'just turtle graphics' or 'just for kids'. This is a highly inaccurate view of a fascinating language, for while it is true that Logo is an ideal introductory language, it is also a powerful high-level language which is particularly suited to processing symbols rather than numbers.

Logo certainly began as an educational language, as did Basic. But whereas Basic came out of the Fortran-based scientific tradition and was designed to deal mainly with numbers, Logo comes from the Lisp artificial intelligence (AI) tradition and was designed to deal with more general symbols. The people involved with the early development of Logo in the late Sixties were also closely involved with AI research. They believed that AI had something to say about learning, and that Lisp-like languages were necessary if people were to write 'intelligent' programs. These languages were intended to be closer to the way in which people think than the more machine-oriented, high-level languages such as Fortran and Basic.

Imagine this scenario: an MIT (Massachusetts Institute of Technology) professor comes home after a hard day hacking at Lisp code in the AI lab, and meets his kids back from school. "Hey Dad, we've been learning Fortran programming in our maths classes. The MIT professor sees red, and begins to design a new language. Now this story has no historical truth, but I believe it does capture one of the ingredients that went into Logo's origins.

Logo was initially implemented on mainframes (there were only mainframes at that time). It was used in a variety of projects during the Seventies, mainly at MIT in the US and Edinburgh University here. The projects involved such things as teaching programming to young children, learning mathematics in secondary school, exploring mathematical modelling for physics and maths undergraduates, and teaching AI at undergraduate level.

A Basic interpreter could be fitted into a few kbytes of ROM, but a logo interpreter needed around 30k as well as a fair amount of room to run in. While Basic had been easily implemented on micros, it was only with the appearance of larger memories that Logo on micros became feasible. 1980 saw the first microcomputer versions, and a language that had previously been restricted to a few universities and research labs suddenly became widely available.

Today, most micros have at least one full version of Logo. A number of Logo dialects now exist, the three most widespread being MIT Logo (the original), LCSI Logo (LCSI is a company set up by ex-MIT people including Logo's founder, Seymour Papert) and Edinburgh Logo, the home-grown (but less popular) variety.

The turtle
Start up a Logo system and you'll be presented with a 'turtle' in the middle of the screen; this is usually a triangular shape, although this varies — on the Atari it is actually a turtle shape. The turtle is an 'object' with which we can communicate. You can give it simple commands to move across the screen — FORWARD, or to turn — RIGHT 90. The turtle carries a pen and it draws a line as it moves. You can tell the turtle to lift up the pen so that it does not draw on the screen (PEN UP) or put it down again (PEN DOWN). With these simple commands we can draw shapes onscreen. If you make a mistake, such as misspelling a command, Logo will complain. The error messages are clear and to the point. Logo takes error-reporting very seriously: it is not an afterthought, but an important part of the whole system. The turtle was originally a robot that responded to the drawing commands. We've seen how to give the turtle simple commands, but communication should be two-way. The turtle can provide information about itself: where it is on the screen, whether the pen is up or down, and so on. Try the PRINT HEADING command — Logo prints out the direction in which the turtle is facing (measured in degrees, with 0 considered as straight up the screen). It is this metaphor of the turtle as a communicating object that lies at the heart of Logo's success as an introductory programming language. If you practice drawing a few shapes with the commands I have mentioned so far, you will quickly meet the need for a method of repeating a sequence of commands. For example, repeating four times the commands FORWARD 40 RIGHT 90 will produce a square. In Logo, you could shorten this by writing

```
REPEAT 4 [FORWARD 40 RT 90]
```

END

The commands I have presented so far are referred to as 'primitives'; they are part of Logo itself and are understood by the system as soon as it is loaded. Logo can also be taught new commands or procedures. You can define a procedure called 'square' by writing

```
TO SQUARE
  REPEAT 4 [FORWARD 40 RT 90]
END
```

You type this into a full-screen editor that is part of the Logo system. These editors vary slightly from machine to machine, so you will have to consult the manual as to how to use it.

We can now type SQUARE as a command, use SQUARE with other commands (for example, REPEAT 12 [SQUARE RT 30]), or even use it as a sub-procedure in the definition of other procedures:

```
TO TOWER
  REPEAT 4 [SQUARE FORWARD 40]
END
```

Logo treats these procedures exactly as if they were primitives (except that they will be forgotten when you switch off). The basic idea of programming in Logo is therefore one of extending the language by defining new procedures until it can deal with your problem. FORTH and Lisp also have this type of extensibility.

Some of the advantages of extensible languages include hiding nasty details within sensibly-named procedures, creating special environments for others to use (for example, for children's programming), and developing your programs in a top-down fashion. Logo is an interpreted language (like Basic) so you can enter anything you can think of and Logo will do its best to understand it.
like into a procedure definition. When you ask Logo to obey that procedure it goes word by word through the procedure, obeying the primitive commands as it comes to them, or looking up the definitions of any sub-procedures and then running them. Only if a procedure is not present at the time when Logo wishes to run it will it complain: you can write your top-level procedures using lower-level procedures that you have not yet written.

While top-down design of programs is a good thing, you may be glad to learn that Logo is also open to other methods of use. The most interesting programs are not written top-down, or bottom-up for that matter, but rather 'middle-out' (that is, by writing a program to solve an interesting bit of the problem and then expanding, adding and refining). Most Logo programs are written that way.

**Variables**

The procedure SQUARE always draws a square of side 40 units. In this sense, SQUARE is rather like a primitive such as PENUP which only has one possible effect. Some other commands, such as FORWARD, are followed by a number which acts as an 'input' and determines the exact action to be taken. We can write a SQUARE-drawing procedure which requires an input in this way:

```
TO SQUARE :SIZE
  FORWARD :SIZE
  RIGHT 90
  SQUARE :SIZE
END
```

To call this procedure we now type SQUARE 40, Logo looks up SQUARE in its list of known words, and the turtle goes forward 40 units and turns right 90 degrees. Logo then sees that it must now do SQUARE 40, so it looks up SQUARE and the turtle goes forward 40, turns right 90, at which point . . . The procedure will run forever, so after it has drawn the square and is retracing its steps, you stop the turtle (CTRL-G stops Logo in almost all versions).

That's a fairly unusual way of drawing a square, but what about the 'square spiral' shown in Fig 1? Think about drawing this starting from the inside. The turtle must first do FORWARD 5 RIGHT 90, and then carry on with the rest of the spiral. But the rest of the spiral is almost the same as the whole spiral, if you see my point. I'm suggesting that this shape—a spiral beginning with length 5—is made up of two parts, FORWARD 5 RIGHT 90, followed by a spiral beginning with length 10. So, in Logo:

```
TO SPIRAL :SIZE
  FORWARD :SIZE
REPEAT 4 [FORWARD :SIZE RT 90]
END
```

To call this procedure we now type SQUARE 30 or SQUARE 60 in order to get squares of side 30 or 60 respectively. SIZE is called a 'variable' and it works in this way: whenever the procedure is called, Logo stores away the number following SQUARE in a 'box' and sticks the label SIZE onto it. Then, later, when Logo sees :SIZE, it finds the right box and replaces :SIZE by the value it finds there.

The variable used here is said to be 'local' to the procedure call: that is, as soon as the procedure has finished running, Logo forgets that it ever had a variable called SIZE. This way of using variables is very similar to the formal parameters in a Pascal procedure definition, but is rather unlike the way variables are used in Basic.

The reason for the colons (read them as dots) will be fully explained next month. For the time being, you can take it that a word with : in front of it must be the name of a variable. No : means that the word is the name of a primitive or of a procedure.

**Recursion**

```
TO DAILY.GRIND
  WORK
  SLEEP
  DAILY.GRIND
END
```

Here we have defined a procedure in terms of itself. This is called 'recursion' and is widely believed to be a highly mysterious process. Not so! Look at this definition of a square:

```
TO SQUARE :SIZE
  FORWARD :SIZE
  RIGHT 90
  SQUARE :SIZE
END
```

When you type SQUARE 40, Logo looks up SQUARE in its list of known words, and the turtle goes forward 40 units and turns right 90 degrees. Logo then sees that it must now do SQUARE 40, so it looks up SQUARE and the turtle goes forward 40, turns right 90, at which point . . . The procedure will run forever, so after it has drawn the square and is retracing its steps, you stop the turtle (CTRL-G stops Logo in almost all versions).

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REPEAT 4 [FORWARD :SIZE RT 90]
END
```

To call this procedure we now type SQUARE 30 or SQUARE 60 in order to get squares of side 30 or 60 respectively. SIZE is called a 'variable' and it works in this way: whenever the procedure is called, Logo stores away the number following SQUARE in a 'box' and sticks the label SIZE onto it. Then, later, when Logo sees :SIZE, it finds the right box and replaces :SIZE by the value it finds there.

The variable used here is said to be 'local' to the procedure call: that is, as soon as the procedure has finished running, Logo forgets that it ever had a variable called SIZE. This way of using variables is very similar to the formal parameters in a Pascal procedure definition, but is rather unlike the way variables are used in Basic.

The reason for the colons (read them as dots) will be fully explained next month. For the time being, you can take it that a word with : in front of it must be the name of a variable. No : means that the word is the name of a primitive or of a procedure.
In this case, it is natural to describe the shape in terms of recursion; any other description would be rather artificial.

In attempting to understand how this procedure works, bear in mind that each time SPIRAL is called, a new variable called SIZE is created. Each value of SIZE is known only to that particular procedure call. Think of each procedure call as producing a copy of the original procedure, complete with its own library of local variables.

The alternative to recursion is to use 'iteration', which is the name given to repeating chunks of code using WHILE/WEND, REPEAT/UNTIL and FOR/NEXT loops, or even GOTOs. In Logo, REPEAT is used for very simple situations, but otherwise recursion is usually used in preference to iteration.

Two objections are often raised to the use of recursion: firstly, that it is difficult; and secondly, that it uses a lot of computer memory. The reason many people find recursion difficult may simply be unfamiliarity. Some computer languages (most versions of Basic, Fortran and Cobol) do not have recursion, and even languages that do (Pascal) never really encourage its use. There are, however, a great many problems in computing that are most easily, and most naturally, expressed using recursion.

The problem over use of memory is a real one. Most versions of Logo alleviate this problem somewhat by efficiently implementing so-called 'end recursion' — that is, procedures in which the recursive call is in the last line. In this situation, recursion does not use any extra memory as it runs. It is often worth recasting procedures into an end recursive form if it is possible to do so.

The only way to get used to recursion is to use it. Turtle graphics is an ideal area in which to learn to think recursively. You may find it strange at first, but it won't be long before it is iteration that begins to seem slightly difficult.

Recursive procedures that carry on running until they are stopped by typing CTRL-G are of limited usefulness. A couple of recursive procedures from real life illustrate the solution to the problem of stopping:

TO ADJUST.SOUND
IF LOUD.ENOUGH THEN STOP
TURN.CONTROL
ADJUST.SOUND
END

TO DRINK
IF UNCONSCIOUS THEN FALL.OVER
SWALLOW.BEER
DRINK
END

These are examples of 'stop rules' which are implemented using the familiar IF/THEN structure. You can do exactly the same thing in Logo, so to stop the spiral program as soon as the length of the side exceeds 100, write:

TO SPIRAL :SIZE
IF :SIZE > 100 THEN STOP
FORWARD :SIZE
SPIRAL :SIZE + 5
END

When Logo meets STOP in a procedure, it stops executing that procedure and returns control to the procedure that called it. If the procedure was called from the initial command mode ('top-level') then command returns to there.

Here is another example which draws a series of shrinking squares, one on top of the other:

TO TOWER :SIZE
IF :SIZE < 5 THEN STOP
SQUARE :SIZE
FORWARD :SIZE
TOWER :SIZE - 5
END

LCSI Logo uses a slightly different syntax for IF. In this version you write IF :SIZE < 5 [STOP], where the THEN is omitted, and the action is given as a list.

Example program

Let's tie all these threads together by writing a program to draw the 'snowflake curve', which is a recursively-defined curve. Fig 2 shows how the curve is defined: an equilateral triangle forms the level 0 curve. Take each side, divide it into three parts, and construct an equilateral triangle on the middle section. This is the Level 1 curve. Now take each line in the drawing and repeat the process of division to get the Level 2 curve, and so on.

The start is easy enough:

TO SNOW :SIZE
REPEAT 3 [FORWARD :SIZE RIGHT 120]
END

draws the level 0 curve, but you now need to replace the straight side (FORWARD :SIZE) with a more complex shape which is dependent on the level. Your second attempt therefore is:

TO SNOW :SIZE :LEVEL
REPEAT 3 [SIDE :SIZE :LEVEL RIGHT 120]
END

As to drawing the side, if it is level 0 then it is simply a straight line. Otherwise it is made up of four sections, each of one lower level.

TO SIDE :SIZE :LEVEL
IF :LEVEL = 0 THEN FORWARD :SIZE STOP
SIDE (:SIZE / 3) (:LEVEL — 1) LEFT 60 SIDE (:SIZE / 3) (:LEVEL — 1) RIGHT 120 SIDE (:SIZE / 3) (:LEVEL — 1) LEFT 60 SIDE (:SIZE / 3) (:LEVEL — 1) END

This is part one of a six-part series.
Just because you bought an IBM computer, you don't have to miss out on the JUKI 6100.

It did seem a trifle unfair, after all. Because the JUKI 6100 quickly became one of the best-selling letter quality daisywheel printers in the UK. So now we've introduced the brand-new JUKI 6100-I, which, as the suffix suggests, is IBM graphic printer compatible. It has all the features of the original 6100, including graphic mode and full word processing support, yet it costs just £379 plus VAT.

Another new release is the highly successful JUKI 6000. There aren't many letter quality daisywheel printers designed specifically for use at home. The high speed JUKI 5520 dot matrix printer is a stunning example of high quality advanced technology at a remarkably low price. Complete with graphic mode, it's ideal for your personal computer, and even has an optional 4-colour print function.

See them all for yourself at your local JUKI dealer.

They may not have been out for long, but they'll be around for a good deal longer.

*IBM is a trade-mark of IBM Corporation.
Living computers stalk the Silicon Valley spys in this months selection of books. David Taylor dips into the realms of disbelief.

Alive, alive-o
Title: The Biology of Computer Life — Survival, Emotion and Free Will
Author: Geoff Simons
Publisher: Harvester Press
Price: £15.95

Fundamental questions are raised by this peculiar book including the question of whether computers are capable of appreciating any sort of morality. The question of whether computers will evolve sexual feelings, and the question of whether Geoff Simons, author of a previous thought-provoking tome Are Computers Alive?, is more or less off his chump.

I mean you do wonder. Mr Simons, chief editor at Manchester’s National Computing Centre, is one who believes vehemently that computers are fast becoming a new type of living creature. Notwithstanding that he’s well aware of all the fuzzily philosophical and semantic ifs and buts surrounding such a concept — What does living mean? What defines thought? — Mr Simons is himself such a live wire that he too easily gives the impression that computers are about to take over the Earth’s unsteady reins any minute.

I was reminded, as I reeled through this book’s ever more bizarre and fanciful predictions, of a day the BBC once persuaded me to spend in the company of Erich von Däniken. He, though superficially lucid and a best-selling author besides, tends to unsettle his audience by taking it as read that many of life’s imponderables can be put down to the fact that once upon a time-warp, Little Green Men looked in on us. For him it stands to reason that they’ll shortly be back.

Von Däniken, some might suppose, has stepped over the thin dividing line between far-seeing conjecture and the nuthouse. Whereas Geoff Simons has (to date) only got perilously close to the edge. What will happen in the next half century with computers, or with anything else — even supposing there is a next half century — is anybody’s guess. Most of us prefer to get by pro tern on the assumption that we’ll manage for the next dozen years or so and maybe think again after that.

Mr Simons is hell-bent on thinking through everything now. It is his technique of combining obscure academic references with hip, James Burkeian phrasing of sensationally ooh-er predictions which I find intensely irritating, for example ‘It is highly
likely that computer organisms will evolve consciousness... but we should also remember that much important human information processing is unconscious: we can recall such unconscious (or semi-conscious) accomplishments as Poincaré's identification of the transformations used to define Fuchian functions with those of non-Euclidean geometry and Kekulé's formulation of the structure of the benzene molecule.

Personally I could not, off-hand, recall either one. It makes it hard to leapfrog alongside go-getting Geoff into believing that my PC is poised to go conscious, go unconscious, or come to that go and make a pot of tea off its own bat.

Call me a stick-in-the-mud realist, but I find life's hard enough, for the moment, getting to grips with DOS. 'We can speculate,' chunters on Mr Simons ters evolving feelings, 'on what emotions will be like in organisms able to evolve feelings, 'on what emotions will be like in organisms able to process information at the rate of hundreds of millions of operations every second'.

We can indeed. Or we can speculate, for that matter, on whether pigs might fly. My point is that in either case, we ought perhaps to speculate yet again on where such extravagant speculation gets us. Apart, that is, from into print.

Floppy days are here again
Title: Disk Basic On Your Micro
Authors: Michael Chadwick & John Adrian Hannah
Publisher: Sigma Press
Price: £7.50

A happy hacker's starter for those moving over for the first time from cassettes to floppy storage and full of hints like don't leave disks in the rain or write them wearing their jackets with a bino. You're shown how to file your friends' phone numbers or catalogue your books. You get 40-odd programs to fiddle about with—Basic tailored for BBC, VIC-20, Applesoft and MS-DOS machines—and potentially hours of fun if you're more absorbed by DIY than running off-the-shelf applications. Nothing startling, but not bad for £7.50 if you've finished your homework.

Cloak and dagger
Title: Espionage in the Silicon Valley
Author: John D. Halamka
Publisher: Sybex
Price: £8.85

This is all very unsavoury stuff. In an all-American gee-whiz and pruriently chop-smacking fashion, it details a catalogue of hi-tech spy cases which have bedevilled California's Silicon Valley and given even hard-bitten FBI agents pause for thought.

Murder, bribery and extortion infest a text which, we're assured, is factually based but is 'far from being open to wide-eyed, open-jawed attention. We get to meet James 'Jimbo' Harper, whose alcoholic lover had access to classified security files and was prepared to pass on copies to Polish intelligence in exchange for well-stuffed plain envelopes.

Out of the woodwork comes Larry Lowery, a black-market chip dealer and generally nasty piece of work now awaiting trial on charges of dumping off a heroin addict who was scheduled to testify against him in a $3.2 million chip theft case.

And we get lots of smudgy pictures and Xeroxed letters to lend authenticity to a nauseously seedy tale—one which perhaps could have been sub-titled Silicon Valley of the Dolls. In a word: yech.

Yet more DOS
Title: Running MS-DOS
Author: Van Wolverton
Publisher: Microsoft Press/Penguin
Price: £16.95

This Microsoft-with-Penguin paperback is handsomely produced, and more chattily accessible than IBM's pink ring-binderful. But as one who has hammered along and hard at the original manual anvil of PC-DOS, I wondered how much I might discover that I hadn't already known. To which the answer proved to be, as Van Wolverton might put it, zilch.

Well over fifty PCs, aside from IBM's oldstager, now use Microsoft's masterpiece (or a slightly tailored version of it) as their operating system. That looks like reason enough to do a primer. The only snag is, of course, that well over fifty PC makers have already done it and, in the case of the most universally known IBM version, done it comprehensively well.

So what's the point? Simplicity, modest Mr Wolverton says. His book skips the knottier passages of the senior manual and more succinctly arranges what you need to know to get applications up and running chop-chop. It assumes nothing, Braille keyboards.

I found it pretty absorbing, despite the lack of surprises. Van Wolverton has an easy as well as authoritative style and makes a good job of those areas where the IBM manual is not at its best describing EDLIN, for example, or getting together batch files.

I don't as a rule welcome manual re-writes when the original is half-way decent, but this one is sufficiently well produced and civilised in its approach to deserve a recommendation.

Does he like computers?
Title: Micros For Handicapped Users
Author: Peter Saunders
Publisher: Helena Press
Price: £5.95

There is a notorious approach, invariably well-meaned but stupidly insensitive, just the same, of talking down to the physically disabled as if they were all mentally handicapped too.

Hardly surprising, it is deeply frustrating for those suffering from physical misfortune, but whose wits are as sharp as anyone else's, to be treated as if they are only to be addressed via an interpreter. It is an attitude which the BBC (whose programmes for the handicapped are as a rule excellent) brilliantly parodied in a radio series called Does he take sugar?

In the case of the mentally handicapped, also, there is too often the public supposition that they can only ever be addressed in absurdly simplified or grotesquely coochy-coo terms—taking no account of the fact that mental handicaps vary enormously in their severity.

Perhaps for such reasons, the pleasures and benefits which the handicapped can quite obviously gain from mastering micros are widely underestimated. Scarcely any computing books address the possibilities with so much as an addendum. But this one, part of a commendable series from Yorkshire's Helena Press, does its best to combine encouragement for the idea of computing (with several very moving case histories) and hard information.

With an enormous amount of well-researched reference, it describes how the disabled can set about getting started or finding out more about what's available from specialist suppliers and agencies, like switches worked just by a blink, electropalatographic brain keyboards.

The main text is regretfully uneven (several writers are included) and, to an indefensible extent, it patronises the reader. 'What about the power supply?... we are for example asked, 'all those trailing wires and plugs and switches?'. Nevertheless this book is of course to be welcomed: the information content is high, the need for it even higher. Micro-computers can often readily provide the stimulation and fascination of which many disabled people feel in desperate need. As this book's foreword points out, it is the ability and the disability which we should rightly concentrate on.

JUNE 1985 PCW 211
SPECTRUM EXTENDED BREAK

Are you a machine code dabbling with a Spectrum? Do you keep getting stuck in endless loops? If so, the routine in listing one (or listing two if you don't have an assembler) should help. It 'extends' the function of the BREAK key by so that it functions not only at the end of every Basic statement, but also every fifteenth of a second, even when executing machine code.

Z80 mode 2 interrupts are used to jump to the routine, which executes the housekeeping tasks (keyboard scanning and clock) normally undertaken by the Spectrum interrupt system, and then tests the BREAK key (using the ROM routine at 1F56 hex). If this is pressed, an error 'L BREAK into program' is caused by a routine at 1F54 hex. If this is not found, the system must be restarted, since it is self-disabling.

The routine can cope with:

(i) Hardware crashes (an interface I speciality!)
(ii) Any situation in which interrupts are disabled (most peripheral operations)
(iii) Any situation in which other mode 2 interrupts are set up (many machine code games)
(iv) Any situation in which the system variable ERR-SP is altered

Apart from these restrictions, it makes a very useful tool for debugging that latest machine code masterpiece that will keep crashing!

P F Heesom

Listings

Listing 1: A Z80 SUBROUTINE CODE

1000 INT 3:RET 56
1001 INT 3:RET 56
1002 INT 3:RET 56
1003 INT 3:RET 56
1005 INT 3:RET 56
1007 INT 3:RET 56
1009 INT 3:RET 56
1010 INT 3:RET 56
1011 INT 3:RET 56

Listing 2: A BASIC LOADER

10 LET X=0
20 IF X$=55777 TO 5580:READ A:LET T=1:T=A:POKE X,A:NEXT X
30 IF X$=1976 THEN GOTO 100
31 LIST X$=65500 TO 65507:READ A:LET T=1:T=A:POKE X,A:NEXT X

Setting the clock

defr AT 1154H
10 ORG D9E1H
20 IM 2
30 EI
40 ED 47
50 CT
60 RST 8
70 ED 1H
80 ED 1H
90 ED 1H
100 ED 1H
110 ED 1H
120 ED 1H
130 ED 1H
140 ED 1H
150 ED 1H
160 ED 1H
170 ED 1H
180 ED 1H
190 ED 1H
200 ED 1H
210 ED 1H
220 ED 1H
230 ED 1H
240 ED 1H
250 ED 1H
260 ED 1H
270 ED 1H
280 ED 1H
290 ED 1H
300 ED 1H
310 ED 1H
320 ED 1H
330 ED 1H
340 ED 1H
350 ED 1H
360 ED 1H
370 ED 1H
380 ED 1H
390 ED 1H
400 ED 1H
410 ED 1H
420 ED 1H
430 ED 1H
440 ED 1H
450 ED 1H
460 ED 1H
470 ED 1H
480 ED 1H
490 ED 1H
500 ED 1H
510 ED 1H
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810 ED 1H
820 ED 1H
830 ED 1H
840 ED 1H
850 ED 1H
860 ED 1H
870 ED 1H
880 ED 1H
890 ED 1H
900 ED 1H
910 ED 1H
920 ED 1H
930 ED 1H
940 ED 1H
950 ED 1H
960 ED 1H
970 ED 1H
980 ED 1H
990 ED 1H
1000 ED 1H

Familiarisation with most of these procedures can be done with little more than a PROC call and an END. The procedures will work on Basic 1 and OS 1.2, and should work on both the BBC and Electron. F Timer: adds together two items, on a 12-hour clock. The times must be in REAL format, with the minutes forming the decimal part, for example, 8.45 + 0.15 = 9.15.

P Error: error-handling routine, used to allow controlled abortion of program. Needs to be customised for particular applications, but can be used, for example, to close files, disable printers, return edit function, and so on. Also prints out the line at which the error occurred, allowing speedy editing and correction. Must be enabled by having ON ERROR PROCCerror as (preferably) the first line of the program.

PLoad: to get and validate the file name of an input data file. The file is then *LOADed at address 80300, to allow data to be read using induction (or possibly P Readln). The address of the top of the data file is stored in the 'memtop.' Could be modified fairly easily to save data to file in the same format.

P Key Scan: a keyboard scan routine that uses INKEY (0) to avoid holding up a program. Four parameters are required: format%- selects valid characters to be read (X%, y%) - TAB (X%, y%) print position nchars%- the maximum length of the input line

The routine prints out the line input, and allows deletion of characters until RETURN is pressed, when the flag return% is set TRUE and the input is put into variable com$. The value of format% determines what inputs are allowed. A value of 0 reads any character from the keyboard, 1 turns lower-case letters to upper-case, and 2 allows numerics only. The routine must have variables initialised before use: comS$=STRING$(255, " "):wipe%=TRUE.

S L Williams
Anyone who has spent time roaming around their Memotech memory via the PANEL command will find this assembler program of much use, as it allows the disassembled code to be printed out by using the system variable FEXPAND. A point to note is that this program is designed for use with the DMS80 printer; other printers may require a different bit check in the status routine (see your printer manual for further details). This program is executed (after typing RUN to reset the FEXPAND variables) by entering PANEL, then using the list command L to disassemble an area of RAM. Execution of the utility then requires only a press of the P key (make sure your printer is switched on!), and you get an instant hard copy.

For details of how to enter this program into your machine, see the assembler section of the Memotech manual.

**Program notes**

The program is label-driven and is totally independent of its position in memory, hence the lack of memory locations to the left of the assembler.

Consequently, the program will run on any MITX regardless of its memory capacity. This program was written by a member of the Memotech Owners' Club. Anyone wishing to enquire further about the activities of the club should send an SAE to: MOC, 23 Denmead Rd, Harefield, Southampton SO2 5GS. The annual subscription is £7. Any other Memotech submissions are always welcome.

**Label explanations**

**STRT-FINI** : set system variable FEXPAND

**PANEL** : check for P key press

**START** : main program loop

**LPRINT** : cause line feed and carriage return

**WAIT/LOOP1** : idle loop

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SUBSET

David Barrow presents more documented machine code routines and useful information for the assembly language programmer. If you have a good routine, an improvement or conversion of one already printed, or just a helpful programming hint, then send it in and share it with other programmers. Subroutines for any of the popular processors and computers are welcome but please include full documentation. All published code will be paid for.

Send your contributions to Sub Set, PCW, 62 Oxford Street, London W1A 2HG.

Z80 SOUNDTEX

SOUNDTEX from John Hardman of Wellington (alias JSOH 635 of W452) is a Z80 implementation of the 'Soundex' system — a fairly reliable method of coding inexact data which dates back to the US census of 1890. Incidentally, John doesn't think a computer was used at the time, and he is quite right, but the 1890 census does figure prominently in computing history nonetheless. It was the head count which killed the bookmark trade by introducing Herman Hollerith's punched cards to the US census of 1890.

To encode a name or similar data as a sequence of one letter and three digits, with truncation or zero padding as necessary. Encoding a head name follows six rules:

1. Write the name as you think it is spelled.
2. Retain the first letter.
3. Ignore spaces, punctuation and non-codable letters.
4. Replace second and subsequent letters by their group code:
   - group 1: BFPV
   - group 2: CGJKSXZ
   - group 3: DT
   - group 4: L
   - group 5: MN
5. Delete consecutive repeat digits.
6. Truncate or append zeros to give a four character result. The method produces identical codes for phonetically similar names, simplifying reference where idiosyncratic spelling can be a problem: for example:
   - code J565: Barney, Bernie, Bram, Brian, Bronwen.
   - code J500: Jamie, Jan, Jane, Jenny, Jim, Joan, John, Jean, Jenima, Jennie.
   - code J260: James, Janica, Johannes, Jonas.

John suggests an ideal modern use for the system — dealing with telephoned orders or queries from existing customers. How often have you fumed at the time wasted in having to spell both your name and address on a peak-rated long-distance call? A quicker response is possible, preventing aggravation and keeping charges low, if customer accounts can be accessed by a Soundex code key formed from the received sound of the name and address. And, of course, a name spell request is out of the question when processing after-hours orders left on an answering machine.

DATA SHEET 1

<table>
<thead>
<tr>
<th>FOOTNOTE</th>
<th>ACTIONS</th>
</tr>
</thead>
<tbody>
<tr>
<td><strong>SOUND</strong></td>
<td>Convert name to 4-character Soundex code.</td>
</tr>
<tr>
<td><strong>J08</strong></td>
<td>To encode a name or other word data as a one-letter, three digit sequence where phonetically similar data results in identical code.</td>
</tr>
</tbody>
</table>

- **ACTION:**
  - WRITE 'B': Reset write-pointer.
  - count = 0.
  - READ (upper-case) char.
  - IF char >> 'A' OR char < '1': THEN
    - REPEAT C.
    - WRITE-char.
    - count = count + 1.
  - IF count = 0 THEN
    - (lastchar OR char)
    - REPEAT E.
    - READ (upper-case) char.
    - IF char >> 'A' THEN
      - (tabcount + 6)
      - REPEAT F.
      - (tabgroup OR char)

C6H2

214 PCW/JUNE 1985
**8086 DISPLAY MAINTENANCE**

Our first code for the Intel 8086 (and its 8-bit databus stable mate, the 8088) comes from B.J. Clayton of Bexleyheath. SCNUPD is a routine to maintain a display which may be independent of the system, perhaps at the far end of a serial line. The routine works by rapidly checking the ASCII codes in an update screen buffer (containing recent input) against those of a current screen buffer (present display state). On finding an updated character, it escapes from the repeating CMPSB instruction, calculates the character’s line and column position and outputs it to a display cursor subroutine, outputs the character’s ASCII code to a display print subroutine and copies the character to the current screen buffer. Having found one updated character, SCNUPD intelligently checks the highly probable condition of an updated following character. In this case calculation and output of the cursor position is unnecessary. The secondary loop NCHAR, which needs only to change the character at each incremented cursor position, continues until a non-updated character is found, when the quick buffer scan is resumed.

280 and 8080 programmers might look with envy at the two single-line instructions which perform the quick buffer scan. The combined REPNZ CMPSB operation executes in 11 + 2*8 clock cycles (T states) with the following iterative sequence: 1. Exit sequence if CX = 0. 2. Service an interrupt request. 3. Compare the memory bytes addressed by DS * 16 + SI and ES * 16 + DI, setting Overflow, Sign, Zero, Half-carry, Parity and Carry-result flags. 4. Increment or decrement SI and DI. 5. Decrement CX. 6. Exit sequence if zero flag = 0 (bytes differ).

**DATASHEET 2**

**MODE FLAGS**

The 8086 has instructions which auto-increment or auto-decrement depending on the state of a direction flag DF. Like the decimal flag D, which causes the 6502 to perform binary or BCD arithmetic, the 8086 DF flag sets an operating mode which changes the meaning of some instructions.

The unknown state of a mode flag can cause errors within stand-alone subroutines. Unless it is explicitly set or reset at the start of the routine, it becomes a necessary input condition. This may be fine when the subroutine is written to be an integral part of a complete program and the mode state is controlled. However, in more general-purpose library routines — the Subset Class 1 standard — should operate correctly in unknown conditions and can only do that by controlling their own mode state.
Twice is not enough — the third episode in the Ultima story kicks off this month’s selection of the best games around for the Atari, Commodore 64 and Spectrum. Stephen Applebaum is your intrepid fall-guy.

For a little peace . . .

Title: Ultima Ill: Exodus
Computer: Atari, Commodore 64 (and others from Softsel only)
Supplier: Softsel, US Gold
Format: Disk
Price: £49.95 (Softsel), £19.95 (US Gold)

Traveller, beware — something stirs in the land of Sosaria. The hard-earned peace, fought for many moons ago, has been shattered by a devouring evil. Once more the sound of Orc drums, banished from Sosaria with the fall of Mondain and Manax, has pierced the calm air, striking terror into the hearts of the happy and prosperous subjects of Lord British.

Little is known about the new protagonist. The only clues are the babblings of a fright-stricken old man, an incomplete cloth map and the word ‘Exodus’, scrawled in blood on the deck of a wrecked ship. As you are the chosen one, it is up to you to make sense of these cryptic clues and banish the evil from Sosaria forever.

The quest starts with the player defining a number of characters who will fight for Lord British. Up to 20 individuals can be selected from the five races that inhabit Sosaria: Human, Elf, Dwarf, Bobbit and Fuzzy.

When all the characters have been chosen, they can be divided up into groups of four. These ‘parties’ are far more reliable than a single, loner character as all the members are able to rely on each other, making them collectively stronger in battle.

The land of Sosaria is vast and contains many towns (usually the first stop-off point) where armour, weapons, food and other provisions can be bought, and snippets of information gained from some of the inhabitants. As well as the mostly friendly towns, a party is likely to stumble across one of the many dungeons dotted over the land. For the most part a dungeon is depicted as a now-familiar 3D maze. Although they are dangerous places, and hold death for unwary travellers, the dungeons are often a source of help and players will have to visit them if they are to complete Ultima Ill.

The greatest problem facing the explorer are the other nasties that inhabit the land. Most of these will engage you in combat, so you have to make sure that all your characters are armed with either weapons or magic.

A battle is depicted by a special combat screen, showing both the player’s party and their assailants. Skirmishes often involve hand-to-hand combat as well as spells being thrown back and forth.

If you see that one of your characters is going to die, it is best to restore the game and go back to your last saved position. Although this sounds drastic, it is a good idea because when a character is killed, the program wipes it from the playing disk completely, making you one man short. The only way to return the group to full strength is to restart the game from scratch.

Unfortunately, I can’t describe the whole of Ultima III as it’s such a complex adventure. I hope, however, that this small taster has been enough to whet your appetite for more.

Anarchical bad taste is the best way to describe Seaside Special, a game which unashamedly pokes fun at Maggie’s cabinet — the one made up of MPs that is, and not the one containing Dennis’ drinks.

On a moral level Seaside Special, which involves bumping off figures such as Norman Tebbit and Nigel Lawson with radioactive seaweed, might appear rather unethical, especially in the wake of the Brighton bombing. Taken for what it is, however, Seaside Special is nothing more than a great piece of surreal fun, a kind of computerised Spitting Image.

Unfortunately, the game’s writers do not have the affrontery of the Spitting Image team and have concocted a ludicrous Invasion of the Body Snatchers-type scenario so as not to cause
The witching hour

Title: Cauldron
Computer: Commodore 64, Spectrum 48K
Supplier: Palace Software
Format: Cassette
Price: £7.99

Cauldron is one of the few British games which is graphically on a par with some of the better software produced in the States. The witch looks impressive, zooming across a moonlit sky, while the house, complete with thatched roof and smoke wafting from its chimney, is a real joy to look at. I am looking forward to seeing Leinfellner's next game.

Crowning glory

Title: Talisman
Computer: Spectrum 48k
Supplier: Games Workshop
Format: Cassette
Price: £7.95

Cauldron should change your mind about this young programmer's ability. Although it draws heavily on both Defender and Manic Miner, Cauldron's excellent graphics take it way out into a class of its own.

The simplicity of Talisman's scenario betrays just how difficult the quest itself is. But for those who like to know who is doing what to whom, here's a quick run-down of the story so far.

The old overlords have been overthrown and evil forces have once again taken over the land. The player's task is to locate the object, in this case the Crown of Command, that will thwart the nasties' dirty deeds.

Before setting out on the quest, each player must first select a character. There are 10 to choose from, ranging from an elf to a sorceress, each one having different abilities. If only one player is taking part, he can play the game as a straight adventure by selecting a single character. Alternatively, masochists can compete with up to three other computer-controlled personalities. I must warn you that this makes for a very difficult game, and should be avoided by novices.

In play, Talisman is virtually a mirror of Valhalla. The screen is divided into three windows. The top one displays the present location and any characters around at the time, while the middle and bottom windows give the condition of the character of the player whose go it is and detailed pictures of the objects present, respectively.

Another option, selected by pressing SPACE, enables a player to check at a glance the status of all the other characters. I found this useful for checking on their 'health' to see if they were weak enough to risk fighting. As well as the odd punch-up there are various tasks to be completed, puzzles to be solved and friends to be won over. Unfortunately, I did not get far enough into the game to find the Crown of Command, as I was constantly killed.
Time out
Title: World Series Baseball
Computer: Commodore 64, Spectrum
Supplier: Imagine
Format: Cassette
Price: £7.95 (Commodore), £6.95 (Spectrum)

If you are tired of playing American football and Mr Wimpey leaves a bad taste in your mouth, take a look at World Series Baseball, a 'new' Imagine game based on our ancestral cousin's butch version of rounders.

WSB is for one or two players and should excite even the most weary gamer. The playing area is displayed as a view overlooking a massive sports stadium dominated by a large video screen. A game starts with each team running onto the field and taking up their positions, either batting or fielding.

The player taking the part of the pitcher (bowler) can pitch a ball in one of eight ways, depending on the direction of the joystick. For instance, pushing the stick forward and pressing the fire button releases a 'high ball', while the opposite produces a low ball.

Once a pitch is thrown, the opposing team has decided to make a run, the fielder can try to get him out by throwing the ball to one of his team-mates who then touches the appropriate base with the ball. Of course, a player can also be caught out.

Batting is rather more difficult than fielding. When a ball is bowled to your batsman, the giant video screen shows an enlarged side-on view of the ball flying towards the batter. Even with this feature I still found myself either swinging the bat too early or too late, and generally missing the ball.

A nice feature is the 'crowd pleaser' sequence where a line of cheer-leaders, pom-poms and all, run onto the pitch sporting the colours of the home team. After a swift jig they run off to be followed by the two teams.

World Series Baseball is a game which should keep most people happy. I was disappointed with the unimaginative sound effects, but on the whole they were compensated for by the unusual display.

Bouncing babies
Title: Pogo Joe
Computer: Commodore 64, Atari + joystick
Supplier: Softsel
Format: Disk + cassette
Price: £24.90 (Commodore) £24.78 (Atari)

Pogo Joe is another Q*Bert-type game.

No, wait... don't turn away, this one is really different... promise. Like old Bert, Joe's one enjoyment in life is bouncing around cylinder tops in order to change their colour. 'So what's different?' I hear you cry. Well, the major difference is the excellent screen display, and animation that is far superior to anything else along the same lines, the closest you are likely to come to true arcade quality.

As Joe pogos his way around the screen, several eggs appear amid an impressive explosion of white dust. These hatch into a host of different characters, ranging from toy spinning tops to tiny yellow elephants in blue suits. (Not surprising, when you consider that the game is for six-years-olds upwards.) Some of these little characters run away from Joe and can be caught, while others hunt him, causing him to explode if they touch him. There are even a few mischievous critters which turn a cylinder back to its original colour when they land on it.

Transport tubes appear in some of the higher screens. These are black-topped cylinders which teleport Joe to another transport tube, avoiding all the monsters. Cylinders with green flashing tops, however, vapourise all the toys when Joe lands on them.

Although I only looked at the Commodore version, Pogo Joe is also available for the Atari. According to the manual the two versions are the same, except for the inclusion of a carnivorous cylinder for Atari users.

A neat inclusion in the program is a menu which allows the player to 'customise' a game to a certain extent. That is, it can be set up for one or two players, with any of the 64 different screens chosen to start on and the speeds of both Joe and the toys defined.

Overall, Pogo Joe is an extremely classy game which should keep both the young, and young at heart, happy for hours.

Musical construction
Title: Rock 'n' Bolt
Computer: Commodore 64 + 1/2 joysticks
Supplier: Activision
Format: Disk, cassette
Price: £19.99, £10.99

Rock 'n' Bolt is a complex puzzle based around a building site. As Louie, a construction man, you have to face the challenge of erecting a 100-storey building. The only way to complete the job in quick time and so collect a nice fat cheque at the end, is to rush around with your blueprints, bolting the monolith together.

A practice mode has been included to allow you to take as long as you like.

Harder levels have set time limits in which to complete a floor; any longer and Louie goes through a strange process of disintegration.

While fixing the girders together Louie can pick up a wage bonus by landing on gold bolts, or even gain an extra life by touching a green bolt.

Rock 'n' Bolt is a deceptively simple game on the surface. In play the story is very different, and it doesn't take long before you're sweating with the frustration of not being able to return to the lift to reach the next floor. If frustration leads you to give up Rock 'n' Bolt, just sit back and listen to the great music. It'll soon fire your enthusiasm.
Ours prints exactly what it's told to as well.

Unlike the proprietors of PRAVDA, we're all for freedom of the press. On the other hand, we're certainly not in favour of freedom for the printer. We're as critical of documents that don't say exactly what they're supposed to as anyone at the Kremlin.

That's why we'd like you to take a look at the new Epson DX100 daisy wheel computer printer. It comes from Epson and will simply not tolerate smudgy, messy type. It is also fanatical about towing the computer line as it were.

That's because it has a 5K memory buffer built in. For those who may not know, a buffer does two things. First, it allows the DX100 to store more than a page of text while it's still printing. Setting your computer free to do other things. Second, the buffer makes sure that the DX100 does exactly as it's told. A printer without a buffer can't keep up with the computer. So it has a tendency to defect. Leaving your documents with chunks missing. Rather like this.

So get yourself £475 (+VAT) and you can have an Epson DX100 of your very own. You will then be in possession of a printer that firmly subscribes to the belief that documents are always better read than dead.

Home computers and the DX100: Spectrum QL, BBC model B and Acorn Electron are all fully compatible.

Personal computers and the DX100: Epson PX-8, HX20 portables and QX10 desktop, IBM PC, Apricot, Apple and DEC Rainbow are all fully compatible.

THE EPSON DX100 DAISY WHEEL PRINTER £475 (+VAT).

Reveal all about the Epson DX100 and where I can get one, quick.

Name
Company
Address

PCW/6/85

To: Epson (UK) Ltd., Donnad House, 388 High Road, Wembley, Middlesex HA9 6UH or phone Epson Freefone.

EPSON
of different outputs from one mains input. It might be hard to find an exact American equivalent. There are a number of other points to be born in mind when you plan to take a British computer to the US. You should not use a computer in the US unless it complies with FCC rules for radio interference. British law is much less strict, so most UK machines will need metal or conductive paint screening around the circuit board before they're legal.

Some computers derive timing signals from the UK mains, which alternates at 50Hz, so they'll run at a different speed (if at all) when connected to the 60Hz US supply. Likewise, British television sets and monitors refresh the screen 50 times a second, while their American counterparts expect to be refreshed at 60Hz. In many cases the signal is generated using a 'dual-standard' communications equipment purchased here won't talk to Ma Bell. Again, dual-standard components are probably in there somewhere, but you'll have to find out how to let them know about their change of environment.

It is certainly possible to make a British computer work in the US, but there are lots of things that could go wrong in the process. You'd be wise to avoid machines that are unknown in the US, or could run into maintenance problems after you get the hardware working. Battery portable machines are obviously going to make the crossing most easily, but you could still run into interfacing problems.

The Arabian way

Recently, you answered a request to provide information on a computer system running in Spanish. Are there any computers or dealers you can recommend for potential users wishing to work in Arabic? The ideal system my contacts require would run at the 220 voltage in the Far East, and be capable of presenting both English and Arabic visual displays.

Dr RP Newton, University College, Swansea

Most modern computers are capable of displaying Arabic characters, since they allow the character shapes to be redefined at the whim of the user. You draw the characters, dot by dot, with a character design program. Each new definition takes the place of a 'normal' letter or symbol, and you can chop and change between the two sets at will. The exact procedure will vary depending upon your choice of machine — appropriate instructions will accompany the character design program. But this doesn't get around the problem of data entry, since you presumably need a 'backwards' keyboard, to accept data entered from right to left. It shouldn't require too much work to implement such a feature, reading characters one by one from a keyboard with appropriate replacement legends.

Ramez Halaby & Co, of PO Box 147, Jeddah, Saudi Arabia, specialises in Arabic computer systems. It has advertised various conversion kits in back issues of PCW including an adaptor and keyboard called 'Arab RAM' for the Sinclair ZX81. This was described as 'the first Arabic Personal Computer in the world' when it appeared a year or so ago. Nearer home, An Arabic conversion kit for the IBM PC is available from Microware, 637 Holloway Road, London, for £600. Microware also offers an 'Arab Word Processor' package at the same price.

Defining hacking is difficult these days. What began as a term of praise for an obsessive programmer has acquired a more restricted — and less complimentary — meaning. 'Hacking', as in communicating with other computer brains (with or without the consent of their owners), is a difficult hobby to break into. The hacking community is very tightly-knit, partly because of the strange hours you have to keep if you want to take advantage of the cheapest or least congested connections. Hackers carry out most of their communication — logically enough — by computer, so the best way to contact them is to join them! I don't know of any specialist hackers' shops — the hobby is probably too small and widely dispersed to make them economically viable. The only good book on hacking which I have seen is The On-line Handbook by Ray Hammond. It shows how to get signals into a form which can be transmitted by telephone; and a telephone. A printer — of any kind — will also be very useful.

The computer and the modem generally communicate via the infamous RS232 interface. Low-cost modems sometimes plug directly into the computer without the need for such an interface, but this generally means a reduction in versatility. Similarly, the cheapest computers contain simplified RS232 interfaces which restrict the flexibility of your system. Look for a machine with an interface capable of sending and receiving simultaneously at two different speeds.

There are two types of modem — the acoustic coupler and the direct-connection model. The acoustic coupler is a simple microphone-and-speaker contraption which you fix to your telephone handset. It transmits and receive bleeps, and buzzes down the line.

Transatlantic power struggle

I am an American currently resident in Britain, and am looking at personal computers. One I have my eye on (the Wren) runs only on 240v power. If I return to the US, I will have to feed it 120v power, so I have two related questions.

Firstly is it possible to rig the 240-120b transformers I use for my American appliances here, to use a 240v computer there? Secondly, is there a single component in the power supply (for example, a transformer) which I might be able to replace in the US?

D E Netherton, London N3

The 'auto-transformers' which are used to convert 240v into 120v should be symmetrical components and thus work in either direction, but I suggest that you check this with a competent electrician in the US.

In theory you can convert most appliances to run on a different supply by changing the internal transformers, but this won't always be a simple one-step modification: modern computers use a variety of supply rails (generally including +12, +5, -5 and -12v), so you may need to replace a number of transformers. Make sure that the replacement components can provide the correct current as well as voltage. At worst, you may find that a specially-made composite transformer is used in the UK machine to generate a range of different outputs from one mains input.
Unfortunately, it also relays any other background noises in the room at the time, unless you jam it very carefully onto the handset, so the acoustic coupler can be rather unreliable. Direct-connection modems are more expensive but more reliable. They plug directly into the telephone circuit (you'll need one of the new rectangular BT sockets), and electronically generate the whole lot of bits of computer communication.

Computers communicate at a variety of speeds: a serious hacker will need to be able to use 1200/75, 300 baud, and 1200/1200 baud. The first figure refers to the speed of data reception, the second to the speed of transmission. The 1200/75 speed is used by Prestel; 300/300 is favoured by businesses and bulletin boards. These are electronic notice boards which data run by amateurs, through which hackers send and receive messages. At 1200 baud it takes about seven seconds to transfer a screenful of information.

To find out more, such as the phone numbers of bulletin boards, read the 'Networks' section of PCW. Like so many areas of computing, the only real way to find out about hacking is to try it. Once you have taken the plunge, as in any hobby, you will find lots of people eager to advise you further.

Colour the Atari

I have an Atari 600 XL, which has very nice graphics for the price. Unfortunately, the resolution in 16-colour mode is 80 x 192 — it's like painting with a brick!

Graphics mode 7 has a resolution of 160 x 96, which is a lot better because each dot is a near-perfect square. Unfortunately again, only four colours can be displayed at once. Is it possible to have 16 colours on screen at the same time, in mode 7 resolution?

Richard Doncscombe, Denton, Manchester

The short answer to your question is No, but let's look at the Atari in a bit more detail.

The Atari 600XL is a re-styled version of the Atari 800, launched in 1979. When that machine first appeared it lacked the 16-colour modes — you were stuck with modes 0 to 8, giving five colours in text modes, and two or four colours for graphics. You also had five sprites, or 'player/missiles' and they could each be a different colour, so you could — in practice — get nine colours onto the screen at a time, although the sprites could only occupy a restricted area.

After a while Atari replaced one of the graphics chips in the 400 and 800 with a device called the GTIA, which had the extra fourth bit that you mention. However, these were grafted onto the original design. For a long time they weren't documented, and there were restrictions on their use. Now they've popped up, officially, as modes 9 to 11 on the XL machine.

The problem is that Atari has only changed the GTIA chip to give 16 colours in new modes. ANTIC, the other graphics controller in the machine hasn't changed. ANTIC can only read 40 bytes of graphic information in the time necessary to display a screen. To store 16 colours you need four bits, or 8 bytes, so you can only get 80 dots onto each image of graphics when using 16 colours. The hardware just can't read the data any faster. This isn't a criticism of Atari — every micro design has this problem. Machines like the Memotech and Commodore 64 get around it by restricting the number of changes of colour on a line. On the Sinclair QL, the graphics controller can stop and start the processor to give itself more time to scan the display memory. In that case, with 512 dots on each line, each in one of four colours, the processor only gets a look-in 40 per cent of the time. Even a 68008 processor finds that something of a handicap!

You can increase the number of colours on an Atari if you use devisive machine code, but it's quite hard work. About a year ago I produced some graphics for a Central TV series, squeezing just over 100 colours out of a standard Atari, with a resolution of 160 x 192 — but it took me three months to do it in a flexible way. The trick is to write a program which changes the colours dynamically as the dot flies down the screen. Since the TV draws each line in about 1/200,000 second, your program has to be very efficient but it operates entirely on the palette of fourteen colours on each line, and you are still stuck with just four or five colours on a given line.

Which micro for Cobol?

Which micro can run CIS Cobol, I am using Micro Focus's version for my Computing A level at college and would find it helpful if I could run it at home.

A Lake, Edenbridge, Kent

To the best of my knowledge, CIS Cobol is only available for machines with disk drives and an Intel-type processor (8080, 8086, 8088, and so on). This rules out a lot of home computers, which use other processors or non-standard disk systems. Any CP/M-80 or CPM-86 machine should run the system, although you might run into problems with lack of memory on a few home computers. A CIS Cobol compiler will set you back about £400.

Cobol is a standardised language, so it might be worth looking at another popular implementation for micros. RM Cobol the TRS-80 is cheaper than Micro Focus's version, and seems to work just as well. You can pick up a TRS-80 system next to nothing so it might be worth considering if you're determined to run Cobol at home.

BBC interfacing problems

I run a small business in Jamaica and decided to have it computerised. While I was in London, I purchased two BBC Model B computers with disk and printer interfaces, cables, colour monitors and Epson FX80 dot-matrix printers.

I am having problems interfacing the computers with the printers. The manual says if you have a serial command you can print on the parallel port. If you've got a hardware problem, you should be able to isolate the fault to the printer, cable or computer.

This goes to show how important it is to have a system fully demonstrated before you buy it. Take note of any special commands used when the machine is up and always buy the exact hardware you've seen working.

Help for Aquarius

With reference to the letter "Aquarius: Age of Aquarius?" from S Forster, POW for April, Mr Lebov of Radofin Electronics would be pleased to aid you in your search for books and software for the Aquarius, and help with any queries.

Phone (01) 205 0044, or write to Radofin Electronics, Hyde House, The Hyde, London NW9 6LG.

Unfortunately we can't answer questions on an individual basis, so please don't send a SAE with your query.

JUNE 1985 PCW 221
Calling Prestel

When you join Prestel (or Micronet 800) you will be given three things. An identity number, a password and a telephone number. When you dial the number (often 618 or 612) you should hear the modem tone. Switch your modem on-line, and after a few seconds you should see a welcoming message from Prestel, and your password. Provided that all is well you will then be asked for your identity number, a password and a telephone number. This is used because it enables transfer of binary files using the Xmodem protocols.

At this stage you should see the Prestel main menu (Page 0) which contains ten items, but the exact contents vary. If you are a Prestel Microcomputing subscriber, you will normally go straight to the Prestel Microcomputing main menu. In either case you can always find your way to page 0 by pressing *0# on your keyboard.

Once you have logged on, Prestel is fairly simple to use. It is based on menus, you select items from the menu by pressing the relevant number on your keyboard (there is no need to press return), you will be taken to the page in question. This may well be another menu, but you will eventually get to the information you are looking for.

Alternatively, if you know the number of a page that you want, you can go directly to it. Just press 'page-no#' (again there is no need for a carriage return — in fact ordinary Prestel keypads don't have a return key at all). So, if it is page 21 you want to read, just press *21# (which, incidentally will lead you to a useful introductory lesson on using Prestel).

Information providers

There is a whole range of subjects on Prestel — everything from news and weather to air travel, from what's on at the theatre to government information. The contents are provided by many independent organisations, called 'information providers' or IPs. Each organisation pays Prestel a certain amount for the privilege and if it so wishes it is allowed to charge people to look at the information provided. These charges are added to your Prestel bill. You will find a small price tag at the top of each page stating how much it costs to view it. If a page does have a charge, the menu will tell you how much it is before you choose it. Around 60 per cent of the pages are free.

**CUG's**

Some areas are closed off by the IPs to form 'closed user groups' or 'CUGs'. These are areas where the IP will charge a subscription, (in addition to your Prestel subscription) or restrict access in other ways to allow only certain groups of people to look at them. Prestel Microcomputing (which includes Micronet 800 and other micro related IP's) is a CUG. It is the area that is of most interest to micro users, and is indexed from the Prestel main index on page 0. You are presented with a range of options which include news of the micro scene, information about computer clubs, an art gallery, software to download and a range of other items. This area includes the Micronet 800 and Viewfax 258 sections, which are the two main commercial IPs dealing with micros. It also includes ClubSpot which is an area run entirely by amateurs.

Peter Tootill dials up Prestel this month and looks at the facilities available to the micro user.

If you have problems with strange characters at this stage, check your RS232 settings, one common cause of problems when calling Prestel is that you need to use seven data bits, even parity and one stop bit. This is different to most bulletin boards which are now using eight bits, no parity, one stop bit. This is used because it enables transfer of binary files using the Xmodem protocols.

When you join Prestel you need to use seven data bits, even parity and one stop bit. This is different to most bulletin boards which are now using eight bits, no parity, one stop bit. This is used because it enables transfer of binary files using the Xmodem protocols.
under the auspices of the ACC (the Association of Computer Clubs). The ACC has the distinction of being only amateur IP on the Prestel database, the pages are provided free of charge by Prestel because the information and facilities provided by the ACC are a big attraction to micro users.

Prestel is a very big database, and it is well worth browsing. If you do find anything of interest make a note of the page number, because it can be very difficult to find your way back. This is the main problem with Prestel, although there is a subject index, it can be very difficult to find what you want. A keyword search facility would be very useful.

National Mailbox

I said earlier that when you join Prestel you are given three things, well that should read four. You are also given an account number (sometimes called your ‘systel’). This is a number that other people can use to send messages to you using the Prestel ‘Mailbox’ facility. This number is the one that you give to friends, and the one that will be published in the Prestel Mailbox directory, if you request it. Your identity number and password should be kept secret, as anyone who uses them could run up a big bill for you.

If you have messages waiting for you, Prestel tells you this when you logon to the system, you just key 0 to read them. They can be stored, and re-read later at page 931.

UK free networks

<table>
<thead>
<tr>
<th>Bulletin Board</th>
<th>Phone Number</th>
<th>Notes</th>
</tr>
</thead>
<tbody>
<tr>
<td>BABBBS-Bath</td>
<td>(0225) 23276</td>
<td>300/300 baud rate; 9pm-8am weekdays, 9am-noon weekends; Atari-based system, ring-back system</td>
</tr>
<tr>
<td>BABBS-Felixstowe</td>
<td>(0394) 276306</td>
<td>300/300 baud rate; 24 hours daily; Apple users’ group</td>
</tr>
<tr>
<td>BABBS TWO-Basildon</td>
<td>(0268) 778956</td>
<td>300/300 baud rate; 24 hours daily; Apple users’ group with special area for queries to Apple UK</td>
</tr>
<tr>
<td>Bettisfield</td>
<td>(094875) 378</td>
<td>300/300 baud rate; 9pm-9am daily; remote CP/M system</td>
</tr>
<tr>
<td>Blandford Board</td>
<td>(0258) 54494</td>
<td>300/300 baud rate; 24 hours daily</td>
</tr>
<tr>
<td>CABB</td>
<td>(01) 631 3076</td>
<td>300/300 baud rate; 24 hours daily + 1200/75</td>
</tr>
<tr>
<td>CBBS SW</td>
<td>(0392) 53116</td>
<td>300/300 baud rate; 24 hours daily</td>
</tr>
<tr>
<td>CBBS Surrey (Woking)</td>
<td>(04862) 25174</td>
<td>1200/75 and 300/300 baud rates; 24 hours daily; jokes, jobs, reviews, news</td>
</tr>
<tr>
<td>CNOL Lancaster</td>
<td>(0524) 60399</td>
<td>300/300 baud rate; 24 hours daily; Clinical Notes Online service, mainly for medical users; works in conjunction with a database on the Datastar network</td>
</tr>
<tr>
<td>Computers Incorporated Newcastle</td>
<td>(0207) 543555</td>
<td>300/300 baud rate; 24 hours daily; primarily business-oriented</td>
</tr>
<tr>
<td>Forum 80 Hull</td>
<td>(0482) 859169</td>
<td>300/300 baud rate; 5-11.30pm weekdays, noon-11.30pm weekends; Bell 103 standard, midnight-8am daily; international electronic mail, library for up/download</td>
</tr>
<tr>
<td>Forum 80 SPA</td>
<td>(0926) 39871</td>
<td>300/300 baud rate; 11pm-midnight daily; TRS-80 and Genie users’ group</td>
</tr>
<tr>
<td>Forum 80 Wembley</td>
<td>(01) 902 2546</td>
<td>300/300 baud rate; 7-10pm weekdays, midday-10pm weekdays; electronic mail, library for downloading; ring and ask for Forum 80</td>
</tr>
<tr>
<td>Hamnet Hull</td>
<td>(0482) 497150</td>
<td>300/300 baud rate; 6pm-8am daily</td>
</tr>
<tr>
<td>Liverpool Mailbox</td>
<td>(051) 4288924</td>
<td>300/300 baud rate; 24 hours daily; electronic mail, program downloading, TRS-80 information; messages for PCW can be left on the board and will normally be read by us within 24 hours</td>
</tr>
<tr>
<td>Mailbox-80 W Midlands Stourport</td>
<td>(0384) 635336</td>
<td>300/300 baud rate; 6pm-8am daily</td>
</tr>
<tr>
<td>Manchester Open Bulletin Board</td>
<td>(061) 7368449</td>
<td>300/300 baud rate; 24 hours daily + 1200/75</td>
</tr>
<tr>
<td>MBBS-Mitcham</td>
<td>(01) 640 2617</td>
<td>300/300 baud rate; 10am-10pm Thursday and Sunday; BBC-based system with jokes, graffiti, electronic mail, and Atari and BBC sections</td>
</tr>
<tr>
<td>MG-Net CBBS London</td>
<td>(01) 399 2136</td>
<td>300/300 baud rate; 9-10pm Sunday; electronic mail, program downloading</td>
</tr>
<tr>
<td>Microweb Manchester</td>
<td>(061) 4564157</td>
<td>300/300 baud rate; 24 hours daily; Micro User magazine, mainly for BBC users</td>
</tr>
<tr>
<td>NBBBS-North Birmingham</td>
<td>(0827) 288810</td>
<td>300/300 baud rate; 24 hours daily</td>
</tr>
<tr>
<td>OBBS Manchester</td>
<td>(061) 4271996</td>
<td>300/300 baud rate; 24 hours daily except 7pm-9pm, weekends except 10am-10pm</td>
</tr>
<tr>
<td>PIP-Sheffield</td>
<td>(0742) 667983</td>
<td>300/300 baud rate; 24 hours daily; Bell 103 midnight-8am daily</td>
</tr>
<tr>
<td>Southern BBS</td>
<td>(0243) 511077</td>
<td>300/300 baud rate; 8pm-2am daily; ring-back system (dial the number, let phone ring once, and then ring back); messages, downloading</td>
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<tr>
<td>Stoke ITEC</td>
<td>(0782) 265078</td>
<td>300/300 baud rate; 9am-7am daily</td>
</tr>
<tr>
<td>TBBS London</td>
<td>(01) 348 9400</td>
<td>300/300 baud rate; 24 hours daily; remote CP/M system</td>
</tr>
<tr>
<td>TBBS London Metro</td>
<td>(01) 341 7840</td>
<td>300/300 and 1200/75 baud rate (including Prestel compatibility); 24 hours daily; temporary number for the TBBS Nottingham system</td>
</tr>
<tr>
<td>WABBBS-Worthing</td>
<td>(0903) 42013</td>
<td>300/300 baud rate; 24 hours daily; ring-back system (dial the number, let phone ring once, and then ring back); Atari-based</td>
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JUNE 1985 PCW 223
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- JUNE 1985 PCW 225
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DIARY DATA

Readers are strongly advised to check details with exhibition organisers before making arrangements, in order to avoid wasted journeys due to cancellations, printer's errors, and so on.

London
- (Barbican). Business Telecom Exbn. Contact: Online Conf's Ltd, (01) 688 4466. 21-23 May.
- (Bloombury Crest). Microfilm Exbn. Contact: Beta Exbns Ltd, (01) 405 6233. 21-23 May.
- (West Hotel). International Videodisk, Optical Disk and CD ROM Conf & Exbn. Contact: Meckler Comm's, (01) 240 0865. 24-25 May.
- (Earls Court). Business Computer Show. Contact: Reed Exbns, (01) 643 8040. 4-6 June.
- (Kensington Exbn Centre). Computer & Peripherals Equip't Trade Exbn (COMPETA). Contact: Network Events Ltd, (0280) 815226. 4-6 June.
- (Barbican), Office Automation Show & Conf. Contact: Cahners Exbns Ltd, (061) 832 4242. 4-6 June.
- (Earls Court). Software Show. Contact: Reed Exbns, (01) 643 8040. 4-6 June.
- (Novotel), Commodore Computer Show. Contact: Genesis PR Ltd, (01) 935 7777. 7-9 June.
- (Olympia), European Unix User Show. Contact: EMAP Int Exbns Ltd, (01) 837 3699. 12-14 June.
- (Stuttgart). Computing in Clinical Laboratories. Contact: Dr Trendelenburg, (0711) 2034 482. 14-16 June.

WRITING FOR PCW

Your chance to contribute to the magazine.

We're offering readers a chance to get rich (well, at least richer) and to influence what's published in the magazine — by writing for it. We welcome approaches from would-be writers, including those who have never appeared in print before. It's often users with practical experience who have the most interesting things to say, so don't worry if your prose is less than perfect, we can take care of the polishing.

If you have an idea for a feature write, with a brief synopsis, outlining the proposed structure and content. If your article is accepted, we'll then send it in for consideration. Remember to put your name and address on both the covering letter and the manuscript — along with a daytime phone number if possible. Manuscripts should be typed or printed out (dot matrix output is fine), in double-line spacing with ample margins top and bottom and on each side.

Any accompanying program listings should be supplied on disk or cassette.
The Moebius Function

Definition. The function of Moebius \( \mu(a) \) is defined for all positive integers \( a \) by the equalities \( \mu(a) = 0 \) if \( a \) has a squared factor distinct from 1, \( \mu(a) = (-1)^k \) where \( k \) denotes the number of prime divisors of \( a \), and \( a \) greater than 1 has no squared factor distinct from 1. In particular, for \( a = 1 \) we assume that \( k = 0 \) and therefore take \( \mu(1) = 1 \).

Alternative definition: \( \mu(1) = 1, \mu(p) = -1, \mu(p^n) = 0 \) for \( n > 1 \) and \( \mu(mn) = \mu(m) \mu(n) \) when \( m \) and \( n \) are coprime; that is, \( m \) and \( n \) have no common factor other than 1. \( p \) denotes a prime.

This function is thus very easy to evaluate for isolated numbers whose factors are known, and attention has focused on its use to evaluate more complicated allied functions.

In 1884 J P Gram published \( \mu(n) \) together with the sum:

\[
S_n = \sum_{k=1}^{n} \mu(k)k^{-1}
\]

for \( n \leq 300 \); subsequently Euler's conjecture that as \( n \) tended to infinity \( S_n \) tended to zero was rigorously proved.

The function:

\[
M_n = \sum_{k=1}^{n} \mu(k)
\]

has, however, attracted a great deal of attention. In 1897, F Mertens tabulated \( \mu(n) \) and \( M_n \) for \( n \leq 10000 \); over the period 1897 to 1912, RD von Sternbeck tabulated \( M_n \) for all \( n \leq 150000 \), then in steps of 50 up to 500000, followed by 16 values chosen in the range from 600000 to 5000000. These tables were constructed with the hope of shedding some light on the problem, believed to be still unsolved, of the behaviour of \( M_n \) for sufficiently large \( n \). This problem is intimately connected with the Riemann hypothesis, whose consequences are to be found throughout classical number theory.

The Moebius function is related to Euler's Totient Function (see PCW, May) thus: if \( \phi(n) \) denotes Euler's Totient Function and

\[
\Phi(n) = \sum_{v=1}^{n} \phi(v)
\]

where it is known that \( \Phi(n) = n\phi(n)^2 + a (n \log n) \) (order of \( n \log n \)), then the sum of \( \phi(v) \) is most easily calculated from the formula in Fig 1 where \( [x] \) denotes the largest integer not greater than \( x \) and \( \text{Min}(x) \) denotes

\[
M_n = \sum_{k=1}^{\sqrt{n}} \mu(v) \leq x
\]

that is, the generalisation of \( M_n \) in the obvious way. JWL Glaisher (1940) published tables of \( \phi(n) \) going from 1000 to 10000. It is interesting to note that \( E(n) = \Phi(n) - n\phi(n)^2 + a (n \log n) \) is positive for all \( n \leq 100000 \), but these are beyond the scope of this article.

Problem Tabulate the functions \( \mu(n) \), \( S_n \), \( M_n \), and possibly \( \Phi(n) \), the latter to be calculated using the above formula.

Demonstrate the plausibility of the now proven Euler conjecture referred to above, speculate on the behaviour of \( M_n \), demonstrate the anomalous sign of \( E(n) \) at \( n = 820 \), and attempt an explanation.

Readers are invited to submit their program listings, output and hardware details together with their conclusions relating to this problem to Mike Mudge, 'Square Acre', Stourbridge Road, Penn, Nr Wolverhampton, Staffs WV4 5NF. (Tel: (0902) 892141). A suitable prize will be awarded to the 'best' entry received by the 1 September 1985. Criteria will include accuracy, originality and efficiency. Please note that submissions can only be returned if a suitable stamped addressed envelope is included. Ex-
appeared from Sweden, and Z80 code using a two-pass compiler on a ZX81 came from West Germany. A Spectrum, fitted with a 7608 voltage limiter, ran in Basic for 100 hours to duplicate the ENIAC result for pi.

This month’s winner is Ronald B Shepherd of Cottingham, Humberside, who used Prospero ProFascal version 2.1 on a Sharp MZ700B (64k, Z80A, clock frequency 4MHz) with twin 5¼in floppy disks and printer. Ronald calculated e to 5000 digits (2000 in 54 minutes) and pi to 2000 digits (6½ hours), and having written these to disk analysed them statistically.

This analysis, including frequency, runs and serial test, was based upon the algorithms of WJ Kennedy and JE Gentle, *Statistical Computing*, 1980. The whole work was extremely well-documented with references, full listings and tabulated output. Suggestions for further work included the gap test and a study of the “m” root of using Newton’s Method, together with the digital analysis of Euler’s Constant, gamma.

A well-deserved prize is on its way to Humberside.

---

**MICROCHESS**

Kevin O’Connell watches the moves at the 1984 Dutch Computer Chess Championship.

In the 1984 Dutch Computer Chess Championship, played at the University of Leiden, the victor of 1983, Chess 0.5X, repeated its previous year’s feat of winning all its games. Here is the game it won against the program that took second place.

**White**: Nona
**Black**: Chess 0.5X

**Board Position**

1. d2-d4 Ng8-f6
2. c2-c4 e7-e6
3. Ng1-f3 Bf8-b4+
4. Bc1-d2 Bd4xd2+
5. Nb1xd2 d7-d5
6. a2-e3 0-0
7. Bf1-e2 Nb8-c6
8. 0-0 Bc8-d7
9. a2-a3 Qd8-e7

Black has a sound but cramped position.

10. a3-a4?

This is a wasted move which creates a hole on the b4 square which Black should be able to exploit.

10. ... Nc6-b4
11. Nf3-e5 c7-c5

(This frees Black’s game.)

---

**Move Analysis**

**White’s position is looking desperate** — Black starts the mopping-up operation.

12. d4xc5 Qe7xc5
13. Nd2-e4!? (An interesting idea. If 13 ... Nf6xe4, 14 Ne5x d7 wins material, and if the black queen moves, then 14 Ne4xf6+ shatters Black’s pawn defences in front of his king.)

13. ... d5xe4
14. Ne5xd7 Nf6xd7
15. Qd1x d7 b7-b6
16. Rf1-d1

(It seems as though White has done rather well after all, having occupied the open d-file, but the light-squared bishop has very little scope.)

16. ... Nb4-c6
17. Kg1-h1

(This is an irrelevancy, but 17 Qd4-d6 Rf8-d8 18 Qd6xc5 b6xc5 would only highlight the weaknesses created by White’s tenth move. 17 Rd1-d6 would be even more disastrous after 17 ... Nc6-e5 18 Qd7-e7 Rf8-c8 and Black wins a rook.)

17. ... Ra8-d8
18. Qd7-c7 f7-f5
19. Rd1-d7 Rd8xd7
20. Qc7xd7 e6-e5
21. Ra1-d1 f5-f4

(White still has control of the d-file, but what can she (when first programmed, Nona was named after the then women’s world champion, Nona Gaprindashvili) do with it? Meanwhile Black continues aggressively, succeeding in weakening the dark squares near White’s king and in giving the rook more scope.)

22. Rd1-d5 Qc5-b4
23. Rd5-d2 (Cutting off the black queen’s access to e1.)
24. Nc6-d4! (The white queen’s access to a square (d2) is cut off in turn and to very great effect.)
25. Qd7-d5+ Kg8-h8
26. Rd2-d1

(There is nothing better.)

25. ... Nd4xe2

(Black conducts the mopping-up operation which follows very efficiently.)

26. a4-a5 Qb4xb2
27. a5xb6 a7xb6
28. g2-g3 Ne2-c3
29. Qd5-d6 Rf8-g8
30. Rd1-d2 Qb2-b1+
31. Kg1-g2 f4x e3
32. f2x e3 Qb1-e1
33. Kg2-h3 Qe1x e3
34. Rd2-b2 Qe3-f3
35. Rb2xb6 Nc3-d1
36. Rb6-b2

(A forlorn attempt to distract her opponent from mate in two, which was threatened by 36 ... Nd1-f2+ 37 Kh3-Qf3 Qf3-g4 (or 37 ... g5-65).)

36. ... Nd1-e3
37. White resigns 0-1

(It is still mate in two (after 37 Qd6-g6 — anything else allows mate in one.)
Rupert Steele reports on the rumblings in the ACC Council, which now has a new chairman and fresh ideas for the ACC and its responsibilities. He also presents a round-up of the new clubs.

John Bone of Newcastle Personal Computer Society and Computer-Town! North-East has been elected as the new chairman of the Association of Computer Clubs in a contested election (in which I did not stand) at the recent meeting of the ACC Council, but I shall continue to write this column and to deal with correspondence from clubs arising from it. Other correspondence and telephone enquiries should be directed to John Bone.

At Council, there was considerable interest both in the insurance schemes that the ACC runs on behalf of the affiliated clubs, and the idea of a regional structure for the Association. Some delegates expressed an interest in acting as the ACC regional coordinator in their areas. Andrew Holliman is now in charge of this, and anyone interested should contact him at 5 Trinity Close, Balsham, Cambridge CB1 6DW or phone (0223) 893983. We all regard the establishment of a proper regional structure for the ACC as being important for the computer club movement as a whole.

Club News

It has become clear that in my concern to introspectively avoid looking only at London and the Home Counties, I have almost entirely ignored the whole area! This month’s club news is therefore almost entirely ignored the whole area! London and the Home Counties, I have to introspectively avoid looking only at it. It has become clear that in my concern with the introduction to the equipment is connected with the club, but this is unclear.

Moving on to Sussex, Robert Cooke is secretary of the Eastbourne and District Computer Club. He can be contacted at 22 Selwyn Road, Eastbourne, Sussex BN21 1LR, and the club meets on the fourth Wednesday of each month at the St Aidan’s Methodist Church Hall, Whitley Road, Eastbourne.

In Midhurst, West Sussex, there is the Midhurst and District Club. It meets on the second and last Thursday of each month at ‘North Mill’, the Grange Centre, Bepton Road, Midhurst, and welcomes members with any level of computing experience, especially those who wish to learn but have never liked to ask. Subscriptions are £3 a year plus £1 a meeting for over 17s, children £1 a year plus 25p/meeting. For details contact Val Weston at 69 Petersfield Road, Midhurst, West Sussex; tel: Midhurst 3876, or call Robert Armes on Midhurst 3279.

From Sussex writes NL Rees of 12 Hayes Close, Ringmer, Lewes, East Sussex BN8 5HN, who is running a Casio Pocket Computer User Group. The idea is that Casio PC owners will be able to get in touch with each other locally to exchange programs and ideas; this will help correct his impression that there has not been a single program published for the Casio Pocket computer. If you are a Casio owner, why not drop him a line or call him on Ringmer 812475 to see how it’s going?

In Hampshire, Kevin Weatherford, on Alton 87478, runs ACEG (Alton Computing and Electronics Society). It meets at 7.30pm on the second Wednesday and last Friday of each month at the Alton Community Centre, and is planning to build a micro-mouse. Kevin’s address is ‘Sheen’, Old Odiham Road, Alton, Hants GU34 4BW.

And winning this month’s catchy acronym prize is BOGBUG, which is the Borough of Gosport BBC Users’ Group. It currently meets on the second and fourth Thursday of each month in members’ homes. Contact Graham Dubber at 128 Wych Lane, Gosport, Hants PO13 0TE, or phone (0329) 282221 (evenings).

For a mention in this column or to let the ACC know about your club: Rupert Steele, 12 Philbeach Gardens, London SW5 9DY (01) 370 0601.

For any other ACC business or to obtain the address of your local club: John Bone, 2 Claremont Place, Gateshead, Tyne and Wear NE8 1TL (0632) 770036.)
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**Program of the Month**

**BBC Alpha**

by Mark Needham

BBC Alpha is a version of the artificial intelligence blocks world simulation. By entering commands in natural language, the program will simulate the placing of blocks on a table; questions can then be asked about the arrangement. Although the program is long, it is well-written, easily modified, and a good introduction for those wishing to dabble with AI.

---

**Nick Walker selects the best of readers' programs — for details on submitting your own, see the end of this section.**

One of the frustrating things about artificial intelligence (AI) is the amount of memory even the most simple AI project consumes; this makes it almost impossible for the home micro owner to do anything useful. The Program of the Month is the best example I've seen of AI on a home micro. Written for the BBC with disk drives, the program recreates the classic experiment popular in the early days of AI on mainframes — a blocks world simulation. Despite its length, the program is an excellent starting point for dabbling with AI, especially natural language understanding.

Commodore 64 owners who also have an interest in electronics and logic circuits will like the logic simulator published this month. Not only does this allow you to enter logic circuits as truth tables, but it also lets you connect the design to the outside world via the user port. This means you could design a circuit, connect it as you would the real one, and test it making any changes before you put the circuit into hardware.

Other programs include RCW's first program for the Enterprise and two games — Nine Men's Morris for the Spectrum and a very professional version of Yahtzee for the Atari.

We would like to publish programs for the Memotech. If you have written any please send them in for consideration.

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Main Sentences Syntax:

(HELLO) (ALPHA) (); MY NAME IS unknown
(HELLO) (ALPHA) (); PLEASE (command)
(HELLO) (ALPHA) (); I'LL TELL ME (question)

Adjectives
Red, yellow, green, blue, cyan, magenta, white, round, square, cubic, circular, and triangular.

Names
Cube, circle, triangle. (Square cannot be used as an object name).

Example noun
1 - THE RED, TRIANGULAR OBJECT
2 - AN OBJECT WHICH IS TO THE LEFT OF THE GREEN CUBE
3 - A GREEN CUBE WHICH IS NOT UNDER A SQUARE OBJECT WHICH IS THE SAME COLOUR AS THE RED TRIANGLE
4 - A RED AND CIRCULAR OBJECT

The first object in a sentence is remembered and is then known as it.
E.g. PUT THE RED CUBE ON THE BOARD
   WHAT IS THE TO LEFT OF IT ?
   IT being the RED CUBE

Command Syntax
PUT (any noun) (preposition) (any noun) - Put an object on the board
MOVE (any noun) (preposition) (any noun) - Move an object around
REMOVE (any noun) - Remove an object from the board
QUIT (THE GAME) - Exits ALPHA
END (THE GAME) - or.Quit the game unless gamed
STOP (THE GAME) -
EXIT (THE GAME) -
BLIND -
FIND (any noun) (adj) - Change object's attributes
ENABLE (THE) (I TALK / LIST) - Display of commands
DISABLE (THE) (I TALK / LIST) - Send words to CHATTERBOX II
PLAY (THE GAME) -
SHOW (THE GAME / GRID 3) -
LOAD (THE GAME / GRID 3) - Load the board positions
CLEAR (THE GAME / GRID 3) - Move all objects off the board

Question Syntax
WHAT (OBJ/SHAPE) IS (a noun)
WHAT (OBJECTS) BLOCKS (one) THERE (preposition) (a noun)
WHAT IS THERE (preposition) (a noun)
HOW MANY (adj) (a noun) / OBJECTS ARE (THERE) (preposition) (a noun)
IS (a noun) (preposition) (a noun)

Definitions
[] - Contents of brackets are optional
( ) - Contents hold alternatives, separated by one or more /.
/a noun/ - A specific object if ALPHA is to answer the question correctly.
E.g. IS THERE A RED CUBE TO THE LEFT OF A YELLOW OBJECT ?
may give the wrong answer if there are more than one yellow object on the board.
/a noun/ - Can be any object. The PUT first object in the PUT command must be on the board.
(preposition) - E.g. TO THE LEFT OF, THE SAME COLOUR AS Etc.
(adj) - E.g. RED, YELLOW, SQUARE, TRIANGULAR Etc.
(name) - E.g. CUBE, CIRCLE, CIRCULAR.
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**PROGRAM FILE**

**NLM SYNTAX:**

(ADJECTIVE/AND/NAME/OBJECT/BLOCK) preposition group

(ADJECTIVE/AND/NAME/OBJECT/BLOCK)

(ADJECTIVE/AND/NAME/OBJECT/BLOCK)

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(ADJECTIVE/AND/NAME/OBJECT/BLOCK)
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**PROGRAM FILE**

```
19100  IF NUMX >= 4 THEN
19070    IF FAX(?F8B(XPX, YPX), SRCHX) <> ATTRX THEN
19090      NEXT LX; IF LX = OPRINT THEN
18090        MAND, F8B(X2X, Y2X - 1) = 0 THEN
18110          OUT$ = "": RETURN
18095      IF (FNX(LIX, 4) = RX AND SRCHX = 4) OR (FNX(L1X, 3) <> RX AND SRCHX = 3) THEN
18100          PROC(LIX): A$ = "C013"
18030      B = SUB18500
18200      = 3
18210      IF (BXDIV8).1 > 1 THEN AS = "8011": PROCW(ZX = F8B((BXMOD8) + 1, (LIXDIV8)): GOSUB 12500:
18200          PROCW((BXMOD8) + 1, (LIXDIV8).1, LIX): ZX = LIX: GOSUB 12500
18100      LIX = LIX + 1: IF LIX <= NUMX THEN
18070          IF F8B(X1X, Y1X + 1) <> 0 OR (X1X = F8XMODB) + 1 AND Y1X = BXDIV8 THEN
18080            IF Y1X = 4 THEN
18090            X1X = FNX(LIX, 1): Y1X = FNX(L1X, 2): IF FNB(X1X, Y1X) <> 0 OR INSTR(081S, CHR$(LIX)) > 0 THEN
18075            L1X = 1
18070            L1X = L1X + 1: IF LIX <= NUMX THEN
18060            IF LEFIS(SHS(LIX), 2) = "00" AND (0 - 8XtL1X, 4).87.ANIMNCHX.4)8148-8X(LIX, 3)()N&ANVJ
18010          005UB18500: IF N(X) = 4 THEN
18000          OUT$ = "": AS = "8029": PROCW AS = "8043": PROCW FLX% = 1: RX = 0: 13%= 0: 82,0:081$ = "": SRCHX
17240          RETURN
17230      IF 2D2 = 0R 2D2 = ASCP$ THEN
17220      7=7-1: IF Y>OTHEN
17190        NEXT X: IF N(Y) = 2 AND LEN(P4 > I THEN
17180        7=0: 00T017230
17160      IF C = 1 THEN P = +CHR$(X)
17140      IF EVAL(MIDS(X., 2)) = 1
17120      NEXT DX: RETURN
17110      NEXT DX: FX = "": FOR X7, 0703
17080         A = A - LENAS + 1
17070         PRINTAS: REM
17060         A = 66001: 8 = 0: C = &7000
17050         IF AS = "..." THEN 1240
17040         7=7-1: IF Y>OTHEN
17010        RETURN
```

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2800 DATA TRIANGULAR,A012
2010
2820 REM KKK
VALUES KKK

0

2830

2840
2850
2860
2870
2880
2890
2900
2910
2920
2930
2940
2950
2960
2970
2980

2990
3000
3010
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3030
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3050
3060
3070
3080
3090

DATA
DATA
DATA
DATA
DATA
DATA

ONE,V001,TWO,V002,THREE,V003,FOUR,V004
FIVE,V005,SIX,V006,SEVEN,V007,EIGHT,V008
NINE,V009,TEN,V010,ELEVEN,V011,TWELVE,V012
THIRTEEN,V013,FOURTEEN,V014,FIFTEEN,V015
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REM

mmx

DATA

KKii

REM

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FOR Y=3 TO 0 STEP -1
H=X DIV 16^Y
HEXS=HEXS,CHRS(Hf48-7+(H>9))
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NEXT Y
=HEX$

0

0

0

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PRINT".CLEARING MEMORY .;;FORX=&7000 TO B7BFF:0X=0;NEXT X(PRINT

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CISBYTE=&FFF4:0SWRCH=&FFEE
PRINT .CREATING MACHINE CODE .;
FORXX=OTO2STEP2)PRINT'.PASS .+STR$(XX-(X%=0));

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[OPT X%
3110
3120 .POSCUR LDA *31
3130
JSR OSWRCH
3140
LDA 172
3150
JSR OSWRCH
3160
LDA 173
CLC
3170
ADC *1
3180
3190
JSR OSWRCH
RTS
3200
3210 .CLRIN LDY *0
LDA *32
3220
3230 .CLOOP STA (1701,7
INY
3240
CPY *160
3250
BNE CLOOP
3260
RTS
3270
3280 .START LDA *&7C
STA 171
3290
LDA *128
3300
STA /70
3310
LDA *0
3320
STA 172
3330
STA 173
3340
STA 174
3350
JSR POSCUR
3360
3370 .CHARIN LDA *145
LDX *0
3380
JSR OSBYTE
3390
BCS CHARIN
3400
TVA
3410
CMP *128
3420
BCC JPO
3430
CMP *144
3440
BCC MOVCUR
3450
CMP *13
3460 .JPO
BNE JP1
3470
3480
RTS
CMP *127
3490 .JP1
3500
BNE JP2
JMP DEL
3510
CMP *32
3520 .JP2
BEQ CHAROK
CMP *ASC.,.
3540
BED CHAROK
3550
CMP *ASC"?.
3560
BEQ CHAROK
3570
CMP *65
3580
BCC CHARIN
3590
CMP *91
3600
BCC CHAROK
3610
CMP *97
3620
BCC CHARIN
3630
CMP *122
3640
BED JP3
3650
BCS CHARIN
3660
AND *95
3670 .JP3
3680 .CHAROK JSR OSWRCH
INC 172
3690
LDA 172
37003710
CMP *40
BNE JP4
3720
LDA MO
3730
STA 172
3740
INC 173
3750
LDA 173
3760
CMP *4
3770
BNE JP4
3780
LDA *0
3790
STA 173
3800
JSR POSCUR
3810 .JP4
JMP CHARIN
3820
3830 .MOVCUR CMP *140
BEQ LFT
3840
CMP *141
3850
BED RGT
3860
CMP *142
3870
BEQ DWN
3880
CMP *143
3890
BEQ UP
3900
CMP *128
3910
BEQ CL
3920
CMP *136
3930
BEQ INS
3940
JMP CHARIN
3950
LDA 173
3960 .UP
BEQ UPDATE
3970
DEC 173
3980
JMP UPDATE
3990
LDA 173
4000 .DWN
CMP *3
4010
BEG UPDATE
4020
INC 173
4030
JMP UPDATE
4040

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\ Y Position
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\ Clear input area
\ 170 Pointer to Screen
\ Location

\ Start of input routine
\ Set up Pointer to Screen
1.

\ Set up X & Y Positions

\ Wait for key press

\ Check less than 128
\ Check less than 144
\ Return 7

0

\ Check that range is ok
64< char <91
\

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96< char <123

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\ Print character if ok
\ Move X pos one

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\ Check for end of line

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\ Move to next line down

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\ Check for bottom line

\ Check for cursor movement
\ Cursor right
fa

\ Cursor down
\ Cursor up
\ Clear input area (F0)
\
\
\
\

Insert character (F8)
Key no good
MOve cursor up
No move if at top

\ Move cursor down

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- LDA &70
- STA &71
- STA &72
- STA &73
- STA &74
- STA &75
- STA &76
- STA &77
- STA &78
- STA &79
- STA &80
- STM &E0
- LDA &79
- STA &FE6C
- STA &FE6D
- STA &FE6E
- STA &FE6F
- STA &FE70
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244 PCW JUNE 1985
Commodore 64 Logic Emulator

by B Candler

This program will be of great value to anyone who likes to experiment with logic circuits, and also should be useful for teaching purposes.

The user may enter a circuit consisting of gates and latchses into the computer, to see what it does (or to see if it works as planned!). The concept of a logic emulator is not new, but this program is as far as I know unique in that the 'circuit' in the computer's memory may actually be connected to the outside world via the user port. For example, you may design a burglar alarm and connect it to the sensors using option 1 from the main menu. If you wish to connect the user port to your circuit, type a number from 0 to 7 (according to which bit of the user port you are interested in), followed by 'O' or 'I' (for output or input), and then the appropriate edge-triggered clock input and negative edge-triggered set/reset inputs. If you wish to connect the user port to, then RETURN. Type 'S' when you are ready to start execution.

4) To 'run' the circuit, use option 2. If you wish to connect the user port to your circuit, type a number from 0 to 7 (according to which bit of the user port you are interested in), followed by 'O' or 'I' (for output or input), and then the number of the circuit point which you wish to connect the user port to, then RETURN. Type 'S' when you are ready to start execution.

5) Circuit points 0-9 may be set to a '0' value using the top row of number keys (1 to 0), or set to a '1' value using the keys from Q to P. All other circuit points will be automatically updated, using the circuit data you have entered. The logic states of point 0-229, plus the user port, are continuously displayed as a table onscreen.

6) To stop, press F7. Pressing 'M' will now take you to the main menu, where you can copy, save, load, list or clear the circuit.

Note that the circuit data is not lost when the program is stopped and re-run, or even when other programs are loaded.

As stated, there are 4096 circuit points and there is 12% for external gates (each gate uses three bytes plus two bytes per input, or 13 bytes total for a D flip-flop) so huge circuits are possible, you could try designing your own computer using discrete logic!
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[Program file for ALGOL 68]

[Listing for ALGOL 68 program]

[Instructions for using the ALGOL 68 program]
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MICRO-MECHANIC is a simple to use program requiring no computer expertise. MICRO-MECHANIC is written for the Sinclair Spectrum 48k, and is based on the original two-player game which dates back to 1400 BC. Each player has nine counters, and the object of the game is to remove your opponent's counters by sliding to an adjacent point. To form a mill you need to get three of your counters in a straight line, and if this is achieved you can then remove one of your opponent's counters. A player who is reduced to two counters or who is unable to move loses the game.

Spectrum Nine Men's Morris
by Arthur Lindon

Nine Men's Morris is a game for the Sinclair Spectrum 48k, and is based on the original two-player game which dates back to 1400 BC. Each player has nine counters, and the object of the game is to remove your opponent's counters by sliding to an adjacent point. To form a mill you need to get three of your counters in a straight line, and if this is achieved you can then remove one of your opponent's counters. A player who is reduced to two counters or who is unable to move loses the game.

- 10 REM ************
- 20 REM NINE MEN'S MORRIS
- 30 REM by Arthur Lindon 1985
- 40 REM
- 50 BORDER 5: PAPER 7: CLS: P: MS-DOS 23658.8
- 60 IF PEEK 65368 <> 0 THEN GO TO SUB 1560
- 70 PRINT AT 2,8;"NINE MEN'S MORRIS!" AT 3,8;"************
- 80 AT 4,8;"1 AT 0.77 DO YOU WANT TO SEE?" AT 7,6;"THE INSTRUCTIONS? Y/N"
- 90 AT 8,8;"YES" THEN GO SUB 1448
- 100 DATA 1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,1,...
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Atari Yahtzee

by Ken Hall

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home computers. Very little needs to be

this program but the program shows all the

capabilities of the Atari — redefined

character sets, player/missile graphics,

sound, and so on, making it very

professional and great fun to play.

Type in listing 1 without the CLOAD at

the end and make sure it works, add CLOAD and save to tape. Then type in

listing 2 and save it after listing 1 on

tape. To play Yahtzee, rewind the tape

and type CLOAD.
```
PROGRAM FILE

1130 DATA 288,248,236,230,254,254,252,248,0,296,254,224,252,224,254,254,
1140 DATA 0,304,254,224,252,240,240,240,240,0
1150 DATA 1140 DATA
1160 DATA 312,126,224,238,226,254,254,126,0,320,246,246,254,246,246,246,
1170 DATA 0,328,124,124,0,124,124,124,124,0
1180 DATA 336,62,28,28,220,220,252,120,0,344,206,220,248,252,222,222,22,
1190 DATA 2,0,352,224,224,224,254,254,254,0
1200 DATA 360,198,238,254,254,238,238,238,0,368,230,246,254,254,254,238,
1210 DATA 238,0,376,124,236,238,238,254,254,254,0
1220 DATA 384,252,238,238,252,240,240,240,0,392,124,238,238,238,254,124,
1230 DATA 30,0,400,252,198,254,252,222,222,222,0
1240 DATA 408,126,224,124,6,254,254,252,0,416,254,124,124,124,124,124,124,
1250 DATA 0,424,246,246,246,246,254,254,124,0
1260 DATA 432,246,246,246,246,124,56,16,0,440,238,238,238,254,124,56,
1270 DATA 0,448,238,238,238,254,124,56,0,456,238,238,124,56,124,124,124,
1280 DATA 0,464,254,30,60,120,254,254,254,0
2010 ken hall[INV]":X=1:GRAPHICS 18:POKE
756,Q/256:FOR I=19 TO 1 STEP -1:POSITION 1,6
2020 ? #6;Y$(1,X):SOUND 0,50,10,10:X=X+1:FOR W=1 TO 25:NEXT
2030 W:SOUND 0,0,0,0:FOR W=1 TO 15:NEXT W:NEXT I
4040 FOR W=1 TO 2000:NEXT W
4050 GRAPHICS 0:POKE 710,18:POKE 712,178:POKE 752,1
4055 ? "***YAHTZEE***":? "A dice
4060 game for up to four players":
4065 ? "All five dice can be rolled threetimes.Any dice
4070 can be held while the others are":
4075 ? "Rolled .Positions score -":? "1 to 6=Face value of
4080 number selected":
4085 ? "3 KIND=3 the same-Face value scores":? "4 KIND=4 the
4090 same-Face value scores"
4095 ? "F HOUSE=3 and 2 of any dice-Scores 25":? "S
4100 STRT=1234,2345 or 3456-Scores 30"
4105 ? "L STRT=12345 or 23456-Scores 40":? "YAHTZEE=5 of any
4110 dice-Scores 90"
4115 ? "CHANCE=Scores face value of all dice":? "If TOP TOTAL
4120 is 63 or over a BONUS of 35 given ."
4125 ? "EXTRA YAHTZEEs may be put in any of the LOWER
4130 positions . It scores 50 PLUS the position score.
4135 ? "Press numbers to HOLD dice,Press HOLD again to change
4140 back dice.Press [INV]0[INV] to re-roll.";
4145 ? "Use Joystick to select score position and TRIGGER to
4150 enter score."
4155 ? ""***[INV] LOADING PART TWO [INV]***"
5050 POKE 764,12:CLOAD
GOTO 2000
```

```
130 DATA 0
44 FOR G0=1 TO 13:FOR PG=1 TO PL
60 Y=2:FOR J=1 TO 5:FOR L=0 TO 15 STEP 0.5:SOUND
0,100,10,1:NEXT L:POSITION X(PG)-5,Y:? "*":FOR L=15 TO 0
65 STEP -1
66 SOUND 0,100,10,1:NEXT L:POSITION X(PG)-5,Y:? "*[INV]":NEX
67 T IF TH=1 TO 3;POSITION 20,0;:"PUSH
68 trige TO THROW;"
80 IF STRIG(0)=1 THEN 80
90 GOSUB 300:FOR 1 TO 9 STEP 2:IF DH(1)=0 THEN
91 D(1)=INT(RND(0)*6)+1:RSD(1,1)=CHR$(D(1)+48)
92 NEXT I:GOSUB 400:IF TH=3 THEN 120
100 POSITION 20,0::"0 or hold 1-2-3-4-5":GOTO 130
110 IF DH(1)=1 AND DH(3)=1 AND DH(5)=1 AND DH(7)=1 AND
111 DH(9)=1 THEN POP :GOTO 120
115 NEXT TH
120 POSITION 20,0:"select THEN trigger":
130 S=STICK(0):IF STRIG(0)=0 THEN 530
135 IF S=15 THEN 130
```

---

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PROGRAM FILE

140 POSITION X(PG)=5,Y=5. " " IF S=13 THEN Y=Y+1:IF Y>17 THEN Y=2
150 IF S=14 THEN Y=Y-1:IF Y<2 THEN Y=17
160 POSITION X(PG)=5,Y=5. ["INV"]*["INW"]:SOUND 0,5,10,10:FOR W=1 TO 20:NEXT W:SOUND 0,0,0,0:FOR W=1 TO 20:NEXT W
170 GOTO 130
180 POSITION 0,0,0,0. " " :FOR I=1 TO 9 STEP 2:DH(I)=0:NEXT I
190 NEXT PG
200 NEXT GO
210 GOTO 1800
300 K=0:FOR RO=1 TO 7:FOR I=1 TO 9 STEP 2:K=K+1:IF K>6 THEN NEXT RO:NEXT I:NEXT RO:RETURN
310 IF DH(I)=0 THEN POSITION 9+I,0:? CHR$(I)
340 FOR I=15 TO 5 STEP 0.5:SOUND 0,1*10,K,11:IF (A+B+C+D+E=A*4+6) THEN NEXT W:NEXT I:NEXT W
400 FOR I=1 TO 9 STEP 2:IF DH(I)=0 THEN POSITION I+9,0:? CHR$(I)
430 RETURN
500 IF Y>7 AND Y<11 THEN POSITION 20,0:? #6;" INVALID
505 SELECTION":GOTO 905
505 FOR I=1 TO 4:FOR D=1 TO 7 STEP 2:AS$=RSS$(D,D):BS$=RSS$(D+2,D+2)
510 IF RSS$(D+2,D+2)<RSS$(D,D) THEN 700
520 IF Y>=2 AND Y<=7 THEN W=Y-1:GOTO 800
550 IF Y=17 THEN SC=A+B+C+D+E+YZ
560 IF Y=16 THEN IF YZ=50 THEN 700
570 IF Y=15 THEN IF (A=B AND A=C) OR (B=C AND B=D) OR (C=E) THEN SC=0:FOR I=1 TO 9 NEXT I:GOTO 670
580 IF Y=14 THEN IF YZ=50 THEN SC=80:GOTO 670
590 IF Y=13 THEN IF (A=B AND A=C AND A=D) OR (B=C AND B=D AND B=E) THEN SC=A+C+D+E:GOTO 670
600 IF Y=12 THEN IF YZ=50 THEN SC=110:GOTO 670
610 IF Y=11 THEN IF A=B AND A=C AND A=D OR (B=C AND B=D AND B=E) THEN SC=A+B+C+D+E:GOTO 670
620 IF Y=10 THEN IF YZ=50 THEN SC=140:GOTO 670
630 IF Y=9 THEN IF A=B AND A=C AND A=D AND A=E THEN SC=A+B+C+D+E:GOTO 670
640 IF Y=8 THEN IF YZ=50 THEN SC=170:GOTO 670
650 IF Y=7 THEN IF A=B AND A=C AND A=D AND A=E THEN SC=A+B+C+D+E:GOTO 670
660 IF Y=6 THEN IF A+B+C+D+E=5 THEN SC=200:GOTO 670
670 IF SC=0 THEN POSITION X(PG)-1,Y=7:SC=0:GOTO 680
675 POSITION X(PG)-1,Y=7:SC=0:GOTO 680
680 LSC$(PG)=LSC$(PG)+SC:POSITION X(PG)-1,9; ?LSC$(PG)
690 POSITION X(PG)-5,Y=5; " " :TSC$(PG)=TSC$(PG)+SC:POSITION X(PG)-1,21;21:TD$(PG)=TD$(PG)+SC
700 SD=(Y+Z)+A+B+C+D+E:GOTO 670
700 FOR I=1 TO 9 STEP 2
810 IF D(I)=W THEN SC=0:W
820 NEXT I:IF SC=0 THEN POSITION X(PG),Y=5:SC=0:GOTO 840
830 POSITION X(PG)-1,Y=5:SC
840 USC$(PG)=USC$(PG)+SC:IF USC$(PG)>62 AND B(PG)=0 THEN USC$(PG)=USC$(PG)+35:B(PG)=1
850 POSITION X(PG)-1,9; ?USC$(PG):SS=0:GOTO 680
900 POSITION 20,0,0: " " :POSITION Filled ";
905 RESTORE 920:FOR I=1 TO 10:READ N:SOUND N,0,10,10:FOR W=1 TO 25:NEXT W
910 NEXT I:SS=0:GOTO 680
920 DATA 91,0,121,128,121,108,121,0,96,91
920 RESTORE 1220:FOR I=1 TO 14:READ N:SS=SOUND N,0,10,10:FOR W=1 TO 34:NEXT W
930 IF I=15 THEN NEXT I
940 IF SS=0 THEN 1220:SS=0:NEXT I
950 RESTORE 1230:FOR I=1 TO 10:READ N:SOUND N,0,10,10:FOR W=1 TO 20:NEXT W
960 GOTO 1250
975 DATA 188,30,140,30,110,40,92,30,92,30,92,30,110,30,110,30,10,40,30,110,30,186,120,0,50
980 ZAY=50:POSITION 20,0,0: " ";FOR R=1

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1.47: "3 THREES": POSITION 1.5: "3 FOURS"
2687 POSITION 1.6: "3 FIVES": POSITION 1.7: "3"
SIX": POSITION 1.9: "TOP TOTAL"
2630 POSITION 1.11: "3 OPA KIND": POSITION 1.12: "4 OPA
KIND": POSITION 1.13: "FULL HOUSE": POSITION 1.14
2640: "S STRAIGHT": POSITION 1.15: "L STRAIGHT": POSITION
1.16: "YANTZEE": POSITION 1.17: "CHANCE"
2660 POSITION 1.19: "BOT TOTAL": POSITION 1.21: "FULL
TOTAL": POSITION X(1)-4.1: "A$"
2700 FOR I=1 TO PL: POSITION X(I)-4.2: "1": POSITION
X(I)-4.3: "2": "8"
2710 POSITION X(I)-4.4: "3": "8": POSITION X(I)-4.5: "5":
46: "POSITION X(I)-4.6: "6": POSITION X(I)-4.7: "6": "8"
2720 POSITION X(I)-4.9: "T": "T": POSITION X(I)-4.11: "3"
2750 IF I=2 THEN POSITION X(I)-4.1: "1": "B$"
2760 IF I=3 THEN POSITION X(I)-4.1: "1": "C$"
2770 IF I=4 THEN POSITION X(I)-4.1: "1": "D$"
2780 POSITION X(I)-4.21: "FT": "FT": NEXT I: GOTO 40
6000 RESTORE 4050: FOR I=1 TO 10: READ C:FOKE 1536+1, C:NEXT I
6010 POKE 512,0:POKE 513,6
5520 RETURN
6050 DATA 72,167,178,141,10,212,141,26,208,104,64
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AXIS AT HOME WITH TECHNOLOGY
Above we show you two printers (to the same scale). On the left is the OKI MICROLINE 82A - one of the most successful standard dot matrix printers ever manufactured. On the right is the printer that will become the NEW standard for dot matrix printers - the new MICROLINE 182 - from OKI.

In the past OKI have always achieved excellence in their printer products - now we believe they've reached perfection! OKI's revolutionary design concept for the new Microlines sets hitherto unparallel standards of performance, styling - and price.

The new MICROLINE 182 is the first of a whole new range of printers from OKI which fulfil all the requirements of today's printing needs. With operating noise level reduced to an almost unbelievable 58dB. and a print speed of 120 characters/second, listings, invoices and many other applications are all handled quietly, with utmost speed and efficiency. If your requirement is for high resolution computer graphics, the MICROLINE 182 will reproduce your screen images with a degree of accuracy never before seen from a matrix printer. True underlining, superscript and subscript are...
The new MICROLINE 182 to the same scale as the 82A

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PERFECTION
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- Even faster throughput (160 cps)
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The reputation of OKI MICROLINE printers was built on excellence of quality and reliability. The new Microlines are no exception - even higher quality, greater reliability and performance bring the new generation of OKI MICROLINE printers - to near perfection.

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<tr>
<th>Model</th>
<th>Price (plus VAT)</th>
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<tr>
<td>KP810 (80 column)</td>
<td>around £339</td>
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<tr>
<td>KP910 (156 column)</td>
<td>around £429</td>
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**PC compatible versions**

<table>
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<tr>
<th>Model</th>
<th>Price (plus VAT)</th>
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<tbody>
<tr>
<td>KP810PC (80 column)</td>
<td>around £399</td>
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<td>Portfolio Management</td>
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- C-systems C v2.0 £230
- De Sage C86 v2.4 £145
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- Mutilkey £170
- db-VISTA (source) £395
- V-FILE £295
- C-refine £245
- C-to-Base (source) £150
- Phonix £250
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On the ball: proving that every cloud has a silver lining for a computer company, Sperry and Systemserve are promoting a computer-based identity card service to ‘beat the menace of hooligans at football matches’ and ‘restore the fortunes of soccer in Britain’. Step up the robot design, lads, and you might be able to give England a chance in the next World Cup.

Bridge of Sighs: one joke doing the rounds at the moment concerns the name of the next Acorn machine, now that the Olivetti connection has been established. Acornetto is the suggested title, although Cambridge’s Silicon Fen isn’t as attractive as Venice.

Start turns: following the Commodore 64 game Jack Attack (in loving memory of founding father and now Atari renegade Jack Tramiel) comes Super Pipeline II, featuring Sir Clive in a C5 at the end of the first level. Scopio Gamesworld is reported to have enlarged on the same theme with its C5 Clive but this time keeping it in the family – the game runs on the Spectrum.

Punting: back in Silicon Fen, and still on Sir Clive, we hear the great man once invested in the TV show Splitting Image. Perhaps he should have invested more if he wanted to escape being lampooned, though doubtless he’s not bothered by his puppet or its antics.

We also hear that Sir Clive is an avid reader of ChipChat — we’re waiting for him to enter the caption competition before we believe this. And if you could spare the time, Sir, we’d also like to know if the American Timex machines are coming to the Continent. Could it be that Portuguese holidaymakers are in for a Sinclair surprise?

A-maze-ing: long before mice began to breed on desk-tops, A-maze-ing: long before mice being flown in office automation products made their way around mazes. The next UK micromouse finals take place on the last day of the European Personal Robot Congress, which runs from 2-4 July at the London West Hotel. Having watched mice career around fairly simple mazes, it’ll be interesting to see how they cope with the Japanese maze being flown in especially for the event. It’s not clear whether ritual suicides will be in order for any mice which fail to rise to the challenge, but it will give competitors a chance to tune up for the August World Finals to be held in Japan with the assistance of the Japanese Science Foundation — showing that this is serious business as well as fun.

Ultimate goes to Hollywood: back-patting, fixed grins, and phrases such as: ‘Didn’t they do well’ were once again the order of the day at this year’s Golden Joystick Awards. The ceremony produced few surprises, with Ultimate being voted Software House of the Year and Knight Lore the best game. However, as is customary at these functions, not everyone was happy with the results. While it was all smiles and laughter above-board, downstairs in the gentlemen’s toilet the losers displayed a bitchiness more appropriate to Hollywood than home software.

On well, at least we can be grateful that the winners resisted thanking everyone from their great-grandmother to the inventor of the silicon chip for their success. Am I blue? little-known music maker IBM, or ‘Big Blue’ as it’s sometimes referred to in its more famous role of computer manufacturer, launched an expensive publicity campaign on the unsuspecting French earlier this year. Musical microchips were used in advertisements published in a French paper — open the page and the chip began to sing the praises of the PC. Reports that sales of ear plugs rose on the same day have not so far been confirmed.

Wang: this year Wang promoted its office automation products at a show featuring ‘Nell Gwynnes offering their wares, court jesters, bunting, banners and balloons’. They’re more sophisticated than that across the Atlantic. The autumn conference of the Office Automation Society is a ‘total immersion workshop’ being held ‘in lecture rooms and jacuzzi’. Meet you by the pool, Nell.

Following yonder star: not that it’s likely, of course, but we’ve some good news just in case you should want to find out if you have any family connections with Ronald Reagan or his Irish ancestral home of Ballyporeen. The local priest has produced a case you should want to find out if you have any family connections with Ronald Reagan or his Irish ancestral home of Ballyporeen. The local priest has produced a database of the relevant records — Ballyporeen is the package used and a Northstar Advantage the machine.
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