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EDITORIAL

PCW is acutely aware of the need for consumer protection in the microcomputer business. We try to advise and guide prospective buyers, often through the 'Interrupt' feature. Now we are delighted to report that the suppliers themselves have decided that the time has come for more positive action. To this end a Computer Retailers Association has been formed. At the time of going to press, 41 retailers have agreed to join the association and to abide by its strict code of conduct. This code is designed to protect the consumer and we think that it is in every readers interest to study the draft. In order that you may do this we publish it in full as part of the article 'Straight Dealing' on page 42 of this issue of PCW. Should you have any comments to make then write to PCW, marking your envelope CRA. As the code is still in draft form, this is your opportunity to influence the final product. PCW will pass all correspondence to the executive committee of the CRA.

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Guidelines for contributors
PCW welcomes articles of interest. Don't be put off if your style of writing is 'under developed' . true worth lies in the content, and shaping features comes naturally to us! Manuscripts should not exceed 3,000 words and authors are asked to use triple-spaced lines with a wide left-hand margin; diagrams, listings and/or photographs should be included wherever possible. Please enclose a stamped, self-addressed envelope if you would like your article returned.

Because of the foregoing, it is necessary to add that the views expressed in articles we publish are not necessarily those of Personal Computer World. Overall, however, the magazine will try to represent a balanced, though independent viewpoint. Finally, before submitting an article, please check it through thoroughly for legibility and accuracy.

Subscription rates: Britain £8.00 for 12 issues, USA $20 for 12 issues (surface mail), Continent and elsewhere £9.80 for 12 issues. All prices include postage and packing. Supplies to specialist shops can be arranged by negotiation direct with the publishers.
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Graham Knott & Jeff Orr now moved....

to new premises due to expansion to accommodate larger stock and workshop facilities for the Microcomputer user.

Our new number is

051-933 5511

ring us at any time for your requirements

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**NEW Vastly improved 625 TV adaptor for Pet.** Handles reverse field graphics, exceptional picture. £25 complete plus VAT

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### PET

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<td>Pet 8k</td>
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<td>Pet 32k</td>
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**Disk Units**

- Comptuhink 400k Random and Sequential complete to fit 8k Pet (via expandamem) £795 to fit 16/32k Pet (direct fitting)

**Memory Expansion**

- 24k Exandamem for Pet £320

**Interfaces**

- Uni-direct I-EEE to RS232 £89
- Bi-direct I-EEE to RS232 £140
- Bi-direct 2 ported I-EEE to RS232 £175

**A/D Converters**

- AIM 161, 16 channel A/D convertor for Apple, Applem, Nascom etc £130
- Petsett 1, AIM 161 including all interfacing requirements for Pet, complete £168

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- New C65 Video Adaptor a vast improved 625 video convertor for Pet, works extremely well £25
- Stack Page Printer Interface copies screen contents onto 20m.a. loop complete with software £25

**APPLE**

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- Appleplus (b&w) 16k £830
- ITT 2020 (colour) 16k £950
- 16k RAM upgrade £85

**Communication Card**

- Printer Card £110

**High Speed Serial Card**

- Disk Drive with DOS £425

**Extra Disk Drive**

- £375

**Diskettes (10's)**

- £30

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**SORCEROR**

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- Sorceror 32k £859
- AIM 65 £249.45
- NASCOM £165
- KIM £99.95

**MANUALS**

- New Pet user manual £5

**Diskettes**

- Petset 1, AIM 161 including all interfacing requirements for Pet, complete £166

### Printers

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<td>Teletype 43 pinfeed RS232</td>
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<td>fricition RS232</td>
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<td>pin and friction RS232</td>
<td>£720</td>
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**Anadex DP8000**

- £575

**Perkins Elmer Pussycat**

- £339

**Type写**

- Also Centronics Range, Texas Instruments, Lead Sliger

**Connectors**

- Pet User Port/I-EEE Port £1.10 each
- Pet 2nd cassette Port 85p each
- Hoover for User/I-EEE connectors £2.25
- D.25 RS232 Connectors (State Male or Female) £3.00
- D.25 Hoods £2.25

**Demagnetiser**

- Curved head £4.00

If any requirements are not listed please ring us as we may have them in stock.

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*All prices are + VAT at 18% and include carriage (unless otherwise stated). Please make cheques payable to Stack Computer Services Ltd.*

---

**Stack Computer Services Ltd**

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MULTI-USER, MULTI-TASKING, TIMESHIRING, MEMORY MANAGEMENT

Basic 64K RAM, 2.4Mb Floppy Disk System: £6,496.00
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(Terminals & Printers to be added to user specification.)

ALPHA MICRO gives a new meaning to the words "Cost Effective." It combines a powerful 16 Bit processor with a proven time-sharing disk operating system to give you data handling and software sophistication parallel to that of high performance commercial minicomputers. It can be upgraded from a simple 64K single terminal floppy disk system up to a 24 terminal, multi-printer, system with 2400 Megabytes of disk storage and 1.02 Megabytes of Random Access Memory without any hardware redundancy.

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Since the system can handle up to 24 terminals, where each user terminal has its own 32 or 48K memory partition, it is ideal in education or research since each user can do his own application, i.e. one can be running the BASIC Compiler whilst another runs LISP; again another one can do programming in PASCAL or ASSEMBLER etc.

ALPHA MICRO Standard Features
- Powerful WD16 16-Bit Processor
- SI00 Bus Compatible
- Expands from 6-24 terminal ports
- Multi-Printer Spooler
- Adaptable to most RS232 peripherals
- Sequential, Index Sequential and Random Access files supported
- Comprehensive disk file management system and utilities
- Multi-User structured file system with programmer/project number and password protection
- Command file interpreter with parameter substitution
- Multiple level DMA and vectored interrupt system
- Multiple pass assembly programming system with linking loader
- ALPHABASIC Extended compiler and re-entrant runtime package
- Index sequential files supported in both Assembler and ALPHABASIC
- File management system with logical file I/O calls
- ALPHAPASCAL, one of the best UCSD implementations
- ALPHALISP, a textual data manipulation language

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BOXED AND BUILT FOR ONLY £325

FEATURES

- Serial RS232 interface.
- 80 characters wide.
- Bi-directional printing.
- 60 lines per minute.
- 10 line print buffer.
- 96 character ASCII set. (includes upper/lower case, $, #, £)
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<td>£120.00</td>
</tr>
<tr>
<td>BK Static RAM board (2048)</td>
<td>£110.00</td>
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380Z/56K complete with DUAL FULL FLOPPY DISK SYSTEM FDS-2
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WHAT OTHER FEATURES SET THE 380Z APART?
The 380Z with its professional keyboard is a robust, hardwearing piece of equipment that will endure continual handling for years. It has an integral VDU interface — you only have to plug a black and white television into the system in order to provide a display unit — you do not need to buy a separate terminal. The integral VDU interface gives you upper and lower case characters and low resolution graphics. Text and graphics can be mixed anywhere on the screen. The 380Z has an integral cassette interface, software and hardware, which uses named cassette files for both program and data storage. This means that it is easy to store more than one program per cassette.

Owners of a 380Z microcomputer can upgrade their system to include floppy (standard or mini) disk storage and take full advantage of a unique occurrence in the history of computing — the CP/M™ industry standard disk operating system. The 380Z uses an 8080 family microprocessor — the Z80 — and this has enabled us to use CP/M. This means that the 380Z user has access to a growing body of CP/M based software, supplied from many independent sources.

380Z mini floppy disk systems are available with the drives mounted in the computer case itself, presenting a compact and tidy installation. The FDS-2 standard floppy disk system uses double-sided disk drives, providing 1 Megabyte of on-line storage.

Versions of BASIC are available with the 380Z which automatically provide controlled cassette data files, allow programs to be loaded from paper tape, mark sense card readers or from a mainframe. A disk BASIC is also available with serial and random access to disk files. Most BASICS are available in erasable ROM which will allow for periodic updating.

If you already have a teletype, the 380Z can use this for hard copy or for paper tape input. Alternatively, you can purchase a low cost 380Z compatible printer for under £300, or choose from a range of higher performance printers.

RESEARCH MACHINES Computer Systems are distributed by RESEARCH MACHINES LTD., P.O. Box 75, Chapel Street, Oxford. Telephone: OXFORD (0865) 49792. Please send for the 380Z Information Leaflet. Prices do not include Carriage or VAT @ 15%.

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- Output via 12-way edge connector.
- CMOS compatible with pull-up resistor.
- Parallel output: active pull-down, direct TTL compatible (one load) open collector type.

MICRO MART

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<tr>
<th>Description</th>
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<td>Z80A microprocessor</td>
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<td>Z80A which will run at 4MHz but is selectable between 2/4 MHz.</td>
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<td>Industrial standard 12&quot; x 8&quot; PCB, through hole plated, masked and screen printed. All bus lines are fully buffered on-board.</td>
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<td>Uicon 57 key solid state keyboard. Monitor/domestic TV interface. Kansas City cassette interface (300/1200 baud) or RS232/20mA teletype interface. The Nascom 2 kit is supplied complete with construction article and extensive software manual for the monitor and BASIC.</td>
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No more slaving over a hot soldering iron - the Nascom 1 is now supplied BUILT! Britain's biggest small system is available fully constructed for you to slot into your own housing for the ridiculously low price of £140 plus VAT (kit price still only £125 plus VAT).

12" x 8" PCB carrying 5LSI MOS packages, 16K MOS memory packages and 33 TTL packages. There is on-board interface for UHF or unmodulated video and cassette or teletype system, video display and EPROM option. The 4K memory block is assigned to the operating system socket, leaving a 1K user RAM. The MPU is the standard Z80 which is capable of executing 15k instructions including all 8080 code.

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NASCOM IMP PLAIN PAPER PRINTER

Fully built and housed in a stylish enclosure for just £325 plus VAT. Interfaces with all micro computers.

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**BOMBING THE PRICES**

Derek Rowe of Abacus can be sure that the horns in the computer world are going to be very stirred up by his deal with Texas firm, Show Financial — and the horns will call him the worst of all possible names. They will accuse him of Bombing the Price of terminals.

In an example of what bombing the price means, take a look at pricing on two devices: the Japanese NEC Spinwriter, and the American Texas Instruments 810 printer.

The Spinwriter is not easy to describe to somebody who hasn't seen one; as a test of describing to somebody who hasn't seen one; as a test of how it worked; such is the spin writer; it looks like a whisky tumbler, it looks like the vertical struts of a basket; the horizontal weaving is done.

In the centre of the cup-sized basket is a hammer, pointed at the paper. The 'struts' of the basket are spun past the hammer, and each strut has a letter moulded to the top of it. When the right letter gets between hammer and paper, the hammer bashés the strut onto the paper. If you are quick and put a typewriters ribbon in the way first, you will end up with a printed character.

As the market stands today, this device is a top quality high-speed typewriter, with the bonus feature of being usable as a terminal. Its official UK price of £2,600 reflects not only the many sophisticated safeguards that the builder has provided; it also reflects the fact that the IBM golf-bal set printer, the 810, from a store in New York, and import it, and pay duty and tax, and the one-off price; and it will cost me £730. "If I ask Texas in Bedford for a price, they won't offer me less than £540, and that's for very high volume. Why don't you print that, rather than going on about the £200 extra Apple charges on exported machines?"

As a matter of curiosity, I asked Texas in Bedford what a single 810 would cost: over £1,450, was the answer. Abacus will be importing the Texas 810, too, but Rowe wouldn't think about discounting policy compared to Bedford. "We will be adding value", says the company, "with a special character set option, and our price will be £1,200 or so; but we're not trying to compete with TI Bedford."

My bet is that Texas will still accuse Abacus of 'bombing the price', which, if they do, will be an accusation that will bring wry smiles to the faces of that company's competitors.

**Ace is high**

A TV games machine called the Acetronic MPU 1000, selling at £3,850, has been launched by Advanced Consumer Electronics (ACE) using the Signetics 200 microprocessor as its central intelligence. Managing director David Rurka revealed his 3-page sermon with the launch announcement, forecasting 'household financial planning and control, learning, recipe and shopping list storage and up-date programs' — all on plug-in modules.

The Acetronic MPU/1000, plus range of plug-in modules. The sermon all but completely obscured the important announcement that a new ACE system would soon be introduced, again in the guise of a TV games system, but one capable of being enhanced to a highly sophisticated home computer.

"I'll forgive him for his waffly sermon, for the sake of Malcolm's spirit of metaphor. "The astronauts who landed on the moon in 1969 would not have known how to operate a digital watch, let alone have any idea of how it worked; such is the speed of micro technology." Egad, that's probably true!"

**Massmem and pi-mem**

Unlucky readers of a local newspaper will believe that a British engineer has invented a computer memory that provides 128 million characters of storage without a disc or tape or semiconductor.

The truth, if less startling than that, is still good news for British micro users. The local company, Courtest, believes it has found a way of using the fact that tape is generally cheaper than disc to offer a high speed tape drive that replaces disc. On the face of it, this is not possible. Tape starts at one end and finishes at the other, as most tape data recorders are used to tie up data in a string as the computer winds it out. Disks, however, can yield any data written anywhere on their rotating surfaces in as little time as it takes to move the recording head to the right track.

Tim Keen of Keen Computers has invented a computer memory that has just finished for the one that is just going to run. For the big 16-bit micro that Zilog is pushing into the market, the Z8000, Joy thinks he has a straightforward version of the tape, offering 128M bytes at £3,850 (discounted to £2,000 for builders of...

**NEWSPRINT**
original mass produced systems) could provide a powerful associative memory, where data can be retrieved directly, rather than as a result of a search.

The price, he conceives, is not low "but we would rather start high and do a deal if necessary". What sort of "deal" he won't say, naturally, but I can't see any reason for supposing that if the system works, it will cost much over £1,000 in a year or so's time.

The company behind this new idea, the Courtest Group, is also planning a word processor, various printers, interfaces, and a consultancy service. Joy says it is backed up with £150,000 capital, has a factory and is making distribution deals — all of which could be more important than bright technology.

The name's the same

The computer revolution in Britain did not begin with the Mits Altair which Martin Underwood imported through his new company Computer Workshop. It started with the Computer Workshop, which put a video display kit on the market, almost a year earlier; and the news that Computer Workshop is dropping out of the kit business probably marks the end of the revolution, and the fact of the New Establishmentarianism in microcomputers, the Leeds shop was opened by an ex Cabinet Minister, Merlyn Rees, the Labour Home Secretary until this year.

Rees was attracted with the offer of a platform: he was asked to speak about computer technology and 'the role of the microcomputer in society and its future development'. His contribution was: a new social class will grow up in response to the micro, in the next decade.

Our picture shows him talking to an Apple micro, demonstrating the ability of the speech recognition circuitry and software to mistake 'seven' for 'end' and turn the whole program off just when it gets interesting. (No, I wasn't there, and for all I know, that didn't happen; but it did happen to me when I tried it.)

New courses

For the lost stranger to these pages, vaguely wondering whether a micro could help run a business, or whether perhaps an Official Minicomputer would be better, the idea of £257 for a one-day seminar to put the problems in context might seem cheap. Yet...

It is one of several 'beginner's seminars organised by the London Chamber of Commerce and Industry, and designed to make sure you only get fleeced if you are really overheated.

"Computer Bureaux vs Mini vs Micro Computers" runs on Tuesday March 16, next year from 2.00 to 5.00 pm. 'How to Negotiate Computer Contracts' runs on Thursday 21 February. A one-day training course 'Introduction to Computers and their Applications' costs more at £70 and there are several dates through to July next year. And finally, a two day 'Introduction to Microcomputer Programming' course — a BASIC course — at £127, runs on 11 and 12, and again on June 11 and 12.

Contact; Ann Measures, training manager, at 69 Cannon St., London EC4N 5AB.

The money writers

It isn't easy, giving away £800 to good software writers. Kent University has tried it, and last year only 20 people were interested.

The £800 forms the prize money for the Kent Software Trophies. It is open to software writers in schools and colleges, and it would seem that software writers there just don't get to hear about it.

The problem, as explained by Dr. David Bateman, who works at the University of Kent, computing laboratory, is simple. Either the £800 goes as prize money, or it gets spent advertising the competition.

This year, thanks to the foresight of the Government, the schools and colleges won't be able to distribute leaflets and entry forms about the competition, because local education authorities are having their budgets cut.

Well, if you want the money, you know what to do. You submit a computer program which you have written. The program must be of practical use in commerce or industry, not just for the school or college. It can be short — 20 lines of code would do, as long as it is 'imaginative', 'useful' and 'well documented'.

Two first prizes worth £300 will go to under 17 and under 19 year old winners, £200 to under 17 and £100 to under 19. Under 17 winners will receive a £20 library voucher, and the under 19 winners a £20 shopping voucher. A further 10 prizes of £50 will be awarded to each age category.

For details, entry forms are needed. Write to Dr. David Bateman, Computing Laboratory, University of Kent at Canterbury, CT2 7NF. And be quick; entries must be in by February 16, 1980.

Micromotion

Adding to the list of computer shows outside London is the at first unlikely candidate of Computermarket 80. This travelling fair has in the past been an orthodox computer industry disaster, delightful for the vanguard of the British industry, respectful attention from a great many people on each exhibitor's stand, and a bit of trouble-free, less rewarding for the exhibitors themselves.

Now it is turning itself into the Travelling Micro Show, if not by that name. Exhibitors who are registered, according to one exhibitor John Godley, include Comma Computers, Compashop, Computer Workshop, Corner Computing Services, CPS (Data Systems) Digitor, ECI, Micromatic Products (and Lovely Bottoms), Lyme Peripherals, Micro Central, Microcomputers, Nascom Microcomputers, Robox, Rostronics... it really is a wonder, you only get fleeced if you don't get to hear about it.

This year, thanks to the theme of 'Taking technology to the computer industry to the first time user' is obviously attracting more people than ever before; dates in March are 4-6 in Birmingham, 11-13 in Manchester, 15-20 in Leeds, 25-27 in London; and details are on 01-437 4187.

Test trauma

A first-class row and a second-class scolding may be brewing over the servicing of personal computers. In the last two months, user associations, manufacturers, trade associations and all have pointed out the fact that not all users get trouble-free servicing of their equipment. What they have not concentrated on is the fact that the means for diagnosing microprocessor faults is still crude. Illustrating the point pretty well is the announced specification of a new 'in-circuit analyser' which, it is claimed, will simplify microsystem diagnostics. The machine is available from BFI Electronics, T.I.S. Electronics, and Zilog/Mostek's Z800 micros only.

It provides in effect a 'dual control' for a microcomputer system. The analyser will allow forty leads to attach to the forty pins of the micro on the board. It monitors the pins, turns the micro off, can over-ride them if certain pre-determined sequences of events occur. For example, a particular memory location or stack location can be specified on...
Micro system diagnostics — from BFI Electronics.

the address bus for up to 16 times, before the analyser takes any action. Action then can include a halt, other memory examination, register adjustment, data adjustment, and so on.

...nothing like this diagnostic facility is available to designers of systems already, through the development systems with their in-circuit emulation abilities.

The question of how many dealers are designers or have micro development systems is less than moot, however. Many a problem has been overcome without the repairer ever having any real idea of why the cure has worked. Best known was the Nascom expansion memory board, which failed if the same memory location was accessed two or three times in succession, but only if one of the buffer chips was a Fairchild or Texas low-power Schottky device — not if it was made by National Semiconductor. Nobody has yet offered a convincing, detailed analysis of why this should have been so.

In the circumstances, the more test equipment available, the better. What about the people to operate it, though? Details from BFI on 01-941 4066.

Bubbles beat dust

A computer on a building site will probably need bubble memory instead of floppy discs, simply because of the heat and the dust. That is, assuming you can find a computer with bubbles. And now, you can, thanks to Sidney Schubert, in charge of his own company Dalestate. He has found an American microcomputer costing £400 in the UK which can take a bubble module of 128K byte capacity.

Included in the price are languages — Basic, Fortran and Cobol — and a floppy disc drive comes as standard. The system is portable, weighing 20lbs. It is made on the US West Coast by Findex, it runs the CP/M operating system on its Z80 processor, and the package includes screen, disc drive, keyboard and printer. The only snag is the cost of the bubble memory, £1,500 per 128K byte module. It can take eight of these, should you be able to afford it. But if you have problems with vibration, dust, heat or movement, then you probably can’t afford not to. Schubert is on 01-660 9660.

Swings and roundabouts

When the country has two importers of the same computer, and each importer sells at a different price, look for the costliest sort of friendship between them. Thus it is between Comart, the big distributor of micro equipment, mainly based on the $100 box, and its Scottish rival Micro Centre.

The two operations are very different in what they do, and in what they try to do. Norman Rouxell in Edinburgh sells at the lower price, direct to end-users. Comart has established a dealership chain, which includes all Byte Shops and Computerland retail stores, plus such other reputable dealers as Tim Moore of Newbury, and David Broad of Comart.

Broad of Comart generally asks the end-user to pay rather more, most of the extra going on dealer support, which, he says, feeds back to the user. The incompatibility between two, equally valid approaches to the total market turned into something like rancour recently, when Rouxell announced the Cromemco hard disc system, and astonished the world by pricing it level with Comart.

He also astonished David Broad by announcing that maintenance would be done by the established repair firm, Computer Field Maintenance. CPF handles Comart maintenance, and the deal was supposed to be exclusive.

Claims and counter-claims aren’t easily sorted out by simple phone calls, and until an angry user can put me right, I can only go on the intelligent guesses of noncombatants in the industry.

The intelligent guess is on price. Comart is now a big enough customer on the more expensive Cromemco systems to pull some weight in California, and to get an understanding that, on big systems at least, anybody selling below Comart prices will not be supplied.

As maintenance, rival stores tell me that there is no need to make a mystery out of it. Computer Field Maintenance, they say, makes money from fixing computers. If you ring the engineer up and ask him to fix a broken computer, it’s quite possible he (or she) won’t bother to ask who sold it to you before agreeing to send an invoice.

Intelligent guesses, however, aren’t guarantees. Users should probably make their own investigations and believe what you like, only make sure you get it in writing if you’re paying for it.

Pet plug

To prove that Pet has become a world of its own, not just a character in the greater play, a new Pet magazine has started up. Obviously, it aims to balance the Commodore-oriented magazine put out by Commodore itself, by being independent. The fact that the Editor, Richard Pawson, is ex-Commodore himself need not mean that he will be biased pro-Commodore; either, as anybody who has ever met ex-Commodore man Derek Rowe of Abaras can testify. Printout, at £9.50 for ten issues in the UK, is available from Greenacre House, North Street, Theale, Berkshire RG7 5EX.

The vast bulk of software written for systems that used Digital Research’s operating system, CP/M, will now run unchanged on the Heathkit micro, says one New York agent, Lifeboat. At $145, the Heath version of CP/M includes a text editor, an assembler, debugger, and various other "utility" items of software that give the user access to a system without having to toggle switches.

Pet printer

Printers for the Commodore Pet computer: at £550, a new range has been announced by Parameterised Computer Systems Ltd. Apart from the fact that this machine, called the X80, plugs directly into the universal plug port of the Pet, the IEEE interface, it doesn’t appear to offer anything over cheaper machines such as the Oki, since it uses a roll of narrow paper — four inches wide. The German manufacturer claims that the matrix print head will last for 50 million characters.

Zilog range expands

Zilog has introduced a family of product development systems — all microcomputers with a Zilog chip as central processor on which to run and test software.

There is a big one based on the giant Z8000 chip, with up to 40 million characters of storage on hard discs, and smaller ones covering the established Z80 and the new single-chip Z8.

What will probably make the equipment, however, is the operating system, Zilog’s RIO, which can link assembler source with high level modules written in PLZ/Sys and shut them around the memory map on command. Sophistication like this is not, of course, for the user of a simple shop-bought system, but for the micro builder who is making hundreds. Don’t ring up out of idle curiosity.

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Steadmans bazaar

A bring-and-buy sale for electronics scraps is going to be held as the welcoming feature of the Great British Electronics Bazaar when whizzkid, Evan Steadman, puts it together next June. Steadman is one of those amazing characters who is never at a loss for a comeback, no matter how rude the comment — and sometimes the comeback is better than his original idea. In the case of the bazaar, last time was on its back and while it worked better than many first times, it was not above critical comment. The comment that seems to have stuck was actually summed up in a letter of praise: “The atmosphere was very good and relaxed, unlike other exhibitions such as Breadboard World was too over crowded.” There is, it seems, over crowded, and too overcrowded. In his bid to exhibit and possible exhibitors, Steadman observes: “You want lots of people to come to the Bazaar, agreed? Well, apart from the reduced admission if they write in for an advance, we are now also offering a free bring-and-buy sale for your wares”. That, he explains, means that there will be benches, on which everyone “who has bits and pieces that they now don’t require” can display their wares free of charge.

To get your cut-price ticket, write with stamp-addressed envelope enclosed to Evan Steadman, 34-36 High Street, Saffron Walden, Essex CB10 1EP. The Bazaar runs Friday, Saturday and Sunday, June 20 to 22 next year.

Glitch-free

Copying a tape with a program is as simple, you borrow another tape recorder, play the program on yours and record it on the other. Getting the copy to load correctly is the problem, however. A tape copying service has been launched by Kansas City Systems. It runs on a non-profit basis and is for bona fide computer clubs only, and according to KCS boss Tom Boley, the copies are guaranteed to load. Tom charges 80p a copy, including tape, for a minimum of five tapes. Details on Chesterfield (0246) 805037.

Fair success

A hobby computer fair in Stuttgart, Germany, is reported successful enough to encourage the organisers to try again next year. The show, Eltro-Hobby 79, attracted Citizen’s Band, ham radio, and television enthusiasts as well as microcomputers; some 25,000 visitors arrived over the time from October 3 to October 7. Next year’s show will be September 10 to 14, and the venue will be the Killesberg exhibition grounds. Details from CEQ Overseas, London, on 01-236 0911.

Spiking the system

The worst thing you can do to your computer is turn it off: and the second worst thing is to turn the washing machine off.

As to the first, all you can do is put a notice on the machine, pointing out that it uses as little power as the fridge, and that it is supposed to have no moving parts.

Turning it on and off makes the parts expand and contract and literally — wear out.

For the second, you could try filtering the Electricity Board’s power supply. It’s worth a try, because the voltages that can appear on the mains when a big coil like a washing machine motor is switched on or off can do dreadful things to a micro — both hardware and software. A mains ‘spike’ at our own PCW Show stopped the chess-playing Vega program’s clock, blew three memory chips on a neighbouring stand, and presumably, introduced uncounted random errors into storage, input and output, all around the hall.

Two products announced this month tackle the problem in different ways. Beyta Logic has announced a mains interference suppressor costing under £20, sold through Logic Box at 31 Palmer Street by Caxton Hall, London SW1.

Rather more costly at £105, but more ambitious in its attempt to clean up the mains noise is the LEA MB 10 from Lightning Elimination Associates, of Vine Cottage, Moreton, Oxon. It provides 13 Amp output, and has an impressive list of performance figures for its active filter.

Neither device, by the way, will stop your micro picking up the multi-million Amp spark that the TV’s electronic photographic flash generates when it stops flashing, and many are the systems that will execute an HCF (Halt and Catch Fire) instruction when they pick up that pulse.

Lighting Elimination will try to avoid this problem too — even to the point of advising you on what to do when lightning strikes next door. The company ‘stresses’ that it provides a total service, as well as supplying a product.

Never mind maths

It is now officially true that you can program a computer without O’ levels. The guardian of what is possible, the National Computing Centre, has produced figures from a survey of school leavers who were trained as programmers. In time, the fact that the established computer industry is that the best sign of a potential programmer is a good grasp of English. After that, a tested design to measure general thinking ability showed a good correlation between those who scored well at it, and those who produced successful programs.

But maths turned out to be no guide at all in chess, bridge, or crossword puzzles.

The average commercial data processing manager, however, remains convinced that home micros are a dream, because ordinary people will never be able to program them. That’s my impression, by the way, not the NCC’s. The NCC, in the person of seminar organiser Eric Bird, contents itself with the observation that data processing managers are experiencing ‘resistance to change’.

Plessey chip board

Fast memory for Z80 based systems: Plessey has announced a board of read/write memory chips that will keep up with high this speed micro. Considering that the board is nothing like $100, and that it costs $769, it is perhaps understandable that Plessey should call it ‘the only memory board on the market for the 4 MHz Z80A’ — but it isn’t true. Cheaper 4 MHz boards are available from Comart, on the $100 bus and providing the same 64K bytes of memory.

Program ADES

Since computers are ideal for tedious, boring, repetitive jobs, the first thing that the computer industry did with them was write programs to handle the tedious, boring, repetitive job of compiling program instructions, drive the compiler, the interpreter and the assembler. The next logical move is the equally drawn-out task of teaching people to write programs, ready for compiling, interpreting or assembling by the computer. For £46 per tape, Pet, Apple and Tandy users can load a program that will do just that.

The supplying company is Applied Data education services, ADES and the programs are called Little Genius. Arrange a demonstration on 01-580 6361.

Mag tape loops

Serious magnetic tape systems for the low-cost microsystem are suddenly proliferating. The question of what took the tape drive makers so long to get realistic prices? is answered by the largely new companies on the scene with a simple “They had a captive market in data logging.”

With V&T Electronics showing an impressive drive using standard halide type cassettes at the PCW Show, and Philips and Pelco showing a mini cassette drive on the Aim 65 system, the range of offerings is getting wider. The latest idea, however,
A £50 drive called the magnetic tape Wafer. It is unique in being a continuous loop, 50 feet long. With a microprocessor controlling a drive system, it costs £120, and individual Wafer tapes are £1.40.

The drive and the control are made by Micro Communications in the US, and the UK agent is Russet Instruments of Richmond.

Cheek
The Online micro show is moving to Wembley. This must be success, and since the organisers have asked me to speak at all three of the shows so far, I can only say that success is well deserved. My totally unbiased opinion, then, is that from July 22 to 24, the exhibition, and the seminar, will go like mad. Unless, of course, they omit to book my speech, in which case, my unbiased opinion is, it will flop, OK?

Byte go soft
At the same time as he was turning a computer into a film producer in Glasgow, Bill Cannings of the Byte Shop chain was starting a new venture in software. What he is producing is a whole series of business and accountancy packages for small users — and the pricing is strictly not retail. Cannings is having the software written by a professional software house. While this doesn’t mean it will be foolproof, it does mean that there is somebody to kick it if and when it goes wrong, as opposed to retail offerings which you can change yourself or throw out. The computer film producer was in fact sold to a local film production company by Canning’s new Computerland shop in Glasgow. The machine was an ITT 2020, and was due to be used to help titling video production for local commerce and industry.

Boss of the Computerland shop is Gordon Coventry; he can be contacted on 041 221 7409.

16'-first sighting
The 16-bit micros are here, proclaims Bill Unsworth of U-Microcomputers — he has found a board with Intel’s 8086 on it. The board is ready to slot into any S100 type system and with it comes CP/M software, and S100 support boards, all from Seattle Computer Products.

The specification of the board is very largely that of the 8086 micro. It will operate with 8-bit memory, or 16-bit memory, or mixed boards. Up to a million bytes of memory can be plugged in (at today’s prices that would be somewhat under £8,000, but not much, so that figure must remain an indication of what the future holds — especially with memory chips still in short supply world wide). Unsworth is sole importer of the Seattle system.

Q.E.D.
Transdata claims this is the first ‘portable 132 column printer terminal’. That presumably means that there are other printer terminals with 132 columns, but not portable; or portable printer terminals, but not with 132 columns; or portable 132 column terminals, but not printers. If low cost were the main selling point, Transdata would have quoted a price, and they didn’t, so you’d better want 132 columns.

Count on it
As an aid to servicing, a frequency counter that will measure signal frequencies between 20 Hz (slower than a Kansas City interface to tape) and 100 MHz (several times faster than any micro-system clock) is available from Continental Specialities. A detailed applications brochure included covers computer clock checks, video synch and scanning measurements, and general oscillator checking, as well as more typically ‘audio’ frequency counting tasks. The company says the device is suitable for the hobbyist.

Other bits
HB Computers have produced a beginners booklet — ‘Microcomputers and The Smaller Business’. If you are completely new to the world of micro-computers you will find this a well written, simple explanation. Questions answered are: “What is a microcomputer?”; “How does it work?” and “What happens if it goes wrong?” Anyone interested should send 50p to HB Computers Ltd., 22 Newland Street, Kettering, Northants.

Anyone want to write or list BASIC programs in French? L’Ordinateur Individuel (the French micro magazine) markets a tape called BASICOIS which enables you to do just this on PET, APPLE II integer, APPLESOFT and TRS-80. Their address is: 41, Rue de la Grange-Aux-Belles, 75483 Paris Cedex 10.
If you want what's best for your PET, choose Commodore software.

Kit Spencer
General Manager
of Commodore Systems
360 Euston Road
London NW1 3BL

The Commodore PET is Britain's best selling microcomputer, with over 10,000 already installed in a wide range of fields, including Education, Business, Science and Industry.

This has led to a tremendous demand for high quality software.

And Commodore has met this demand by producing a first class range of programs, now available from the nationwide network of Commodore Dealers.

Commodore's support also includes training courses, a Users' Newsletter and Official Approval for compatible products of other manufacturers who reach agreed standards.

COMMODORE PETPACS

Over 50 Petpacs of programs are available (mainly on cassette) from Commodore Dealers. These cover such popular titles as Strathclyde Tutorial, Statistics pack 1, Assembler Development System, Stock Market Trends and the Treasure Trove Collection of game packs including the award winning Star Trek, which is packaged with Petopoly. Prices are from £5 to £50.

TRAINING COURSES AND SEMINARS

PET systems are simple to use and any normal advice or assistance you may need can be obtained from Commodore Dealers.

On the other hand, for rapid training on a basic or advanced level, you will certainly be interested in Commodore's intensive 2 and 3 day residential courses. We also run one day general appreciation seminars.

PET USERS' NEWSLETTER

This is Commodore's official method of sharing new information and ideas between the many thousands of PET users. The newsletter is published regularly and for an annual subscription of £10 you can start receiving copies now.

Look out for this sign. It tells you that compatible products of other manufacturers have met with our standards of approval.

To Commodore Information Centre, 360 Euston Road, London NW1 3BL 01-388 5713

I am a PET owner □ Please put me in touch with my nearest dealer □ Please send me details of: Commodore PET Software □ Training Courses & Seminars □ I would like to receive the Users' Newsletter and enclose £10 annual subscription □

Name □
Address □
Tel. No. □

We made small computers big business.
Cromemco comments
The company for whom I work have just purchased a Cromemco System 3 microcomputer, to which, with interest Sue Eisenbach's Benchtest on this equipment. The only comment I can find with her report was with her comments on the RENUMBER command in BASIC. A bit of fiddling on her part would have shown that gaps left in the numbering sequence can be removed by first saving the program and then renumbering the saved program. Incidentally, if any of your readers who have access to a similar system, and who understand the PEEK and POKE commands in BASIC, could explain these commands better than the documentation that comes with it, would they please contact me, I would be very grateful. Contact Oliver St John at 263, Bosse Road, Leicester. Sue tells us that she knew about this rather clumsy way of renumbering but felt that there were other things more worthy of analysis in the space allocated for Benchtest — Ed.

Pascal question mark
For many months, in many journals, I have been reading praise of Pascal, its speed, object code efficiency, power, structure etc. The only sour note has been the language to learn. It seemed to be an ideal language with which to convert my mainframe programs to micro. Perhaps I have been reading your series too quickly, but the ideal seems to have feet of clay.

In my mainframe program the following split loop has been found ideal for fast execution of something that is used 100,000 to 1,000,000 times each run. It eliminates repeated IF statements and value allocations. The Pascal implementation seems to be very messy. Perhaps I have missed the point and a shorter solution is possible, without introducing machine code routines.

FOR L:= A TO X STEP 2 DO
BEGIN
WHILE X<=X DO
BEGIN
L:=L+2
END;
WHILE L<=19 DO
BEGIN
L:=L+2
END;
END
Sue Eisenbach

Yesterdays bugs
With reference to Malcolm Peltu's book review (PCW November '79) — Grace Hopper has played a very important role in the development of computing but she is not responsible for the very useful term 'bug' or its current application. Thomas Edison is noted in the supplement to the Oxford English Dictionary (Vol. I, pp. 377) as using the expression in very much its present sense in the 1880s. Since then the word has had wide use, and even 'ironing out the bugs' was done before the last war, before the age of computers. James F. Sullivan, Bournemouth.

Back on hard times
Having read 'Hard Times' I found it quite interesting. There was one small point, though. The writer stated that the Horsey designed Winchester Head were designed for the Piccolo, but in fact the Gulliver file (62GV) were the first to use it. The head gap (width of track) has now been reduced so that twice the number of tracks are available giving the first 62GV 5MB, 62TM 10MB and 62EH 14MB. The Piccolo file, as does the Gulliver, uses a voice coil driven actuator — unlike the IMI file as far as I can see. The Piccolo file has a capacity of up to 64MB and the track seek time is far quicker than a stepper motor driven type, where the 330 tracks are covered by the system to give an exceedingly short access time of a few milliseconds. The cost of these files are expected to fall, though, for my money, as a home/club system user, I would stick to floppy's until I could buy a voice coil accessed Hard Disc. Looking forward to the follow on. Doug Thompson, IBM Computer Club.

Unfair dismissal
Dick Pountain's dismissal of the Casio FX501/2P's music function (PCW November '79) was less than just. Whilst agreeing with him that the world doesn't need the Stylophone and/or Rolf Harris, there are at least a couple of valid uses for this 'robot Rolf Harris'.

1. The non-musical can experiment and gain some insight of various musical aspects — time, rhythm, etc.
2. The musical, especially young learners, can have a near-perfect example of tempo against which to compare themselves.

At the very least, the 501/2 plus PA-1 plus cassette can be used as an accurate memo n ome.

Having cast my lot for this disgusting noise, I do have a couple of gripes about the new Casio:
1. The 7-pin socket on the calculator is protected by a small, removable plastic clip which has broken or lost. Surely, for a few pence more, Casio could have provided a slide or hinged device.
2. I really miss the displayed memory number of the 201/2. This was extremely useful for codifying input/output. Obviously the programming method of the 501/2 cannot allow memory numbers to be displayed, but a plea to designers of future programmables — how about a 2 or 3 digit positive integer memory, accessible as a normal memory and displayed simultaneously with the X-register? This would double the calculator's potential.

Dave Barrow, Pontefract.

I accept your criticisms, my reaction was rather emotional since I love music. I doubt the value of the 501/2 as a metronome, however, since the calculator lacks direct sound output. Everything must be taped and replayed, which is hopelessly cumbersome.

As to the displayed memory location, I feel that the 10 user definable keys more than make up for the lack of it — Dick Pountain.

Easy convert
I had a great time at your show! While I was there several people asked how to convert 50Hz to 60Hz for use with American video stuff without having to 'butcher' a board, well, here's the answer (see below).

Les Solomon, Technical Director, Popular Electronics, New York.

Period ~2ms 6 cycles in less than 20ms (50Hz)

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Winning strategy?
Re. the advert by F.T. Chambers on page 83 of October PCW. Mr Chambers claims to have a winning strategy, "I certainly have not been beaten by man, woman, child or machine in the last few hundred games I have played".
So I sent him £2.50 for this 'winning strategy' and the first paragraph of his replay reads "I have just received a copy of Petsoft's 'Super Othello' and, testing it against my strategy, I won 21 games out of 25...I am satisfied that a few chess experts have grown-ups.

I have just returned from the Snow and must congratulate you — it was the best I have been to this year. While I was there I overheard various comments which made me feel that the system I am now constructing may well be of interest to others, especially those that require a powerful, expandable system, which is not overpriced, but is readily interfaced to any peripheral. Some of the applications I have in mind are: high speed circuit design and analysis, real time check logging for amateur radio contests, amateur radio telemetry, to name just a few but a few, plus all the usual household functions. The spec is as follows: Demon 80A MK1. Developed by I. Caplan and M. Buckland. CPU Z80A 4MHz; Memory 16K Dynamic RAM, expandable to 48K, 4K Monitor/Editor/Assembler 8K BASIC (optional), Inputs Standard ASCII Keyboard — interrupt driven plus up to 254 other ports; Outputs 256 x 256 B/W graphics display expandable to 8 or 16 colour graphics plus 256 ports, Mass Storage: Initially cassette, but floppies when cash calls. Power Supply: 240V AC with PSU 1, 12V DC for field use with PSU 2; Other Features: Real time clock, non-destructive 'Reset' and 'Break', full Z80 interrupt mode capability, full DMA capability, Nascom compatible monitor routines.
Although it is not intended as a beginner's system and the method of construction would be left entirely up to the builder, the basic circuitry can be simplified or expanded as required. My machine is built into a standard 3U 19" rack which contains the PSU (±5V, ±12V) and 9 card slots on a fully thru' hole plated backplane (very pretty but expensive). The backplane could be wirewrapped (not so pretty, but a lot cheaper) as it uses standard 43 way 0.1" double-sided edge connectors. Anybody interested may write to me and I will do my best to answer all letters. If sufficient interest is shown maybe PCW will print a few articles on this system. P.S: Anyone interested in a version of M5 for the RCA 1802? Readers: Write direct to I. Caplan, 4 Minchened Crescent, Southgate, London N14 7EL. — Ed.

Fax Flack
Congratulations on what generally is a much improved magazine. But, please, if you are going to publish op codes (Fax) could you check what you are doing more carefully — so far I’ve counted 3 basic errors in the Z80 chart. D.E. Rogers, Radlett, Herts. No excuses, but all is revealed in Blunders — Ed.
David Tebbutt reports on the setting up of the Computer Retailers Association.

The microcomputer business is, in the main, conducted ethically and conscientiously. Unfortunately, in common with most human enterprises, there are less savoury elements which are like to give the whole business a bad name.

In order to give the consumer a measure of protection, a Computer Retailers Association has so clearly been set up. Everyone joining pays £300 and agrees to abide by strict code of conduct. A consumer who finds a retail supplier in breach of this code can then inform the secretary of the CRA who will take up the complaint on the customer's behalf. If this fails, an independent arbitration panel will assess the situation. The consumer has the right to ensure that the panel is independent.

At present, anyone involved in the retail side of the microcomputer business is eligible to join the CRA. It is impossible at this stage to investigate the suitability of each applicant in great detail and therefore anyone prepared to be measured against the code of conduct may join. This means that membership of the association is by no means a cast-iron guarantee of satisfaction and, by the same token, neither is non-membership necessarily a passport to disappointment. As with all associations, maturity can only come with time.

Members of the association can benefit in a number of ways - they will receive a certain amount of publicity; consumers are more likely to put their faith in someone who is so clearly committed to such a code of conduct; they would be able to call on fellow association members for advice; and, if a customer's requirement is beyond their scope, they could be referred to a member more able to satisfy that customer's needs, knowing that the customer will get a fair deal.

Finally, let's remind ourselves of the reason for the association's existence - to give the consumer the protection he so badly needs in this business. PCW supports the aims and code of conduct of the CRA. Advertisements in PCW containing the CRA logo will be those of paid-up members of the CRA. Members wishing to comment, be they suppliers, customers or just plain interested please write, see the editorial on the Contents page for details.

Extract from the CRA handbook

The CRA is a Trade Association that promotes professional standards in the sale of computing equipment, allied products and services. Membership is open to companies with a significant interest in computer retailing and who are committed to the spirit of the CRA. All members are obliged to comply with the CRA code of practice which aims to ensure that members shall conduct their business ethically and professionally.

Code of practice

1. Members will not misrepresent their experience or capabilities, and will carry out any work undertaken to the very best of their abilities.
2. Members will not deliberately advertise goods for sale which are not currently available and will avoid excessive claims as to the capabilities of the products offered. Terms that are likely to be misunderstood by the customer or that are not capable of exact definition should be avoided.
3. Whenever goods or services are offered for sale, a clear indication of the true retail price must be included, and every effort should be made to meet the date for delivery given.
4. Members will not knowingly trade upon the innocence of potential customers.
5. Order/sales acknowledgements should be used that help both parties by spelling out the terms and conditions on which business is being done. Such terms should be fair and reasonable and set out clearly, together with a statement of the circumstances under which they may be cancelled.
6. Mail order goods should be acknowledged within seven days. Where money is received with the order, if the goods cannot be delivered within 30 days the customer should have the right to cancel and to have complete reimbursement of that money.
7. Members will divulge to a prospective customer any vested interests they may have when recommending an alternative or additional service.
8. If any work is to be undertaken for a customer, then clear and precise terms must be agreed, in writing, before work commences.
9. Members will not offer any specialist services to a customer, where no 'in-house' skills are available, and where the work is to be subcontracted unless the customer is made fully aware of the intent to subcontract.
10. Members will take full responsibility for any work carried out by any subcontractors on their behalf.
11. Products commissioned and paid for by a client will not be offered to other clients without the full knowledge and consent of the original client.
12. Members will not disclose confidential information that they might gain of a client's business without permission and will not use a client's name as a reference without prior permission.
13. Products offered by members to clients will be subject to a 12-month warranty unless a specific statement to the contrary is included in the contract. This warranty must not adversely affect the customer's remedies against the seller under the Sale of Goods Act.
14. The warranty will not cover any defects caused by misuse and/or maltreatment of the equipment by the customer and will be based on a reasonable use.
15. Members will take all reasonable steps to ensure that services undertaken for a client reach an agreed conclusion.
16. Members will agree to submit disputes with clients to arbitration by a panel appointed by the executive committee of the CRA being acceptable to the client. The subject member should abide by the decision of the arbitration panel who will report its findings to each of the parties in writing.
17. The CRA code of practice should be displayed prominently in the trading premises of a CRA member. A copy should be available to the customer on request.

The Executive Committee comprises: Dr. Tim Keen, Keen Computers Ltd; Colin Stanley, HB Computers Ltd; Tim Moore, Newbear.

Colin Stanley of H.B. Computers

Tim Keen of Keen Computers

Tim Moore of Newbear Computing Store
If you were to hear of a personal computer manufactured by a television and hi-fi company that sells through its own retail outlets and which consists of a monitor, a separate cassette deck and a single board computer boxed under its keyboard, the chances are the Tandy TRS-80 would spring to mind. If you were Swedish, however, you'd probably think of the ABC-80, a personal computer with the quality of finish, attention to detail and price that we've come to expect from Swedish products. Luxor, the northern European electrical chain which sells the ABC-80, is also the manufacturer, while the designer is Swedish firm Dataindustrir AB; that company has also evolved a modular development system called the Databoard 4680 which it manufactures. The ABC-80 and the Databoard 4680 are mutually compatible and, therefore, even though Luxor only manufactures a small system, there is a large range of products available to hang onto it.

The review machine was an ABC-80 microcomputer with a Databoard 4680 floppy disc unit, plus Datadisc 80 dual drive.

BY SUE EISENBACH

The ABC 80 is based on a single board computer. It contains a Z80A CPU, BASIC in 16K of ROM, 16K user RAM (dynamic), 1K Video RAM, a real time clock, a USART and a PIO. This board is within the keyboard case. On the back of the case there is room to connect a cable to a Databoard 4680 bus, an RS232 port, a reset button, and cables to both the cassette and monitor. The keyboard box is well ventilated and solid.

The keyboard was designed with great attention to detail. There are fifty-five keys which are nicely shaped and have a solid feel. Upper and lower case letters, numbers and 32 other characters can be accessed from the keyboard. Both £ and $ are provided as well as ¼, ½, ¾, the division symbol and the more standard characters. There is an upper case shift lock key (with a light) that only turns the alphabetic keys into upper case. So when you switch into upper case you don't have to remember to unshift in order to type line numbers and commas. There are two cursor control keys (left and right) for screen editing. Unfortunately there are no cursor control keys for up and down (however, in BASIC there is an edit facility that compensates for this lack). Any character can be repeated by holding the relevant key down. When listing a BASIC program only one screenful is listed. To see more pressing any character and keeping it down brings up one line at a time.

The character generator chip is Texas PCW 43.
Instruments' Viewdata chip and is therefore compatible with Prestel, Ceefax and Viewdata. The 12" screen can hold 24 lines of 40 characters or can be divided into 72 by 80 pixels. Next to the screen there is a loudspeaker which is connected to a sound generator. When a line is typed in incorrectly a 'peep' is output. There is a real-time clock that can be set and interrogated from the terminal.

The cassette is a digital unit with the surprisingly slow transfer rate of 700 baud. It has a tape counter with a RESET button so that the tape can be set near the program or data required. The cassette runs for about five seconds before any storage is completed. If the ABC 80 does not find any information within ten seconds it stops the tape and displays an error message stating that the program or data isn't on the tape. So if there is a fifteen second gap in the tape, searching will stop at that gap with a (possibly false) error message. Fortunately when transferring data with the loudspeaker's volume up you can hear programs and data being loaded or stored. If there is silence the tape can manually be moved forward and the search continued. Normally turning the cassette on or off is under program control.

The minifloppy system DataDisc 80 was also provided; it had two BASF 80K Byte discs. DataDisc 80 contains a floppy disc controller with two (yes, two!) Z80s. There is an EPROM-board which contains the 4K DDS and some free sockets (suitable for the IEEE-488 interface PROM and a fast printer PROM). The DataDisc 80 unit has space for two memory cards (static) — those were present in the review machine — and three I/O cards. All cards are of Eurocard specifications and attach to a Databoard 4680 bus. The box, a standard 19" rack, is quite substantial and contains a power supply and filtered fan.

**BASIC**

ABC 80 BASIC occupies the lowest 16K of memory and is reasonably sophisticated. Not written by Microsoft it does not have exactly the same features commonly available. If a user finds it inadequate it can be expanded to 24K DataDisc 4680 BASIC. The benchmarks show that it is quite fast. I could not run any tests on the discs through having insufficient free disc space (CCS didn't have any spare discs). The speed of the BASIC is in part due to each statement being translated during program input. If an instruction is not understood an error message appears as soon as the return key is pressed. The message is either an error number which can be easily decoded by looking at a chart attached to the keyboard, or when there is a disc in drive 0, a message rather than a number appears. I found the messages more helpful than the Microsoft variety.

The special features of ABC 80 BASIC include a graphics mode and audio programming. From the keyboard one cannot access the graphics. However the ABC 80 can be put into graphics mode with each screen character position being interpreted as 6 graphic points. Points on the screen can be turned on with SETDOT R, C, turned off with CLRDOT R, C and tested with DOT(R, C).

There is a sound generator that can be accessed as an output port. There are 128 different possible sounds that can be output. The section of the manual describing the sounds was confusing, but it was easy to write a program to play them all. There are a variety of pure pitch sounds, a siren, a bird chirping, as well as a range of noises that reminded me of electrical interference. The full power of the language can be seen from the list of BASIC reserved words. The features of particular interest include:

1. LIST will list from or to a given line.
2. ED uses the cursor keys.
3. DEF FN can take several parameters.
4. INPUTLINE will read a whole line of text.
5. CHAIN allows you to divide programs. Unfortunately there is no COMMON so variables have to be POKED.
6. MERGE allows the user to read two programs into memory.
7. PREPARE US AS FILE N opens a file for writing.
8. INSTR (X$, A$, B$) searches for B$ in A$ and gives X$ its starting position.
9. + concatenates strings e.g. A$ + B$ + C$ + "x".
10. ASCII arithmetic works on strings interpreted as numbers.
11. CALL links machine code routines into BASIC programs.
12. IMP is implication. That is X IMP Y is false only when X is true and Y is false.
13. There are both integers and reals.
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14 Variable names are at most two characters.
15 A real time clock is accessible in BASIC.
16 Sequential access files are implemented on both cassette and floppy discs and random access (rather obtusely implemented) files on disc.

System software
The ABC 80 uses three operating systems: Cassette BASIC, Disc BASIC, and DOS. To enter cassette BASIC one presses RESET once: to enter Disc BASIC, RESET is pressed twice: to enter DOS it's necessary to enter DISC basic and then to type BYE. A useful feature of the disc systems is that they refer to both discs when loading and saving files.

The two BASIC systems (disc and cassette) are very similar. Most commands being common. For example, LOAD, SAVE, and KILL are identical, except that on the Disc BASIC, if they refer to cassette operation, they are suffixed with CAS. The Disc BASIC system has a directory facility whereas the cassette system does not, not even a screen listing of files and programs encountered while searching is in progress. Error messages appear as numbers on the cassette system and as full messages on the disc system. Both BASICs were quite good.

Moving on to the DOS system, it again is straightforward and simple to use. In addition, it includes the following facilities:
SPACE gives the amount of free space on discs.
MAP gives a memory map.
DOSGEN used to generate a new version of DOS and to format discs.
COPY used to copy files and to remove them if necessary.
COPYLIB copies all or part of disc.

A number of utilities that I would have liked to use were missing, although apparently more advanced facilities are available when different disc drives are attached.

Business and industrial potential
For a user who wants to purchase a packaged system the ABC 80 is not the answer because, unfortunately there are no business packages yet written specifically for this machine. As the BASIC is slightly different from other personal computer BASICS, packages written for another machine will need alteration to run on the ABC 80.

The ABC 80 does however have potential as a word processing system. There are two packages available, one of which is Runoff, a good text formatting program (available on DEC machines and very similar to Texwriter). The

sturdy keyboard, uncluttered by any ‘funny’ graphics characters is more likely to suit a typist than several of the other lower priced word processing systems. On the back of the keyboard there is a socket suitable for a golfball or daisywheel typewriter.

The large selection of boards, built by Dat Industriur AB, that can be attached to an ABC 80 make it most suitable for process control. The IEEE 488 interface (which is accessible from BASIC) can be purchased either as a chip to plug into the disc controller card or a card to slot into the expansion box. The PET therefore has lost its unique position as the only personal computer with this interface. The facility for sound enables a programmer to use sound to signal completion of a task, error conditions, etc.

The ABC 80 is suitable for use as a Prestel terminal provided that you have a Post Office approved modem with which to connect it. There is a modem board for the ABC 80 but the Post Office cannot consider licensing this system until they receive an application.

Educational potential
Personal computers are applicable for several different educational contexts. They are used for teaching program-
ming, computer science theory and in laboratories. For all of these applications a level of robustness and portability is required. The ABC 80 seems robust and well made, though it does have a reset button on the back of the keyboard box which is probably undesirable for teaching in school. As far as being portable the ABC 80 is quite light but, like the TRS 80, it is in several sections and would need a trolley if it's going to be moved around regularly.

The ABC 80 is a very nice machine for teaching BASIC. The 16K BASIC, being ROM based, is very easy to use. It is more powerful than any other BASIC in ROM that I've seen. It has line by line syntax checking which is helpful for novice programmers. To teach languages other than BASIC, a substantial investment in hardware and expensive software is required. A disc subsystem must be purchased to run all other languages including the Z80 assembler. In addition, before being able to run Fortran or Pascal the BASIC ROM must be replaced with RAM.

A book is provided that covers an introduction to computers from circuit level to BASIC programming based on the ABC 80. The machine, in conjunction with the book, should provide an edifying entry into computer science. For use in the laboratory, the ABC 80 can be purchased with a wide variety of controller and interfacing equipment.

Homes and games
The straightforward graphics, sound and ability to program the cursor all make the ABC 80 a good machine for recreational computing. The review machine came with a variety of games (most still with Swedish messages). They included chess, Othello, maze games and arcade paddle ball games. The cursor control keys were used as joysticks, Both the graphics and sound are used to good effect. The arcade type games were challenging but neither chess nor Othello were as well designed. Chess accepted illegal moves while Othello did not find its sides or corners.

Documentation
I was provided with three types of documentation: English manuals for most of the Databoard 4680 modular development system, preliminary English manuals for the ABC 80 and Swedish documentation. The Databoard manuals are quite reasonable, clearly written with comprehensive tables of contents. Not having the system described, I cannot say how helpful they actually are. The data sheets on all the Databoard 4680 boards looked sufficiently comprehensive to aid in the selection of new boards.

There were two preliminary documents for the ABC 80. The first, a
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manual for the ABC 80, was translated into reasonably good English (not quite perfect, but understandable). This manual was divided into two parts. The first section was a straightforward, informative general description and instructions for using the ABC 80. The second section described ABC 80 BASIC. It did not go into enough detail but referred the reader to a book called ABC 80 BASIC. As this book is unlikely to be published in English, the User Manual should be expanded.

The second preliminary document supplied was a first translation of the book ABC 80 BASIC written by a technical writer, so jargon when it was translated at all, was badly translated. For instance ‘capsule’ is used when unit, chip, subroutine or module is required. I was told that this version would not be published but I hope a reasonable version is published soon as I thought the book would prove most informative to the new computer user.

The Swedish ABC 80 books were in English, the User manual for the ABC 80, was translated and run. Since the ABC 80 can be expanded by a technician, so jargon

**Expandability**

Besides the monitor and cassette there are sockets for a printer and a connector to the Databoard 4680 bus, so that with the exception of a printer, all expansion must be through the Databoard 4680 development system. If a disc system is needed, there is the DataDisc 80 Dual Disc Unit which has slots in its backplane for five boards, in addition to the disc controller board. There are spare sockets on this DOS card for an IEEE 488 interface PROM as well as a Z80 assembler, text formatter, A 280 assembler, FORTRAN, Extended (24K) BASIC and PASCAL. The PASCAL and the FORTRAN will not be available until April.

**Conclusion**

The ABC 80 is a recent entry to the ‘under £1,000 for a complete system’ class of personal computers. As such it is in competition with PET, APPLE, TANDY, SHARP and SORCERER. When choosing a machine in this class the price, packaging, software and expandability are all important considerations.

At £730 for the basic system the ABC 80 is near the top of the market in starting price. This is because the minimal system is larger than those of its competitors including a 16K BASIC, 16K RAM and a monitor. Turning to the packaging, the ABC 80 is a robust system, even though it isn’t a single unit. The 16K BASI is both fast and powerful but at present there is no other system software available for a based system; neither is there a library of packages on tape written for an English market, that can be loaded and run. Since the ABC 80 can be plugged into a Databoard 4680 bus there are a wide variety of boards and two types of disc units that can be attached in a straightforward manner. Unfortunately the user is locked into one supplier as the Databoard 4680 bus isn’t an $100 bus. This fault is shared with most of its competitors.

**Prices**

Included in the price list, as well as the ABC 80 system, is a variety of DataDisc 4680 components likely to be of interest to an ABC 80 owner. All prices are exclusive of VAT. As much of the system has never been sold in the U.K. prices are not firm.

<table>
<thead>
<tr>
<th>Description</th>
<th>Price (GBP)</th>
</tr>
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<tbody>
<tr>
<td>ABC 80 Microcomputer</td>
<td>£730</td>
</tr>
<tr>
<td>DataDisc 80 Dual Disc Unit</td>
<td>£1190</td>
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<tr>
<td>Expansion Box</td>
<td>£295</td>
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<td>8906 PROM Programmer</td>
<td>£280</td>
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<td>9701 Hi-Speed Printer PROM</td>
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<td>9702 IEEE 488 interface PROM</td>
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<td>Z80 Assembler</td>
<td>£105</td>
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<td>8K Static RAM</td>
<td>£170</td>
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<tr>
<td>3061 8/16/32K EPROM board</td>
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<td>4025 IEEE 488 interface board</td>
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<td>4084 8 bit D/A 4 channels</td>
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<td>4087 UART board</td>
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<tr>
<td>5001 Prototype board</td>
<td>£32</td>
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<td>5070 Prototype board with I/O</td>
<td>£91</td>
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<td>5023 Bus Expansion board</td>
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<td>7900 Dual 8&quot; floppy disc</td>
<td>£2764</td>
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<td>8021 Control panel</td>
<td>£777</td>
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<td>9400 Fortran</td>
<td>£1053</td>
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<td>9500 Extended BASIC</td>
<td>£448</td>
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<td>9600 Pascal</td>
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**Benchmarks**

<table>
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<th>Processor</th>
<th>Performance</th>
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<tr>
<td>BM1</td>
<td>1.1</td>
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<tr>
<td>BM2</td>
<td>2.3</td>
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<tr>
<td>BM3</td>
<td>11.1</td>
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<tr>
<td>BM4</td>
<td>12.1</td>
</tr>
<tr>
<td>BM5</td>
<td>12.6</td>
</tr>
<tr>
<td>BM6</td>
<td>17.7</td>
</tr>
<tr>
<td>BM7</td>
<td>23.9</td>
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<tr>
<td>BM8</td>
<td>33.8</td>
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**Memory Map**

<table>
<thead>
<tr>
<th>Address (Hex)</th>
<th>Description</th>
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<tbody>
<tr>
<td>0000 - C000</td>
<td>16K User RAM (on CPU board)</td>
</tr>
<tr>
<td>C000 - 16000</td>
<td>16K User RAM</td>
</tr>
<tr>
<td>16000 - 20000</td>
<td>ROM for fast printer</td>
</tr>
<tr>
<td>20000 - 24000</td>
<td>ROM or RAM</td>
</tr>
<tr>
<td>24000 - 28000</td>
<td>ROM IEEE 488 interface</td>
</tr>
<tr>
<td>28000 - 32000</td>
<td>ROM DOS</td>
</tr>
<tr>
<td>32000 - 36000</td>
<td>Free ROM space</td>
</tr>
<tr>
<td>36000 - 40000</td>
<td>ROM BASIC interpreter</td>
</tr>
</tbody>
</table>

Minimum configuration 0-4000 & C000-FFFF
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Triton manual — detailed circuit description and constructional
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Manual with, 8k RAM & 8 x EPROM constructional details £5.00
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Triton software — Send SAE for list of programs available for Triton.
Firstly, a Star Wars game, written by Simon Ainsworth of Croft near Warrington. There are two soundtracks, main program and a set of instructions. As usual the dialect of BASIC has its oddities, among them being the use of the suffix % to indicate a decimal real constant. ‘If in doubt just leave it out’ should work on most microcomputers (see page 92 for the program listing.)

A couple of months ago I asked for suggestions for software which could easily blow up the whole computer. Tom Boyd of Holmbury St. Mary has written in to request a simple synthesiser. It would enable pupils to pre-programmed into the machine and when it is 'run', a trace will be viewable on the screen of the scope.

The circuit utilises the special signal available at the rear of the machine called 'OUT'. This is used as a sync signal since it can be pre-programmed. The heart of the interface is the 'tri-state hex buffer' which buffers the data signals. The chip also contains a dual input gate of which one input is tied to ground and the other is connected to the output. This allows the data to be turned on and off at the output of the buffer and thus the output of the analogue section can be controlled as well.

The remaining part of the circuit is the analogue interface between the output of the buffer and the scope. This is designed to allow the output voltage to be pre-programmed up to a voltage in relation to the logic states of the buffers. This consists of a 4K7 resistor, a transistor, a diode and another resistor acting as an attenuator. One of these sections is needed for each of the six data lines from the buffer. The outputs labeled 'Y' are connected to the 'Y' plates of an oscilloscope.

One further point of application interest is that this circuit can be connected to a voltage controlled oscillator and a simple synthesiser can be made.

The circuit

When the 74LS365 receives an output signal from the TRS-80 it goes low at the 5 volt rail. A pretty clumsy method.

The Wavemaster interface to the TRS-80

The program

This command puts the binary value of 'Y' into the binary value of address 'X'. The number 'X' can be anywhere between 0 and 255 as the TRS-80 can access up to 256 ports. We are not interested in the address but only in the data value 'Y'. The desired waveform can be pre-programmed by working out binary equivalents of 'Y'. Using this theory, waveforms can be pre-programmed with good resolution.

Lastly, this month, is a short program for the TI-57 from Simon Walton (13) of Bournemouth. The idea of the game is to finish the series of numbers which are presented. When the display stops enter the number which you think is next in the series. If you are right the program presents another series, if wrong it pauses to display the correct answer. It looks fun.

Data

The edge card on the TRS-80 is double sided and there are twenty contacts on each side, with a spacing of 1 mm and suitable pins to turn on the transistors in turn is as follows:

10 PRINT "WAVE FORM GENERATOR PROGRAM"
20 OUT 254,1
30 OUT 254,2
40 OUT 254,4
50 OUT 254,6
60 OUT 254,16
70 OUT 254,143
80 GOTO 20
90 END

The Program

When the 74LS365 receives an output signal from the TRS-80 it goes low at the pin which is being output on the buffer. The signal is fed to the transistors via current limiting resistors (4K7). As each transistor is driven by the 'Y' signal at the base the emitter current is determined by the collector and the collector current. If R8 to R13 step in linear increments then the final waveform will have better characteristics. The diodes are used because when all points 'Y' are connected together it prevents feedback to the transistors of each channel.

The power can be supplied by the TRS-80 expansion port but if a separate power supply is used then the ground rails of the supply and the TRS-80 must be tied together. The supply must also be smoothed and regulated.

The circuit

When the 74LS365 receives an output signal from the TRS-80 it goes low at the pin which is being output on the buffer. The signal is fed to the transistors via current limiting resistors (4K7). As each transistor is driven by the 'Y' signal at the base the emitter current is determined by the collector and the collector current. If R8 to R13 step in linear increments then the final waveform will have better characteristics. The diodes are used because when all points 'Y' are connected together it prevents feedback to the transistors of each channel.

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Waveform interface

The following circuit allows the connection of an oscilloscope to the TRS-80 via its expansion ports on the edge card at the rear. Any waveform can be pre-programmed into the machine and when it is 'run', a trace will be viewable on the screen of the scope.

The circuit utilises the special signal available at the rear of the machine called 'OUT'. This is used as a sync signal since it can be pre-programmed. The heart of the interface is the 'tri-state hex buffer' which buffers the data signals. The chip also contains a dual input gate of which one input is tied to ground and the other is connected to the output. This allows the data to be turned on and off at the output of the buffer and thus the output of the analogue section can be controlled as well.

The remaining part of the circuit is the analogue interface between the output of the buffer and the scope. This is designed to allow the output voltage to be pre-programmed up to a voltage in relation to the logic states of the buffers. This consists of a 4K7 resistor, a transistor, a diode and another resistor acting as an attenuator. One of these sections is needed for each of the six data lines from the buffer. The outputs labeled 'Y' are connected to the 'Y' plates of an oscilloscope.

One further point of application interest is that this circuit can be connected to a voltage controlled oscillator and a simple synthesiser can be made.

The circuit

When the 74LS365 receives an output signal from the TRS-80 it goes low at the pin which is being output on the buffer. The signal is fed to the transistors via current limiting resistors (4K7). As each transistor is driven by the 'Y' signal at the base the emitter current is determined by the collector and the collector current. If R8 to R13 step in linear increments then the final waveform will have better characteristics. The diodes are used because when all points 'Y' are connected together it prevents feedback to the transistors of each channel.

The power can be supplied by the TRS-80 expansion port but if a separate power supply is used then the ground rails of the supply and the TRS-80 must be tied together. The supply must also be smoothed and regulated.
All our tomorrows

H.G. Wells in 1905 looked forward to a modern Utopia where... registration and identification system would be an essential feature of social regulation. He dismissed fears of bureaucratic threats to human freedom as “mental habits acquired in an evil time”. But that was before the real evils of the World Wars and the totalitarianism of Hitler and lesserHitlers turned such Utopias into the nightmares of Aldous Huxley’s Brave New World and George Orwell’s 1984. The imaginary future portrayed by the writer but the poetic visions of their authors are likely to provide better insights into the shape of tomorrow’s worlds than the megawords of prognostications with which the new decade is filled. We are about to launch...

In The Conquest of Will, Abbe Mowshowitz analyses in about three hundred closely reasoned pages the practical nature and impact of information processing technology. Then he uses the last chapter to place a literary perspective on the machine. Here he summarises his findings, pondering the words of science fiction author Christopher Hodder-Williams in his novel Fists of Digits which concludes: “Eventually the mechanical interlock of technology must conquer all but the individual will. You might conceivably postpone it, but it could only be postponed because for as long as man could not stand by himself and rely on himself, then we held of little value the wind up handing over the mastery of his own will...”

Mowshowitz comments on this and other literature of the future: “Questioning the beneficence of scientific rationalism and technological progress is almost as heretical as denigrating patriotism. People are held of little account in our society, so their licence is free for the asking, operating without poetic licence, however, opens one to a variety of charges, ranging from lack of objectivity to muddled mysticism”.

Braving such charges, he continues, “The belief in the science and technology held the promise of providing: “the knowledge of causes and secret motion of things; and the enlarging of the bounds of Human...empire, to the effecting of all things possible” A disillussionment in the achievements of science and technology has been expressed in many ‘poetic visions’ from Mary Shelley in Frankenstein to Solzhenitsyn in his play, ‘Candle in the Wind’ which draws a sharp contrast between the humanist pretensions of progress and the amoral actions of the scientist.

Magazines like Omni which out of the Penthouse stable) strives to smooth the blend of fact and fiction to monitor new developments and future trends. Generally I find Omni as superficially pretentious as the editorials by its Editor Bob Guccione. In the first necessary issue last October he reached pinnacles of macho absurdity with the He CARTER administration and/or the delicate sensibilities of Wall Street not withstanding, man will reach into the future with the same implacable determination with which his seed rose from the primeval slime.”

Although each issue of Omni is likely to contain at least an article of... to me it lacks any real excitement and vision of the kind which enthused sci-fi magazines like Astounding Science Fiction and others of that ilk, while the factual articles (at least in the realm of computer technology) follow pretty predictable lines.

Life, of course, isn’t all rising seeds and primeval slime and nor is it...yet, at least totally under the control of Big Brother and the punched molecule. Take My Computer... PLEASE! by Steven Ciarcia is an example of an entertaining new trend towards what could be called computer soap operas. Using his own experiences with a personal computer, Ciarcia weaves some whimsical stories in the style of James Thurber with tales about the day the computer alarm did not ring and the feverish and misguided attempts to use a computer to win a fortune on the stock market. Ciarcia’s world is very American, from the strange gambling game Jai-Alai to the huge hospital bills. Nevertheless, as a potent personal things to come, it is a pleasant read.

Now, all that’s needed for facing the future is Eddie, the computer who sings during count down elsewhere. Deep Thought, the second most powerful computer ever built, grapples with The Big Question about the meaning of life - it is a mere seven and a half million years to compute.

The story saps across time and space linked by Earthling Arthur Dent and Ford Prefect (from a small planet near Betelgeuse) who has with him the book for which he was dumped by the Hitch Hiker’s Guide to the Galaxy - a speaking electronic...DON’T PANIC on the cover.

With all its all-embracing computerization, the Guide sells far better than the boring Encyclopedia Glastica. The difference between the books can be gauged from the entries on robots.

According to the Encyclopedia, “a robot is a mechanical apparatus designed to do the work of a man”, and it comments, “The marketing division of the Sirius Cybernetics Corporation defines a
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The role of any telecommunications authority such as the UK Post Office is not merely to provide the minimum level of public service which will avoid an undue number of 'Carter Committees' and questions in the house. Rather than just attempting to meet demand, the Post Office should act positively and imaginatively to encourage the growth of communications and to stimulate the free flow of information.

The Post Office connection

I am not against the monopoly supply of telecommunications services; on the contrary, I believe that (done properly) it is superior to the alternative of unregulated private-sector common-carriers fighting private-sector common-carriers to the alternative of unregulated services; on the contrary, I believe I am not against the monopoly ved. Just to make this quite clear, anyone using a non type approved system (such as Apple II) would be breaking PO regulations and the same would apply to home-built systems. In November 1978 I wrote to the Post Office to ask them if they would waive type approval requirements for microcomputers and terminals working through approved apparatus. The use of couplers would avoid direct electrical connection with the telephone line. The PO refused to make such a waiver. What follows is a resume of how we managed to persuade the PO to change their minds.

Please bear with me if I go through the history of this in strict chronological sequence; I do not want to give you the impression that the Post Office comes to such minor decisions hastily. I am quoting from the Post Office's letters to avoid any suggestions that I am mis-interpreting them. I will not, however, identify the individual concerned in the Post Office Service Department because the problem lies more with the structure of the Post Office and its traditional attitudes to the monopoly privilege and the attachment of non-Post Office equipment. So here goes; it all started before this column did, back in 1978.

5th October 1978

I wrote to the Post Office Service Department saying that many personal computer users were interested in data transmission on the Public Switched Telephone Network (PSTN) for the purpose of program exchange, gaming, file transfer and so on. The letter suggested that ... within some regulatory constraints and guidelines the Post Office should encourage such traffic. The large proportion of calls would be made during off-peak periods i.e. 'after six and at weekends'. Call duration would be relatively long compared with speech calls. Clearly there is a means here whereby the Post Office can increase revenues from existing plant". It then went on to ask three questions.

1 Assuming that operation is via an approved acoustic coupler will it be necessary to obtain type-approval for the micro? If so, how would the approval procedure operate for, say, home-brew systems?

2 Would the use of some form of coupler be an acceptable alternative to full type-approval? In any case, are barrier devices relevant when using an acoustic coupler?

3 What other regulatory guidelines would the Post Office wish to specify for home users wishing to use transmission on the PSTN? I look forward to your reply."

9th October 1978

Received acknowledgment of my letter.

3rd January 1979

Wrote to Post Office:

"I wonder if you are yet in a position to give me the Post Office's views"

11th January 1979

Reply from the Post Office apologising for the delay and continuin:ing: "1 Post Office policy regarding the connection of modems to the PSTN is that such requirements should normally be met by a modem supplied, installed and maintained by the Post Office. Exceptions are, however, made and, for example, privately supplied acoustically coupled modems are permitted in applications where there is need to move the modem from one point of application to another from time to time. In these circumstances it would, of course, be unusual for acoustically coupled modems to be used at both ends of the transmission link. 2 As regards the connection of private equipment (e.g. a personal computer system) to Post Office plant via an acoustically coupled modem, we are concerned with
two main considerations namely:

(a) Electrical safety; the highest voltage occurring within or connected to the terminal must not exceed 250 V A.C. or equivalent DC.

(b) The maximum power level of signals (intended or otherwise) connected to the Post Office line; this is of particular concern because recent experience has shown that interference can be significant especially in certain types of high frequency mains transformers are used in the terminal equipment. For this reason we have recently reviewed the policy and have decided that acoustic couplers will not be evaluated in isolation unless they have the ability to allow only those frequencies which are within the limits laid down... to be transmitted to the Post Office line regardless of the frequencies and levels fed electrically to the coupler from any attachment to it. (I am not aware of an acoustic coupler which currently meets these requirements).

3 Therefore, unless the acoustic coupler to be used as a separate stand-alone modem with the personal computer systems conforms to the above specifications (para. 2b), it will be necessary for all the systems to undergo technical evaluation in association with the acoustically coupled modem with which they will be used. (The use of a barrier unit as you suggest would not in fact prove a feasible solution as problems other than safety exist).

The Post Office evaluation of the computer systems, for which charges to cover the cost of Post Office resources used are raised, would be done on a general or one-off basis as follows:

(a) Pre-built systems

(i) With integral acoustically coupled modem. Suppliers of these systems would need to apply for a type-evaluation of their equipment. If this proved satisfactory a PO/Supplier Agreement for their supply could be drawn up and local Telephone Area Offices (Sales) would then be able to deal with applications for their use without further reference to Telecommunications Headquarters.

(ii) With separate stand-alone acoustically coupled modem. Suppliers of these systems would need to submit their computer system and the acoustic coupler with which it is to be used for type evaluation. If this proved satisfactory a PO/Supplier Agreement for the supply of both the computer system and the acoustically coupled modem could be drawn up as in (i). If the modem is not to be supplied by the same supplier as the computer system, it will be necessary for PO/Supplier Agreements to be taken out with all companies concerned.

(b) Kit and Home-Brew Systems

Individual constructors of these systems would need to submit their equipment and the acoustically coupled modem (either separate or integral) with which it was to be used to Telecommunications Headquarters for a one-off evaluation of their individual installation.

4 When a PO subscriber wishes to use an acoustically coupled modem (with or without an integral input/output unit) in connection with his telephone installation, he must first obtain the written consent of his local Telephone Area (Sales) Office. The conditions under which telephone service is supplied and private attachments may be used are as laid down in the Post Office Telegraphic Trafficking and Use of Telephone Equipment 1978 and amendments) a copy of which can be consulted at any local Telephone Area (Sales) Office.

I trust that the above information proves helpful to you

14th February 1979

Letter to the Post Office.

"I was surprised and disappointed to read of your plan to impose on these products type approval procedures originally conceived for business equipment. I would like to return to this but first of all, perhaps I could respond to your letter point by point.

1 I agree that it is unusual for acoustic couplers to be used at both ends of a data transmission link. Clearly, such an arrangement would involve the use of a computer which could receive on Channel 1. We are aware of this requirement and are encouraging the development of a switchable acoustic coupler which can be used for both the origination and reception of calls on the public network.

2(a) Even as someone who is not an electrical engineer, I find it difficult to understand how an excessively high voltage in a terminal device can transfer itself across a connection insulated by plastic, air and foam rubber to a PO exchange line. But just to be sure, I checked on this with three highly-qualified electrical engineers who confirmed, that in their opinion, this was impossible. I have these opinions in writing if you care to inspect them. In any case, paragraph 3.3 of Technical Guide No. 32 does require that "it must not be possible for the metal framework of the equipment to come into contact with any metallic part of PO telephone installations".

(b) It took me a little time to determine what you meant by the statement that 'recent experience has shown that interference can be significant especially if certain types of high frequency mains transformers are used in the terminal equipment...'

I believe that you are referring to the high kVz/low MHz radiation caused by the types of power supply needed to operate the bubble memory systems employed in certain models of the Texas Instruments Silent 700. In view of the fact that this problem is not caused by acoustic couplers, it would seem to be unfair to require the problem to be solved in the coupler. Does the problem only occur with directly-connected modems? Indeed, are the Post Office's own modems protected against such radio-frequency emanations?

3 Assuming that there is no real danger and that the 'problem' with respect to acoustic couplers can be overcome, would it still be necessary for full type approval procedures to be followed? If it really were necessary, a number of specific issues concern me.

(a) Is it not possible that the PO Service Department will be 'swamped' by developers of kit and 'home brew' systems? At present the department is set up to handle the (relatively few) business applicants for type approval and the addition of a large number of personal users to this queue could cause unacceptable delays for all concerned. The extension of the lead time to some two years would not be unexpected (at least, not by me).”
**Long distance information**

I’ve noticed that component prices in America are cheaper than over here. How easy is it to buy components from there?

If you have a credit card then the simple answer is “easy”. First, look through the adverts in any American computing magazine (Byte is generally the best) and compare prices for the items you want. Send the order on an air-mail letter and print your order and address clearly. If you want the order quickly then ask them to air-freight the letter and print your order for those items that you want.

You need the hardware to interface your micro into the floppy disc electronics, generate the correct control signals (eg head load) for the drive, and record and retrieve the data in an acceptable and reliable format. The software required operates at two levels - one, to control the disc drive and the other to manage allocation and cataloguing of the data.

To design it all yourself from scratch, say, the Western Digital FD1781 or 1791 will be quite an undertaking - alternatively there are S-100 products (eg Versa-floppy) available but you will be faced with the problem of generating the necessary S-100 bus control signals from your own system. As far as the software is concerned, the most common is CP/M but again some modification to suit your system is inevitable.

Mike Dennis

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**Essential validation**

I came across the term ‘Validation’ the other day, does it have a special meaning in programming or is it just a common sense?

Suppose that you asked someone their age and they replied one hundred and twenty nine, you would probably ask them the question again. This is the technique that must be applied to all good programs. None of the data should be allowed to be processed without having been thoroughly validated. In BASIC this is not often easy, but as an example we could validate the answer to the question “How many children do you have?” as follows:

1. INPUT “HOW MANY CHILDREN DO YOU HAVE” C$ 20 IF D$<”0” OR D$>”99” THEN 200 IF C<0 OR C>20 OR C<INT(C) THEN 100 50 PRINT “THANK YOU!": STOP 100 PRINT “I THINK YOU’VE MADE A MISTAKE” GOTO 10

Notice that serious programmers always input data into a string variable so that at least some errors are trapped and the message Illegal Quantity ERROR does not come up. Most validation techniques are straightforward and common sense. Check the following when inputting data:

- **SIZE** - the data contains the correct number of characters PRESENCE - that there is some data present RANGE - check that numbers and codes are within a reasonable range

CHARACTER CHECK - check that data contains only permitted characters ie names contain only letters, etc.

**Reasonableness** - qualities are checked for abnormally high or low values

**FORMAT** - that a code contains numbers and letters in the correct sequence.

Two other techniques that you should really get familiar with are the use of the utmost importance when validating data are Batch/Control/Hash total and Check Digits. These techniques would take too long to describe here but are worthy of further reading.

To summarise - all programs should validate the input to trap erroneous data before it reaches the validation section of a program is usually quite long, but is essential. Sheridan Williams

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**Menu options**

In advertisements and articles about business software I’ve seen the words ‘menu driven software’. What does this mean?

From the operator’s point of view it means that the software is presented with a list of options — usually on the VDU screen. Each option looks like a menu choice, the selection is made from the list and the program then proceeds to carry out the appropriate task. The benefit of this approach is that it is not restricted to the operator alone, the programmer prefers to develop several small programs because they are easier to debug and test and he can concentrate his efforts on one task at a time.

To link all the small programs together a ‘menu’ program is written which is responsible for displaying the options available, accepting the choice and calling the appropriate program — usually from disc. At the end of each program, control is returned to the menu program. In this way the package is self sustaining; this technique can also be thought of as ‘chaining’. Sheridan Williams

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**Good advice**

As a businessman I need advice on how to define the business, whether I can benefit from a microcomputer. Un fortunately, from where I am, all I see is vested interest. Software houses want to sell their packages or services, some are even tied to particular machines. Shops obviously want to sell their machines, maybe I’m just a suspicious old sod, but I really can’t see how to get truly objective advice. Can you help?

I’ve covered this type of question before, but it’s such a common one that it will go over the points mentioned again. You will never get truly unbiased advice. I like to think that I am unbiased but my view of business computers is limited. It may be far greater than average, but my advice is still limited to
those machines that I have tested, tried, and surveyed; hence I too am biased. Look at it this way: if you require legal advice then you go to a solicitor; if you require financial advice then you go to an accountant or bank manager— they are all biased, but less so than most.

So if you require advice on microcomputers, do not go to a shop for unbiased advice, approach a microcomputer consultant. There are several ways in which you can find a consultant. Look through PCW . . . there are several who advertise there; ask to see the Microskill register compiled by Digitus; write directly to me and I can put you in touch with a consultant who specialises in your field. The National Computing Centre (NCC) are doing a feasibility study of a microcomputer consultancy bureau—good news, I must say that there is a great need for one. Finally I do suggest that the consultant you choose should be able to show either relevant qualifications or references, as there are a great many 'cowboys' around.

As for your question on whether you can benefit from a microcomputer, don't be surprised if a consultant tells you that aspects of your business are better off staying as they are. It is possible that these will run more efficiently as they stand—don't look at microcomputers as some sort of universal panacea.

Sheridan Williams

The real business

How long do you think it will be before a pucka business machine comes on the market? Up to now all the business stuff gives me the impression that only a dedicated hobbyist/businessman should attempt using it.

I am not quite sure that I understand your question. Do you mean that all the systems you've seen have had wires and cables trailing all over the place, with naked printed circuit boards abounding? Maybe you see micros for around £2000 upwards and refuse to believe that they can be any good, because you've been told that computers cost upwards of £5000.

There have been pucka business machines on the market for some time now—and even the hobbyist micros are capable of performing fairly simple business tasks. I suggest that you look around one or two shows or exhibitions. . . . I feel sure you'll be surprised. If you are still sceptical then please write back and I will endeavour to prove my case.

Sheridan Williams

Plotting Lissajous
How do I plot Lissajous figures on my micro? I have seen them done but have no idea how to program them myself. Do I need a great deal of knowledge of mathematics and physics?

Lissajous figures are nothing more than two mutually acting simple harmonic motions. An example might be the pattern formed when a pendulum swings in two planes (not just backwards and forwards, but from side to side as well), and has sand pouring out of the pendulum's bob. The trace made by the sand on the floor will be a Lissajous figure. They are fairly simple to plot provided that you don't want them plotted on a teleprinter. If you have direct cursor address--ing on a VDU then you will find the task easy. Here is a program for the Research Machines 380Z, plus suitable mods for other machines like Apple and PET.

```
10 INPUT"SCREEN WIDTH"; W
20 INPUT"SCREEN HEIGHT"; H
60 FOR T=0 TO 9999 STEP 0.01
70 X=W*SIN(A*T)+W
80 Y=H+COS(B*T)+H
90 PLOT X,Y,2
100 NEXT
```

For the Apple change 50 HGR and 90 PLOT, Y. For machines like the PET with no plotting command you will have to calculate the screen address and use 90 POKE V+2+w+y-x,48 where V is the screen base (top left hand corner) address, and the ASCII code for a dot is 46. I won't do anymore for you as half the fun is making the program work; please, no letters saying that the program doesn't work—make it work!

Lissajous figures can be stated parametrically as x=sin at, y=cos bt, and t can have any value (although it is convenient to use the values in line 60 above). Values of a and b will give differing forms of pattern, choose simple small integer values to begin with. Have fun.

I included this question as I was asked at the PCW show to cater for those with a scientific interest too. Please send in more scientific questions as I'd like to include at least one per month.

Sheridan Williams

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You can now buy, for about one-sixth the price of current products, a third-octave spectrum analyzer with more features and capabilities than were previously available at any price. What's the catch? If you don't already own a Commodore PET computer (or, soon, a Radio Shack TRS-80 or Apple), you'll have to get one. This will raise the price to somewhat under one-half the price of competing products, but of course you'll also have a COMPUTER!

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PNC 57
There have been many circuits for microprocessor systems published in the various hobby magazines. These range from simple LED and switch operated designs to sophisticated microprocessors with resident BASIC interpreter, VDU, tape interface etc. Most of the simpler systems have suffered from several drawbacks.

Firstly many of them have been designed with very little thought of expansion. One of the results of this is minimum memory decoding and thus, to add further memory the circuit may have to be modified, in some cases quite extensively. Also, almost without exception such systems have used the SC/MP (or SC/MP II) microprocessor. The main reasons given for the use of this micro are that it is cheap, and easy to understand and use. Now, however, other micross are available which are far more sophisticated than the SC/MP in both hardware and software, while being almost as cheap and just as simple to use.

This circuit (fig. 1) is designed to overcome these problems. It features the powerful Z-80 microprocessor and is designed for easy expansion. It may at first seem strange to use a micro such as the Z-80 in such a simple environment but there are good reasons for this. 1. It is straightforward to use from the hardware point of view. It only needs a single +5V supply and a single phase TTL clock; also no demultiplexing of control signals or addresses is necessary.

2. It provides automatic refresh for dynamic RAM. While this is not used in the basic version, it means that cheap dynamic RAM can be added to extend the refresh controllers (which are expensive, and slow the processor down). All that is needed to interface 16K of dynamic memory is an address multiplexer. 3. It has a very powerful instruction set and a large number of internal registers. This means programs can be written which are faster, smaller and easier to understand (due to less shuffling of data from memory to micro etc.) than the simpler micross (SC/MP).

4. There is quite a bit of software available for it. Despite these advantages it is now not very expensive. The Z-80 can be bought for £10/£12 for the 4MHz version.

The system
The system is almost as basic as you can get. The memory is 1K bytes (using 2102s. 1K is only slightly more expensive than 256 bytes of 2112s). As there is no firmware, address and data switches are provided for loading programs and data into the memory. The data switches can also be read by programs as input. Output from programs is through the eight data LEDs. A switch is provided to interrupt programs via the INT pin. This is useful for such things as signalling to the computer that data has been set-up on the switches, and can be read in.

The circuit includes a PIO consisting of two eight bit ports. Each one can be configured either as an input or output or, in the bit mode, each bit may be separately defined as an input or output. This is a very useful IC as it allows many things (D/A converters, Keyboards and other peripherals) to be connected to the computer with little or no external circuitry.

Also available as outputs from the circuit are sixteen memory block enable lines (1K blocks) and eleven I/O port enable lines. The other five of the sixteen decoded port enables are used on the board, one for the LEDs and switches, and four for the PIO. All the outputs are fully buffered to drive up to twenty LS TTL loads. (Some lines have a slightly lower drive capability as they already drive inputs on the board.)

The circuit
There is nothing particularly revolutionary about the circuit (fig. 1). The heart of the circuit is of course IC1, the Z-80 CPU. This is clocked at 2.5MHz by a simple crystal oscillator built around N1, N2 and N3. As already mentioned, direct memory access is used to load and examine the memory. In the DMA mode the address, data and control signals are connected as a source of address, data, and control signals. The circuit contains data selectors to select between the MPU and the switches. (The data switches are connected via a tri-state buffer because they are also used as a data input peripheral.)

The PGM/LINE switch (S1) is used to select between the two modes. With S1 on LINE, BURSQ is held high, allowing the MPU to have control of the buses. This is acknowledged by BUSAK being high. This signal is used to control the five data selectors (IC2 to IC6). As it is high the data selectors are switched to channel B. Four of these (IC2 to IC5) connect and buffer the 16K memory to the system address bus; IC6 connects IORQ, MREQ, RD and WR control signals onto the appropriate system control lines.

IC8 decodes the high order address bits and MREQ to provide the sixteen 1K page enable outputs (P0 to P15). Only P0 is used in the basic system but the others are useful for system expansion, especially adding ROMs. P0 will go low whenever a location in the bottom 1K of memory is addressed. This signal is therefore used to enable the 1K block of RAM (IC13 to IC20). When P0 and RD are both low, i.e. a read from the RAM block is being performed, FR2 is enabled, putting the data from memory onto the data bus. The memory decoding is not quite complete, so P0 occurs again at 8000 – 83FF, as well as 0000 – 03FF. Memory expansion above 32K will therefore require additional decoding. For this reason it is suggested that A14 should be connected to IC9 by an external jumper to allow easy modifications.

This also applies to IC9; the I/O port decoder, A4, should be connected to IC9 by a jumper. IC9 works in the same way as IC6 but it decodes the low order address bits as the I/O port address appears on the low byte of...
the address bus during IORQ
when IC is of course enabled
by IORQ not MREQ. In the
basic system, port 0 is used
to enable the LEDs and
switches. Ports 4 to 7 are
gated together by N19 - N21
to select the PIO. The B/A
and C/D select lines of the
PIO are connected to A0 and
A1 respectively. The result
of this is the port allocation
shown in Fig. 2.

<table>
<thead>
<tr>
<th>INPUT</th>
<th>OUTPUT</th>
</tr>
</thead>
<tbody>
<tr>
<td>0</td>
<td>switches LEDs</td>
</tr>
<tr>
<td>1</td>
<td>unused</td>
</tr>
<tr>
<td>2</td>
<td>unused</td>
</tr>
<tr>
<td>3</td>
<td>unused</td>
</tr>
<tr>
<td>4</td>
<td>PORT A DATA</td>
</tr>
<tr>
<td>5</td>
<td>PORT B DATA</td>
</tr>
<tr>
<td>6</td>
<td>PORT A CONTROL</td>
</tr>
<tr>
<td>7</td>
<td>PORT B CONTROL</td>
</tr>
<tr>
<td>8</td>
<td>unused</td>
</tr>
</tbody>
</table>

Fig. 2

I/O PORT ALLOCATION

When reading from port 0,
both RD and I0 will be low.
N7 will therefore go low,
thus enabling tri-state buffer IC11
via N11 and N12. The data
from the data switches is thus
enabled onto the data bus to
be read in by the MPU. When
data is written to port 0,
WR and I0 will both be low.
The output of N9 goes low,
validating the data bus to
the MPU data bus. If
exposed to the data bus is
latched into IC10 and thus
put on the LEDs.

IC7 is a bi-directional tri-
state buffer. The direction is
controlled by RD and it is
enabled by BUSAK. Its function
is to increase the drive
capability of the data bus.
It's not necessary in the basic
version and as it seems very
hard to obtain at the time of
writing, it may be omitted.
It must be replaced by a
wire connection between the
MPU data bus and the system data bus. If
expansion over the drive
capacity of the data bus (four
LS TTL loads) is incorporated,
it will have to be included.

DMA mode

When S1 is switched to PGM,
BUSRQ is pulled low. This
informs the MPU that an
event has occurred (in this
case the human operator) wants
control of the buses. The
Z-80 finishes execution of
the current instruction (or cycle
of a block transfer, search or
I/O instruction) and then re-
leases control of the buses.
The data address and control
buses go tri-state, and
BUSAK goes low to indicate
that the bus is available.

The BUSAK disables IC7
and switches the data selec-
tors to channel A. This
connects address switches S11
to S22 via the data selectors
to the system address bus. The
high order nibble is wired to zero
which limits the switches to 4K of
memory. This is no hardship,
however, as it is impractical
to address more than 4K of
memory. With S2 (deposit)
not pressed RD and WR are
held low and high respectively.

Assuming that the address
on the switches is in the bot-
and 1K of memory (less than
4096), the RAM will be enabl-
ed just as in the LINE mode.
As RD is low, IC12 is enabl-
ed so the data from the
selected RAM location
is enabled onto the data bus.
IC10 is held open by the
BUSAK signal via N10. The
LEDs will therefore follow
the data bus and thus display
the contents of the selected
memory location. Any
memory location may be
examined in this way, simply
by setting up the address on
the address switches.

If S2 is now pressed RD
is sent high and WR is sent
low. This enables IC11 via
N8 and N11/N12, and dis-
able IC12. The data bus will
therefore contain the data
set-up on the data switches.
The RAM is in the write
mode as pins 3 are held low
by WR, the data from the switches is thus written into
the RAM location. When S2
is released the system returns
to the read mode so the LEDs
will continue to display the
new contents of the memory
location. This checks that the
data has been written correct-
ly.

Interrupts and reset

A computer is not much use
if you cannot run the pro-
grams you have entered. To
start programs with the Z-80
it is necessary to apply a low
pulse to the RESET pin. This
is achieved by S3. The switch
is debounced by a standard
RS flip-flop (N22 and N23).
This is to ensure that only
one reset pulse is applied
which is important for some
programs. Capacitor C1 dif-
erentiates the output and
applies it to the RESET pin of IC1. This has two effects:
firstly, when S3 off, RESET
is effectively floating so other
circuitry (with open-collector outputs) can be connected to it, and secondly, C1 also pro-
duces only a short (about
1mA) pulse to IC1 to ensure
that refresh to any dynamic
RAM which may have been
added is not lost for long
even to corrupt the data.

S4 is connected in just the
same way as S3 but to the
INT pin of IC1. Pressing S4
thus causes an interrupt of the
current program. The use
of this will be explained later.

N15, N16 and N17 buffer
HALT, RFSH and M1 respec-
tively. HALT also drives LED
D1 which lights to indicate
that the system has halted.
LED D2 is connected to
BUSAK and thus lights when
the system is in the PGM
mode. This is necessary as
sometimes on switch-on with
S1 on PGM, the system will
not enter the PGM mode
until RESET is pressed. All
the control inputs (RESET,
NMI, INT, WAIT, BUSRQ) have
pullup resistors, so external
open collector circuitry can be
connected to them direct.

Construction

The prototype drew a current
of about 700mA with all
LEDs on, so the simple power
supply of Fig. 3 will suffice.
The 7805 regulator should be
provided with a heatsink.
This supply allows little room
for expansion; in that case it's
worth using a higher current
supply. An alternative and
preferable approach is to
mount a simple regulator as
shown in Fig. 3 (with a
smaller reservoir capacitor)
on the board and on each
expansion board; you can
then power the whole lot
from a smoothed but unregu-
lated 5V DC supply.

It is advisable to use the
low power schottky TTL
for all TTL ICs, to reduce
power consumption. In some
cases this is unavoidable
(DM81LS96 and 74LS373 are
only available in LS),
and in some cases virtually
impossible (try getting a
74LS154). The only ICs for
which standard TTL may not
be used are IC21, IC23, IC25
and IC26. All of these have
more than one input driven
from a single Z-80 output and
the fanout of a Z-80 is only
one to standard TTL (four
to LS TTL).

The 2102s can be 250ns or
450ns access time. The
minimum time available for
a memory access is during an
M1 cycle (op-code fetch).
The allowed access time for
the memory is three clock
half-cycles, less about 40ns.
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<td>ADDRESS</td>
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<td>0000</td>
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<td>0002</td>
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<td>0004</td>
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<tr>
<td>000D</td>
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<td>000F</td>
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<table>
<thead>
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<tbody>
<tr>
<td>ADDRESS</td>
</tr>
<tr>
<td>0000</td>
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<tr>
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<tr>
<td>003A</td>
</tr>
<tr>
<td>003C</td>
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<tr>
<td>003D</td>
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</table>
At 2.5MHz this is 660ns. If we allow about 100ns delay of MRQ through IC6 and IC8, and of the data through IC12 and IC7, (a fairly pessimistic estimate) this leaves 460ns for memory access time. There are therefore no problems in using 450ns RAMs.

It is possible to use the Z-80A at 4MHz in this circuit, (the prototype used it). I would in fact advise it as it is not much more expensive (about £3 for the CPU and PIO) than the 2.5MHz version, and you get nearly twice the processing speed. The only other change necessary is to use 250ns memories. You could add wait states etc. to get away with the 450ns memories but it is really not worth it as 250ns 2102s are not much more than 450ns ones and they can be got for about £1.10 (HM).

Construction of the microcomputer is not very critical; the prototype was built on a single sided PCB with no problems (except for mistakes in the PCB). The main thing is to keep everything neat and any interconnections fairly short (problems may be encountered with christmas tree construction methods). About ten 0.1µF decoupling capacitors should be distributed around the circuit, across the power rails, especially near the Z-80.

Operation and programming

Operation of the system is extremely simple. At power-up, if S1 is on PGM, LED D2 should come on. If it doesn’t then press RESET and it will. (If it still remains off, something is wrong.) The LEDs will now display the new contents of the stack pointer (in this case the whole program can be entered into memory. Once entered it is always worth checking that the program is loaded correctly as incorrect programs have a nasty habit of wiping themselves out. Z-80 programs must always be written to start execution at location 0000.

To start the program, press RESET (RESET over-rides BUSQ so the Z-80 will reset with S1 on PGM). This causes the Z-80 to fetch and execute the first instruction and then return to the PGM mode. If S1 is now moved to LINE the program will continue execution until a HALT instruction is met. Putting S1 to PGM at any time will stop the program, allowing memory to be examined and/or modified. Moving S1 back to LINE continues from where the program left off.

It is not possible to do justice to the software capabilities of any microprocessor system in a short article but here are a couple of simple examples.

Counting

The program shown (Program 1) is a simple binary count program. It will count in binary on the LEDs at about 3Hz. The count rate can be varied by changing the contents of locations 0006 or 0009.

Addition

It is unusual to have interrupt available on a switch as in this circuit but it’s a very useful feature in simple systems. One handy application is to send a signal to the computer that data has been set up on the data switches and can be read in. This is demonstrated in Program 2.

Before using the INT switch it is necessary to load the stack pointer with a convenient location to hold the interrupt return address. The Z-80 must then be set to interrupt mode 1.

In this mode an interrupt causes a jump to 0038... the interrupt system is then enabled with an EI instruction. Program 2 simply adds two numbers which are input from the data switches, and displays the result. When each number is required, the input instruction is preceded with a halt instruction. When this halt is executed D1 will light to indicate that the MPU is waiting for data. When the data has been set up on the data switches, INT is pressed. This causes a jump to 0038. Here there is a delay of about 1.3ms before the interrupt is re-enabled, thus allowing that the INT pulse from the debouncing circuit will be over when interrupts are re-enabled, preventing multiple interrupts. After enabling the interrupt, the RETI instruction returns to the instruction after the halt, which in this case reads in the data.

Using the PIO

The Z-80 PIO (IC21) is a fairly sophisticated LSI circuit. It provides two eight bit input/output ports with handshake control, and is fully compatible with the Z-80 vectored priority interrupt system. Despite this it is not hard to use. For simple applications the handshake and interrupt facilities may be ignored. Before using the PIO, a program must set it up. This involves outputting various control bytes to the control port of the required channel (port 6 for channel A, port 7 for channel B). This information includes setting the mode (input, output, bit or bidirectional); in the bit mode a byte must also be sent to define which bits are inputs and which are outputs. If interrupts are being used additional information must be provided about interrupt modes, interrupt vectors and bit mask (in the bit mode only). There is no room in an article of this type to explain the device fully and I would advise those interested to obtain the Z-80 PIO technical manual.

Parts list

**RESISTORS**

- R1, R12-26, R35-42: 1k33
- R9, R10: 330k
- R11: 330k
- R27-34: 180Rk8

**CAPACITORS**

- C1, C2: 100nx2
- C3: 82p
- C4: 10n

**SEMICONDUCTORS**

- IC1: Z-80 CPU
- IC2-6: 74LS157x5
- IC7: 74LS245 (optional)
- IC8, IC9: 74LS342
- IC10: 74LS373
- IC11, IC12: 74LS154x2
- IC13-20: 21L02x8
- IC21: Z-80 PIO
- N1-6 = IC22: 74LS04
- N7-9 = IC23: 74LS08
- N10-13 = IC24: 74LS00
- N14-17 = IC25: 74LS08
- N18-21 = IC26: 74LS00
- N22-25 = IC27: 74LS00

**MISCELLANEOUS**

- S1, S5-S24: 21xminiature slide switch
- S2-4: 3xminiature push switch
- D1, D2: .2" LED (one red, one green)
- D3-10: 8xTLI209
- F1: 2.5MHz crystal
- 2 x40pin
- 2 x24pin: DIL IC socket
- 4 x20pin: these may be omitted but their use makes testing etc much easier
- 1x16pin
- 6 x14pin
The end of work?

"Following a personal initiative by Her Majesty the Queen, the Government is to launch a huge programme with the aim of getting the public engaged in a debate on informatics and society. There will be computer film festivals, programming contests, and an international conference at which computer experts will be thinly diluted with trade unionists, social scientists, natural scientists, and journalists. The doors of hundreds of government establishments where computers are used will be thrown open to the public, and staff will be on hand to talk about their work. The idea is to make the people aware of the potential benefits of information technology, and to stimulate the flow of new suggestions on how to tackle the problems which may arise from it."

A danger that Britain may on the one hand be so engrossed that it will have no say in the matter at all. There is a danger of the public becoming isolated and cut off from the rest of the community, while the consumer, who is virtually unorganised, has no say in the matter at all. If the trade unions had to work out their own attitudes independently to the Government's new £250 million programme for the years 1980 to 1983, to give one example, there would be a danger of the programme being put into action in France at the behest of President Giscard d'Estaing. Of course, nothing of the kind is likely to happen.

Here in the UK, although substantial help is being given towards microelectronics applications, and towards the training of users in industry, there does not seem to be any consciousness of the need to explain these advances to the consumer or the trade unionist, nor to encourage them to participate in the discussion. Let us not ignore the many areas of the changes that will so profoundly affect them.

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shorter working week, for instance, they naturally expect to get there without any loss of basic pay. This puts up our costs, makes Britain even less competitive and stimulates the export of jobs to Europe, America and Japan. If full employment was of supreme importance, the TUC's measures would be implemented without any change in hourly rates, and with increased social security contributions to pay for early retirement and better pensions. That is not a practical possibility, however, and the best that can be hoped for is a trade-off between the various forms of work-sharing and the need to contain inflation.

In everything that has been said up to now it has been implied that man has a right to work, and that he suffers deprivation if he is without a job, quite apart from any economic hardship he may endure. This is indeed a widely held and deep rooted belief. And today the virulence displayed towards alleged social security scroungers indicates that many people still think it is morally wicked to abstain voluntarily from paid employment, even when the effect of doing so may be to leave open a job for someone who really wants it.

Herman Kahn was speculating, 12 years ago, on the question of whether or not in the postindustrial society people could adapt to the idea that work is an interruption of normal life. Some of the benefits of work, he thought, could be derived from other forms of activity, provided they were available and, preferably, institutionalised. The sense of participating in an important activity, the exercise or mastery of gratifying skills, and the establishment of personal identity, for instance, are among the values sought.

More important than any of these, surely, and more difficult to realise, is the absence of guilt feelings, caused by the way society views the unemployed. The man or woman on the dole is either an object of sympathy, to be relieved by alms or charity - which is in fact the original meaning of the word - or he/she is seen as a failure, lacking the skills and ability to compete in a harsh world.

The transition to a steady state economy is now a matter of absolute necessity, if economic discontinuities - and hence political and social discontinuities also - are to be avoided. This is not yet generally accepted, but when it dawns on opinion leaders, attitudes to productive work are bound to shift accordingly. If society ceases to consider economic growth as the goal of paramount importance but rather, as a policy bound to lead to catastrophic failure, then the contribution of the individual to the general good must be evaluated by some other yardstick than the quantity of resources he processes or converts.

The end of work? Clearly not, but it will shrink in importance, as part of a far reaching transformation that can only be dimly perceived. The uses made of information technology in this process could be wholly beneficial, contrary to the image people have been given by the media. Indeed they will be, if, instead of abdicating their power to influence the course of events by concentrating entirely on the microeconomic effects at the work place or within a particular industry, the trade unions and the political parties would begin to think about the institutions needed to provide and control the silicon revolution for the benefit of mankind as a whole.

Eric Avebury
House of Lords
Chess master, David Levy, begins a series of articles on the principles behind programming computers to play games.

Games are fun, but some games are more fun than others, depending on your taste. It's long been recognized that the type of mind required to play good chess, bridge, backgammon or poker, is also likely to be adept at solving crossword puzzles and writing computer programs. Hence it is hardly surprising that many programmers derive enormous satisfaction from programming intelligent games.

In this series of articles I shall discuss the principles of programming a computer to play games, placing special emphasis on the particular problems posed by running these programs on a micro. My aim will be to acquaint the reader with the techniques of games programming so that (s)he will have the confidence and ability to program any intelligent game for a personal computer. Although I shall use a limited number of games in my examples, the same general principles can be applied to any game in which the computer competes against the user or users.

The series will be divided into three parts. The first part will cover all the general principles, giving examples and suggesting interesting programming tasks for the more enthusiastic reader who wishes to test his understanding of a particular topic. In part two I shall discuss some specific games in more detail and describe what work has been done in these areas so that the reader who is interested in a particular game need not re-invent the wheel. I shall also invite readers to write to me with their questions and ideas, and I shall publish the most interesting letters together with my comments (though I regret that no personal replies can be given). The third part of the series will begin when the most interesting games have already been discussed in detail, and it will be possible for me to devote most of each article to the readers' forum.

I very much hope that these articles will be interesting and informative for all of you who are 'into', or would like to be into, computer games.

**Input/output**

I/O on a personal computer is often largely a matter of taste, though certain points are worth bearing in mind when writing a game playing program.

1. **The output should be easy to follow.** You may not think this important, and many programmers take the attitude that if they can understand their output nothing else matters; but how about someone else? If you want to show your program off to a friend it will be so much better received if the output is clear, concise and unambiguous. Remember to output any information that may be helpful, for example in a chess program you should always announce check, checkmate and stalemate. These little touches take hardly any extra effort, and they make your program that much more attractive to another user.

2. **If you want to use neat graphics or printout, plan the layout carefully, taking into consideration all possibilities.** It's not much use having your bridge program display pretty pictures of the cards if one day you discover that when you are dealt ten cards in a suit only nine of them will fit onto one line and your whole display is messed up.

3. **Ensure that the user can easily see whose turn it is to play, and what the
last 'move' was. It can be infuriating to leave the computer for a minute or two and then return to find that the program has moved but you do not know what it has done.

4. Make it easy for the user to enter a move and to clear an incorrect move entry.

5. Ensure that the program will reject an illegal, impossibly or ambiguous move, or any entry that does not conform to your simple input rules.

One-person games

A one-person game does not involve an opponent. You play against a microcosm of the forces of nature and if you make a mistake it may be possible to recover, and then go on to win. Solving a problem or a puzzle is a good example of a one-person game — when you get near to a solution there is no-one to oppose you by suddenly making the problem more difficult. It may seem at first glance that patience games are one-person games, but in fact many patience games do not permit the player any freedom of choice, so the 'game' has no real interest. In the cards and tiles the player either will or will not finish the game, and all of his decisions are made for him by the rules.

A well-known one-person game is the 8-puzzle, in which a 3 x 3 array of tiles contains the numbers 1 to 8 and an empty space. (The numbers are sometimes replaced by letters.) The player shuffles the tiles and then tries to reach some target position by successively moving tiles into the empty space. For example:

```
| 3 | 8 |
| 2 | 5 |
| 1 | 4 |
```

Here the task is simple, and one way in which the target can be reached from the given configuration is by moving the tiles in the following order: 3, 2, 1, 4, 5, 6, 7, 8. With other starting and target configurations the task may be much more difficult, and for that reason the 8-puzzle too simple there is always the 15-puzzle, in which a 4 x 4 array has fifteen tiles and an empty space, then there's the 24-puzzle, the 35-puzzle and the (n^2 - 1) -puzzle. In each of these games the number of atoms in the universe, this algorithm would be somewhat slow in practice. In contrast, however, there does exist a useful algorithm for the interesting game of Nim. Nim is played with a number of piles of objects, often matches, and with various numbers of objects in each pile. The player who removes the last object loses the game. (In another version of the game the player who takes the last object is the winner.)

In order to win at Nim one need only know the following algorithm, and a few exceptional cases: If the number of objects in each pile is expressed in binary, and each binary column of numbers is added (without carrying numbers), then if the decimal totals are all even or zero then the person who is next to move is in a losing position. Here is an example.

```
<table>
<thead>
<tr>
<th>A</th>
<th>B</th>
<th>C</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
<tr>
<td>1</td>
<td>1</td>
<td>1</td>
</tr>
</tbody>
</table>
```

All three totals are even so whoever moves next will lose, provided that his opponent plays correctly.

There are some obvious exceptions to the rule. For example if piles A, B, C and D each have one match then the player who moves next will win, and the same is true of a position in which there's only one pile of matches, provided that there are at least two matches in this pile.

The existence of this algorithm does not detract from the interest of the game since its implementation is somewhat difficult. If we limit ourselves to Nim, unless the number of piles and the number of matches in each pile is small. But for a computer program the task is trivial.

```
<table>
<thead>
<tr>
<th>STARTING CONFIGURATION</th>
<th>TARGET</th>
</tr>
</thead>
<tbody>
<tr>
<td>3</td>
<td>8</td>
</tr>
<tr>
<td>2</td>
<td>5</td>
</tr>
<tr>
<td>1</td>
<td>4</td>
</tr>
</tbody>
</table>
```

The program considers each move that it can make, taking one match from pile A, two matches from pile B, and so on, and it evaluates each of the resulting positions until it finds one where the number of matches is all even or zero, whereupon it makes the move leading to that particular solution.

Once a candidate move has been rejected it may be that the program RAM is required only for the current situation, the move or decision currently under consideration, and workspace for the binary/decimal calculations. The program tries the current position, and if a move is found to be unsuccessful it is 'unmade', and the next move tried. In this way it is not even necessary to store the current position and the candidate position — the program can switch to and fro between them by making and unmaking moves, a technique which is useful for saving RAM in a highly restricted memory environment.

One trick to remember for Nim, or any other game with an algorithmic method of play, is this. Should the program find itself in a theoretically losing position, as might happen at the start of the game, it should make the move that leaves its opponent with the most possible moves. In this way the opponent is more likely to make a mistake. In Nim I would suggest that if your program is in a losing position it should remove one match from the largest pile.

A heuristic method of solving a problem relies on commonsense techniques for getting closer and closer to the solution, until the solution is actually within reach. A heuristic is therefore a rule of thumb — it will usually help us to find a solution to the problem, but it is not guaranteed to do so. In situations where a heuristic does work, it will often find the solution much faster than any algorithmic method, though some heuristics, for best results, are often employed in conjunction with an algorithm. A frequently used device which makes use of heuristics is the tree, and we shall now examine a method of solving the 8-puzzle by use of a tree and a simple heuristic.

We return to the starting configuration on figure 1. We always refer to the starting configuration, or the point from which the program must move, as the root of our tree. Before we can decide which move might be best we must know which moves are possible, i.e. in accordance with the rules of the game. A list of these moves is usually supplied by a subroutine called a legal move generator, which may be extremely complex, as in chess, or very simple, as in the 8-puzzle. It is not difficult to see that in a starting configuration there are three tiles which may be moved, 3, 5 and 8. Our legal move generator would determine these moves by examining the elements of the 3 x 3 array which are horizontally or vertically adjacent to the empty space, and there are many simple methods for doing so. We might, for example, store all the legal moves in a table. If we number the elements of the array table thus:

```
1 2 3
4 5 6
7 8 P
```

our table of moves might look like this:

```
vacant moves
1 | 2
2 | vacant

P | 4 | 5
```

et cetera so that by knowing which element in the array was vacant the program could immediately list the legal moves. This type of approach is called table-driven move generation. It is often the fastest way to proceed but the problem in this way the program consumes too much program memory for it to be a feasible proposition.

Having generated the moves 3, 5 and 8 from our starting configuration, we can now begin to see that the tree is growing.

The branches of the tree are the moves (m_1, m_2, m_3) that can be made from the root of the tree. We may depict the root position by P, the position arising after making the move m_1 is P_1; after making the move m_2 it is P_2, and after m_3 it is P_3. These positions are represented on the tree by nodes.
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to the solution, followed by a statement to the effect that the game is over and it has found a solution in however many moves, which are then listed. If it has not solved the problem the program might then like to know how close each of its moves has come to providing a solution; so at first we should neglect \( P_3 \) and concentrate on \( P_1 \) or \( P_2 \). Since they are of equal apparent merit, the program may choose between them at random. Let us assume that it chooses to expand \( P_2 \), from which it will generate the moves of the 2 tile and the 3 tile. Since the 3 tile was moved on the previous turn, and the program is intelligent enough to know that it does not want to go back to where it has just come from, the only move (\( m_1 \)) that the program needs to consider seriously is the move of the 2 tile, which would lead to the following position:

\[
\begin{array}{ccc}
3 & 8 & 5 \\
2 & 7 & 6 \\
1 & 4 & 6 \\
\end{array}
\]

A simple evaluation function for the 8-puzzle can be programmed by counting how many vertical and horizontal places each tile is away from its target location, and summing them. This use of the Manhattan Distances is quite common in the computer solution of similar problems. If we examine our starting configuration we can see that: the 3 is two places away from target the 8 is two places away from target the 2 is two places away from target (1 horizontally, 1 vertically) the 5 is one place away from target the 7 is two places away and the empty space (do not forget it) is one place away.

So the total of the Manhattan Distances is (2 x 1) + (7 x 2) = 18, and this is the score, \( S_0 \), which is associated with position \( P_0 \).

Counting the Manhattan Distances in \( P_1, P_2, \) and \( P_3 \) we get:

\[
\begin{align*}
S_1 &= 16 \\
S_2 &= 16 \\
S_3 &= 18 
\end{align*}
\]

(Note that when a solution is found, \( S \) will be zero.)

So now the basis of our evaluation function it looks as though moves \( m_1 \) and \( m_3 \) are likely to lead to a faster solution than \( m_2 \), since positions \( P_1 \) and \( P_2 \) seem nearer the target position than does \( P_3 \). And this is where the story really begins.

An obvious, though tedious, algorithmic solution to this problem is to look at each of the positions \( P_1, P_2, \) and \( P_3 \), then generate all the legal moves from each of these positions, look at the newly resulting positions, then generate all the moves from these positions, and so on, until one of the positions is found to be the target (i.e. its score \( S \), the sum of the Manhattan Distances, will be zero). Eventually, this method (which is called exhaustive search) will find a solution, that is so long as the program does not run out of RAM. But by using a simple heuristic we can head the program in the right direction, and hopefully a solution will be found sooner than if the exhaustive search algorithm were used.

So now we see that when we expand the node \( P_0 \), of the three new positions that appear on the tree, \( P_1 \) and \( P_2 \) appear to be more promising than \( P_3 \). It is clearly logical to expand the more promising nodes before the less promising ones, so at first we should neglect \( P_3 \) and concentrate on \( P_1 \) or \( P_2 \).

The best position now on the tree, i.e. the position closest to the target configuration, is \( P_1 \), since its score of 14 is lower than the scores of all the other nodes. So remembering not to allow the retrograde move of the 2 tile, the program now expands position \( P_1 \), and the choice is to move the 1 tile or the 5 tile, giving rise to the following position:

\[
\begin{array}{ccc}
2 & 3 & 8 \\
1 & 5 & 7 \\
4 & 6 & 1 \\
\end{array}
\]

Once again we have a tie, two 'best' positions with scores of 14, and so the program again makes an arbitrary choice.

This process continues until a solution is found. It is easy to see that the method can hardly fail to be substantially faster than the exhaustive search process described earlier. The tree is grown intelligently, rather than in a dumb-ox manner, and better use is made of the available memory. With the exhaustive search process the computer's memory will, unless a solution is found, be filled at a stage when a very large proportion of the nodes on the tree are not of any real merit. With the heuristic approach, when memory is exhausted we at least know that most of the memory has not been wasted on unlikely moves, and we can use the best sequence of moves found so far.

**What to do when Memory is Exhausted**

Working with a personal computer inevitably poses memory constraints on a different scale from those encountered when writing for a large machine. How can the programmer combat this problem when examining large trees in an attempt to solve a one-person game? I shall describe two approaches to this particular problem:

(1) Follow a path through the tree to the best position found so far and output the moves on this path. Then make this 'best position' into the root of a new tree and start again.

(2) More intelligently, when memory becomes full, delete the currently 'worst position found so far' and use the newly scrubbed bytes to store the next position that the programme generates. If this process is continued for long enough, either a solution will be found or the tree will eventually have two paths, each path having no offshoots. When that happens the program must choose the best of the paths, and make the terminal position on this path into the root of the new tree, remembering to output all the moves on the path leading to this position.

For example, our tree generated for the 8-puzzle now looks like this:

\[
\begin{array}{ccc}
P_0 & P_1 & P_2 \\
(16) & (14) & (14) \\
\end{array}
\]

If memory is now full the program would delete \( m_3 \) and \( P_3 \), to make room for the successor position produced when it expands \( P_1 \) or \( P_2 \). Let us assume that both \( m_2 \) (\( P_2 \)) and \( m_3 \) (\( P_3 \)) are deleted, to make way for \( P_1 \) and \( P_2 \). We then have:

\[
\begin{array}{ccc}
P_0 & P_1 & P_2 \\
(16) & (14) & (14) \\
\end{array}
\]

and the program can now output the moves \( m_1 \) and \( m_3 \), making position \( P_1 \) the root of a new tree.

The shortest solution

In most games it is sufficient to win, but there may be reasons why one wishes to win as quickly as possible. For one-person games there exist
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The job of the Sales Ledger is to control and record details of monies owing to a company from the sale of their products or services. If you were to ask the accountant what he would expect to find in his Sales Ledger system he would probably reply something like this: 

"I must be able to post dated invoice or credit note amounts to the account of the customer concerned. Similarly I must be able to post any cash I receive from that customer. I want a free choice in the type of accounting system to be used. If I choose a balance forward system I would only expect to see details of transactions in the current period, but I may wish to have dated balances. If I chose an open item system I'd want reference numbers against each invoice and credit note. I might want to produce remittance advices so that my customers can tell me which invoices they are paying and I'd certainly need to be able to allocate cash paid against invoices. I'd also need to be able to deal with cash I can't allocate, which may mean that I need to be able to indicate any invoices which may be in dispute. Whichever accounting system I may choose I would like to be able to change to the other easily; of course I'd accept a compromise in going from balance forward to open item. I might want to have some of my customers on open item and the rest on balance forward. I'd definitely expect customer statements to be produced at the end of each period and I'd probably want an aged debtor analysis to pinpoint my bad paying customers. Of course I'd need an analysis of VAT amounts as well."

Now although Sales Ledger is primarily the province of the accountant there are other interested parties. The customer for instance may like to see payment terms clearly stated, particularly if he can take advantage of any prompt payments discounts. The Sales manager may wish to see some analysis codes in the system so that he can do reports by Rep, or area. The auditor may wish to see Sales and Cash day book listings to assist him in audit.
The system will allow for expansion up to 1.6M byte disc.

The systems documentation provided is excellent; it covers not only the Sales Ledger system but also Purchase Ledger, Nominal Ledger and Stock Control, and gives full details of all files used. Since some customisation is included, the program is written in BASIC with a small amount of machine code incorporated.

Maintenance is comparatively simple because every system is tailored — errors are ‘phoned in, an attempt is made to retexture the fault and if a bug is found a corrected version of the program is sent to the customer. If the fault proves to be a corruption of the customers copy a new version is provided at nominal cost. There are approximately 30-40 users and because of customisation and the modular design of the package, all have tailored systems.

TRIDATA Sales Ledger
This system was written by Tridata Microsystems Ltd of Birmingham (021-622 1754) and is available direct from them or from most Tandy dealers throughout the country. It has been available since August and there are 33 customers.

The package costs £225 and this includes personalisation and telephone backup during installation. At present no training is provided but a course is starting in January 1980 at a cost to be advised later. The minimum hardware is a 32K TRS 80, 2 mini floppy disc drives and a 128c tractor feed printer, making a total cost of £3,334. The package is written in BASIC and there are plans over the next few months to convert the package to other hardware ranges.

Documentation comprises of a User manual which, though sparse in systems information (a new version is being prepared to overcome this deficiency), is excellent for the user. Not only are the operating steps shown clearly but many helpful tips are given on general microcomputer usage. Customisation will always be arranged at an agreed charge and linkages are provided to other packages written by Tridata — particularly Stock Control, Invoicing and Nominal Ledger. Any system bugs would be corrected free of charge and a file recovery service is provided in case of master file corruption.

The systems were written by Logma Systems of Design of Bolton (0204 389854) and are available from them or B&B (Computers) Ltd. (0204 26644) also of Bolton (previously named B&B Consultants). At present dealerships are being negotiated and it is believed that G.L.A.S. will be available country wide within twelve months. The package is a fully integrated Sales, Purchase and Nominal Ledger system and costs £1,000.

The price will include full personalisation and up to four half day training sessions on site. The minimum hardware requirement is 32K PET, 400K Compu-think dual disc drive and a printer — and the minimum cost is £2,500. There are five users at present but the number is expected to increase in the next few months. In addition to the training given on the package, hardware is delivered locally to Bolton and up to one day of operator training is given on site.

Documentation is provided which gives a good overview of the system but would be enhanced by the inclusion of field layouts. Operating documentation is personalised to each customer, being part of the personalisation service included in the package cost. The package is written in BASIC and customisation is done as required at an agreed price. Any systems bugs found would be corrected free of charge.

GRANT BUSINESS SYSTEMS
This system was written by Grant Business Systems and is available from them at the Micro Computer Centre, London, SW14 (01 876 6699) or from dealers throughout England. The package is an integrated Invoicing, Sales Ledger and Stock reporting system and costs £275.

Documentation is excellent, giving full details of all files used. Since many helpful tips are given clearly but documentation is quite sparse in systems information. A User manual is written in BASIC and there are plans over the next few months to convert the package to other hardware ranges.

Documentation comprises of a User manual which, though sparse in systems information (a new version is being prepared to overcome this deficiency), is excellent for the user. Not only are the operating steps shown clearly but many helpful tips are given on general microcomputer usage. Customisation will always be arranged at an agreed charge and linkages are provided to other packages written by Tridata — particularly Stock Control, Invoicing and Nominal Ledger. Any system bugs would be corrected free of charge and a file recovery service is provided in case of master file corruption.

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72 PCW
Dr. Christopher Evans was a psychologist, computer scientist and visionary, always one step ahead of his rapidly changing Time. With a degree in psychology from Reading University, he approached the computer world from a unique perspective which he turned into many exciting practical projects during his 15 years at the National Physical Laboratory (NPL) in Teddington, where he was head of the man/machine interaction unit. About five years ago, while British industry slumbered in the bliss of micro ignorance, he began to realise how low-cost microelectronics could liberate computer power from the chains of big organisations and place it at the finger-tips of everyone.

When he chaired the first personal computing conference in Britain in May 1977, the Online DIY Computer event, he called the micro a “turning point in computer development”. Until then, he said, the computer industry and most computer users were from big business and big organisations but “the micro revolution will move the computer world in significant new directions, becoming available to an enormous range of human beings”.

True to his style as an enthusiastic doer, not just an invigorating talker, he and his talented team at NPL produced a number of projects which showed how the micro, by cutting costs and providing more computer power, could turn bright ideas into working products.

For example, there is Mickie, the patient-interviewing system which can perform some routine medical diagnoses in an interactive discussion with a person suffering from, say, an abdominal pain. Mickie has proved itself in live hospital operation. Then there are Muppet (subsequently renamed Minni) which is a handheld language translator, Malta the aircraft landing simulator and perhaps most importantly of all, Mavis, which was designed to provide a range of new input and output methods to help disabled people use a computer.

Like the micro which he championed, the most appropriate adjective to describe Chris Evans is “ubiquitous” - you never knew where he would pop up next and what subject he would be discussing. As shown in his book, *The Mighty Micro* (Gollancz), his interests spanned both the historic roots of technology and its most futuristic flowers.

At the NPL he organised a lecture series on the Pioneers of Computing; he was thrilled that computer technology had advanced so rapidly, it was possible to interview the founders while they were alive to witness the astounding impact of their invention. For posterity, he recorded the views of many of the pioneers and these tapes are now available from the Science Museum in London.

At the other end of the time continuum, he was fascinated with science fiction and the possibilities of artificial intelligence creating Ultra Intelligent Machines which, in his optimistic technological enthusiasm, he believed would become a beneficial intellectual helper to Man. He was also passionately (and everything he did was with committed passion) involved in debunking some of the wilder fringes of science, particularly the Uri Geller-style of spoon bending parapsychology.

He was a regular performer on London’s Capital Radio and the BBC World Service ‘Discovery’ science programme. And his frequent TV appearances included a series of interviews with science fiction writers as well as the Thames TV version of *The Mighty Micro* which, tragically, has to be shown posthumously because of delays caused by the ITV strike. Also being a contributing editor to *Omni* magazine brought together his interests in technology and science fiction.

To keep all these activities going (in addition to writing many books, ranging from *A Dictionary of Psychology* (Harrap) to *Cybernetics* (Butterworth) and *The Mighty Micro* required a huge capacity for hard work. But he seemed to have an in-built energy dynamo which carried him through. To be in his presence was to experience that personal energy field.

Yet when giving public presentations he brought a relaxed informality which made him one of the great technology popularisers. In fact, it’s true to say that his populist approach and his wide range of activities led to some personal criticism from fellow scientists with a more academic approach to their subject. Such criticism, however, undervalues the importance of opening up the mysteries of science and technology so that academic achievements can be more widely appreciated.

When *Omni* was launched in the UK, a time capsule containing various mementos from Britain in 1978 was sealed by Chris Evans and placed on display in the London Planetarium — to be opened in the year 2000. Those who open it should remember that at the time of general gloomy pessimism about the future, Chris Evans was concerned enough to send a message to the 21st century and to look forward with enthusiasm to the expanding horizons of the coming micro generations.
One of the most powerful features of the computer both as an information processor and as a control machine is its ability to detect differing conditions or varying situations and to respond to these, often in a sophisticated and complex way. When analysed, this activity reduces to the capability (of the program) to pose a question, to use the available data to establish the correct answer and then to act on that answer.

This particular feature exists in most programming languages and goes under the name of a conditional branch or just a conditional. Before looking at what PASCAL provides in the way of such control structures, it is as well to define the constituent elements. The outcome of a conditional is always one particular course of action chosen from a set of options laid down in the program. The function of the conditional is to select the appropriate course depending on some circumstance. So the format is:

```
SELECTOR
  OPTION 1
  OPTION 2
  etc.
```

Clearly the options are simply sections of code which perform the different actions required. The difficult part is setting up the selection to get the right option in the first place.

**Single and double branches**

In the simplest kind of branch, the programmer may wish a piece of code to be executed only if some condition holds, and the program to continue once this code is completed. If the condition doesn’t hold, the program continues directly anyway. In PASCAL this circumstance is handled by means of the IF—THEN statement which takes the following form:

```
IF expression THEN statement;
```

The expression, defined in Box 1, takes a Boolean value (i.e. TRUE or FALSE) which explains how it behaves as the selector. When the expression is TRUE, the statement following THEN will be executed. Otherwise program control will pass directly to the statement immediately after the ";" which is the next instruction in the program. This type of conditional can be viewed as a "single" branch because there is only one optional statement open to the selector.

An enhancement of this type of conditional is the "double" branch where the selector directs program control to alternative sections of code (depending on whether TRUE or FALSE). At the completion of either alternative, program control passes to the same point in the program—namely the statement immediately following the conditional. In PASCAL this is dealt with by means of the following:

```
IF expression THEN statement
  ELSE statement;
```

Note that there is no ";" between the statement governed by THEN and the reserved word ELSE. It is a frequent error amongst programmers new to PASCAL to insert a separator here, with erroneous results.

Box 2 gives the syntax diagrams for both of these variations on the IF statement, and Box 3 consists of a sample program which illustrates their use. When writing a program which is likely to be used by other people, particularly if data input is to be handled by inexperienced or unskilled operators, it is advisable to accept all input in ordinary character strings, checking on the validity and sorting out the different data types within the program. If the user makes a mistake, the program will detect it and ask for the input again, instead of crashing the processor. Considering that some such programs may run for hours (or even continuously) and may accept simultaneous input from many terminals (e.g. an airline bookings system), it is unnecessary to give further stress to the advantages of this technique. Program READINTEGER (Box 3) is an example of the sort of routine one would use for inputting positive integers up to a fixed maximum length. The maximum number of digits allowed in any particular implementation of PASCAL will depend on the hardware being used so the program specifies INTSIZE as a CONST which can be tailored to different machines (line 2). The technique lies in reading the number in
since a value of -1 means that the tor (line 49) in the IF statement
input string but also as the selec-
each digit as it is "peeled" off the
NUM is used not only to hold
main body of the program, NEW -
ful
being
The
sought
successful
digits.

character form (i.e. ASCII) and
translating each digit into
numeric form. In line 16 the
array NUMBA is primed with
the character codes of the
different
digits.
The program reads the integer
into a character string in proce-
sing. Frequently, just having two op-
ecess again.

MULTIPLE BRANCHING

Frequently, just having two op-
tions at some particular point
in a program is not enough, since
it is necessary for the program to
split many ways. Perhaps the most
explicit example of this require-
ment can be seen in the handling
of a "menu" of the type found
in many "business" packages. Take
the example in Box 4 where
the relation between the options
in MENU and the procedures
listed below is obvious. However,
in order to get the right item in
the menu, the main program has
to go through the jumble of IF's
from lines 22 to 32.

It is for occasions like these
that the PASCAL CASE statement
has been defined (most other lan-
guages have an equivalent facility).
Box 5 shows the syntax diagram
for the CASE statement. The for-
multiple cases.

CASE selector OF options END;

Note that the value taken by the
selector must be one of the items
in the list of constants which label
the different
options. If this is not
the case, the outcome is undefined
so it is advisable to build a test
into the program to ensure that
the selector is within the permis-
sible range. Box 6 shows the way
in which a CASE statement is used
to tidy up SALESLEGDER (yes,
SALESLEGDER, we stick by our
mistakes!). Lines 20 to 25 lay out
the options and SELECTION acts
as the selector. However, before
SELECTION is "allowed into" the
CASE a check is made (lines 17
and 18) to ensure that it will make
a successful selection (i.e. that it
holds one of the values specified
in line 3).

Finally, note the use of the state-
ment separator ". " within the
CASE statement (Boxes 5 and 6)
since a semi-colon between the
last option and the END which
finishes the CASE statement will
result in a compilation error.
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PASCAL RESERVED WORDS
IF THEN ELSE CASE EOLN

JARGON
Conditional Branch
Selector
Case Label

UCSD Exceptions
Undefined selector values “fall through” CASE statements.

EXERCISES
1. Enhance READINTEGER to cater for negative as well as positive integers.
2. Write a program to count the occurrence of each letter of the alphabet and total of all non-alphabetic characters in a piece of text. Use a CASE statement.
3. The situation can arise in OTHELLO where it is impossible for either player to move (i.e. two consecutive PASSES). The current program does not cater for this — adapt it.

Sample program - Othello

In this section we present a full program to illustrate not only the control structures of this chapter but also some of the data structures introduced in the last. Instead of describing the details of this program in the text, we shall exploit the readability of the PASCAL coding in Box 7. For instance, anyone unfamiliar with the rules of OTHELLO should consult the output text in procedure INSTRUCTIONS (line 17).

When tackling a program in this way, the approach should be to look at the data structures defined in the beginning, in conjunction with the body of the main program to try to deduce the programming strategy. Often the choice of data structures will dictate specific programming tactics within the program. A look at the TYPE statements (lines 2 to 5) will show that a board game is to be played and this is confirmed by the presence of the array BOARD with scalar indices and elements limited to FIRST, SECOND, and EMPTY.

In the main program the outer REPEAT UNTIL loop (lines 277 to 300) allows players as many games as they like. It contains procedures to get each game started and to give the score when finished together with an inner WHILE-DO loop, (lines 279 to 297) which controls a single game.
Note the use of BOOLEANS (GAMEOVER, NOMORE, LEGAL and PASS) to make the control structures (both loops and conditionals) obvious and easy to read. During the game, MOVER keeps tabs on whose move it is (lines 293 to 295) and COUNTER monitors the number of successful moves made (lines 290 and 295). After a move has been input (procedure GETMOVE), accepted (CHECKMOVE) and made (FLIPS), COUNTER and MOVER are altered to reflect the state of the game.

The core of the program lies in the "move" mechanism described by these three procedures. GETMOVE gets the player's move from the keyboard and determines whether the characters input refer to any square on the board. This constitutes a check for validity. Note the use of the set VALID (line 193) to guarantee that the CASE selector in DETAILED-CHECK (lines 111 to 121) will find one of the options. Note also that the move can be typed in, in either order — i.e. "4A" will work as well as "A4".

CHECKMOVE checks on the legality of the move, ensuring that the indicated square is unoccupied (line 205) and then "looking" in every direction (lines 210 to 220) to see if a winning sequence of "target" squares exists (i.e. a sequence of the opponent's counters followed by one of the player's own counters). Procedure CHOOSESQUARE handles the different sequences (CASE statement, lines 152 to 182) and checks for the edge of the board, while CHECKIT has the job of tallying up a FLIPS-COUNTER for each direction (line 190). Note that CHECKMOVE looks in all directions, even when the move is known to be legal. This ensures that FLIPS-COUNTER is set for each direction so that the business of making the actual move (FLIPS, line 223 to 241) is fairly straightforward.

Our thanks to Jim Wood of Ithaca Intersystems for letting us use a DPS-I for this project. We were able to use the latest implementation of PASCAL/Z which now supports real numbers.
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One of the most exciting events at this year’s PCW Show was the second microprocessor chess tournament. Competition was much fiercer than last year and the standard of play was very noticeably higher, a sure sign than an increasing number of personal computing enthusiasts are getting to grips with the complex task of writing a chess program. At the first tournament we had only six contestants, this year there were nine and a further fifteen people intimated that they had programs which were not quite ready to participate. It would not surprise me if next year, when it is hoped to hold the first World Microprocessor Championships, we have as many as thirty entries.

A new feature this year was the size of the first prize, £1,500, which was awarded to the highest placed home brew entry. This put together in only a few days. MIKE II was two pawns ahead when it allowed a mate in two by VEGA, and this allowed David Broughton’s program to snatch a vital point. In fact VEGA missed the mate when it was first available, but on the following move, when MIKE II had still not noticed the threat, VEGA was not so generous.

VEGA’s luck held out in round two, when it reached a position in which its opponent, MYCHESS, was a queen and three pawns ahead. Due to an error in MYCHESS’ timing mechanism it loses track of how long it has taken under circumstances, and MYCHESS lost on time despite its overwhelming material advantage. This left VEGA with 2 out of 2 and in the next round it met the Chafitz/Sargon program. Sargon was running on a specially designed chess board which senses the moves made by its opponent’s pieces and illuminates small LEDs to indicate its own moves. This impressive piece of equipment, which will be on sale next year at around £800 ($8850 in the USA) was undoubtedly the strongest program in the tournament. It crashed all the opposition in its path, including the hitherto fortunate VEGA, and by the end of round four it was already assured of first place. VEGA played sensibly in the two final rounds, drawing an up and down game with the Voice Challenger and then beating DELTA in round 5. It is a solid, well debugged program, and despite the fact that it was very lucky I still consider it to be the strongest of the home brew entries and well deserving of the prize, which incidentally was some £300 more than first prize in this year’s British Championship (for humans)!

The games that follow are amongst the most interesting. Readers who would like xerox copies of all the games should send a large stamped addressed envelope and an envelope to: PCW (Chess Games), 14 Rathbone Place, London W1. I should like to thank PCW for sponsoring this important tournament and giving computer chess enthusiasts the opportunity to test their wares. Watch these pages for news of next year’s PCW tournament, the first World Championship for micros!

White: Voice Challenger Black: Sargon
1 d2-d4 g7-g6
2 d1-d2

It is a little surprising to see that a program which purports to have such a large openings book can make a move like this so early in the game.

<table>
<thead>
<tr>
<th>Move</th>
<th>Program 1</th>
<th>Program 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2</td>
<td>d2-d4</td>
<td>g7-g6</td>
</tr>
<tr>
<td>3</td>
<td>b1-c3</td>
<td>d7-d5</td>
</tr>
<tr>
<td>4</td>
<td>g1-f3</td>
<td>f8-g7</td>
</tr>
<tr>
<td>5</td>
<td>d2-d3</td>
<td>0-0</td>
</tr>
<tr>
<td>6</td>
<td>e2-e4</td>
<td>d5xe4</td>
</tr>
<tr>
<td>7</td>
<td>c3xe4</td>
<td>c8-f5</td>
</tr>
</tbody>
</table>

An awkward pin on the knight, which ties White down to defence.

8 e4xf6+ 9 d3-c4 f7xf6 10 c4-b4 e8-c6 11 b4-b5 c8-f5 12 f3xd4 d8xd4 13 b5xb7 d4-e5+ 14 e1-d1??

White had to play f1-e2. Now his king will never be safe.

Of course White is quite lost, but this move makes matters easier for Black by blocking the possible escape square c3.

20 ... g5xe3+ 21 f2xe3 e5xb2+ 22 d2-e1 h2-g1+ 0-1

Voice Challenger is a sporting opponent who resigns when it sees an inevitable mate.

**PROGRAM**

<table>
<thead>
<tr>
<th>R1</th>
<th>R2</th>
<th>R3</th>
<th>R4</th>
<th>R5</th>
<th>Tot</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>Chafitz/Sargon (USA)</td>
<td>W7</td>
<td>W4</td>
<td>W2</td>
<td>W3</td>
</tr>
<tr>
<td>2</td>
<td>Vega (UK)</td>
<td>W5</td>
<td>W3</td>
<td>L1</td>
<td>D6</td>
</tr>
<tr>
<td>3</td>
<td>Mychess (USA)</td>
<td>W8</td>
<td>L2</td>
<td>W4</td>
<td>L1</td>
</tr>
<tr>
<td>4</td>
<td>Tiny Chess 86 (Belgium)</td>
<td>W6</td>
<td>L1</td>
<td>L3</td>
<td>bye</td>
</tr>
<tr>
<td>5</td>
<td>Mike II (UK)</td>
<td>L2</td>
<td>W9</td>
<td>L6</td>
<td>W8</td>
</tr>
<tr>
<td>6</td>
<td>Voice Challenger (USA)</td>
<td>L4</td>
<td>W7</td>
<td>W5</td>
<td>D2</td>
</tr>
<tr>
<td>7</td>
<td>Max (UK)</td>
<td>L1</td>
<td>L6</td>
<td>bye</td>
<td>W9</td>
</tr>
<tr>
<td>8</td>
<td>Delta (UK)</td>
<td>L3</td>
<td>bye</td>
<td>W9</td>
<td>L5</td>
</tr>
<tr>
<td>9</td>
<td>Wizard (UK)</td>
<td>bye</td>
<td>L5</td>
<td>L8</td>
<td>L7</td>
</tr>
</tbody>
</table>

David Levy reports
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TI 58/59 pseudo op-codes

We'll start off with some notes from reader, Rolf Howarth, of Wimborne, Dorset concerning various TI 58/59 operations which are not to be found in the manual. "When a program is entered it is stored as a sequence of two-digit numbers, each of which corresponds to one or more key strokes. However, not all of the 100 possible codes (00-99) are used, and a 'pseudo' op-code can be placed in program memory by entering RCL nn and then deleting the RCL, leaving the code nn as required.

Keycode 82

This is the most useful pseudo code, and is normally referred to as HIR (this is the mnemonic printed when listing on the PC-100). With it one can access the eight internal registers used as the pending operations stack, and print register when the PC-100 is stopped. The format of the instruction is 82 ab, where a is the operation and b the number of the register (1-8) on which the operation is performed. There are six different operations, which are used in the same manner as ordinary register arithmetic. 0 - STO store display contents in internal register, 1 - RCL recall contents of internal register to display, 3 - SUM add display to internal register, 4 - PRD multiply internal register by display contents, 5 - INVSUM subtract display contents from register, 6 - INVPRD divide register by display contents, 7 will perform no operation and 8 and 9 all do the same as 6. Note: When performing register arithmetic with the pending operations registers, place the calculator in scientific display mode, as any number smaller than one will otherwise have its exponent made positive (eg. 0.02 turns into 200. after HIR 38).

These registers may be HI Red when the programmer has no spare data registers, though one has to take into account the fact that they are actually used by the calculator (1).

Keycode 31

This op-code corresponds to the LRN key, which can of course not be placed directly in program memory, as the calculator leaves learn mode when it is pressed. When the code is encountered during program execution, the calculator stops in learn mode at the following location.

DSZ

The decrement and skip on zero function may be used with any data register, not just registers 0-9 as stated by the manual. The number of the register has to be placed in the right place using the same method as when entering a pseudo code. Note that register 0 may not be used, as Dsz 40 is recognised as Dsz Ind.

Finally I would like to give the owners of a TI58/9 a puzzle to solve. It is possible to look at the 380 steps which contain the routines that do the polar to rectangular and sexagesimal to decimal conversions and statistics. I have found out how to do this, and wonder whether anyone else can.

Your ten and up ten!

I would like to make a confession, a sacrilegious though it may be to computer persons, I have always preferred card games to chess. More specifically I am addicted to Poker; seven card stud when played well has a degree of psychological subtlety and complexity for which it is seldom given adequate credit.

Given this leaning (or perversion, in the eyes of some) it is most gratifying to note that the Artificial Intelligence community have recently turned to Poker as a suitable subject for computer simulation.

Rather rashly I decided to try to produce a calculator program for the Casio FX-502 which could make 'intelligent' betting decisions in a simulated card game. Poker is
The 'deck' is of necessity greatly simplified, merely the numbers 1 to 13 with no suits. This means flushes are not possible, pairs, runs and prials (3 of a kind) are the only hands above Ace high. (In an earlier card game I represented suits by 1, 2, 3, or 4 following a decimal point e.g. 2.9, 3.3, but this adds impossibly to the complexity here). The 'hands' are dealt using the DMS format of the 302 so 26.5 is a pair of twos.

The program deals two hands and assesses its own hand before displaying yours. By a series of tests it identifies pairs and prials and then runs, and according to the outcome assigns a 'value' to the hand which is in the range 6-18 for a pair, 18-31 to the hand which is in the perceived strength of its running flushes are not possible; pairs, grossly betting.

The program then compares your last raise with the value of its hand and raises, sees or folds according to one of two algorithms (which depends on the value).

When betting first the calculator 'suckers' you, i.e. conceals the strength of its hand by raising the first bet on the square root of its value.

And to avoid predictability it bluffs wildly on a random basis on an average of one in ten hands.

Given the limitations of a pocket calculator I was surprised that the program could perform this function using the 'assessing' subroutine again but it slows the game down too much.

The calculator keeps a running bank balance for each player, debits each bet as it is made and puts the bets into a jackpot which is credited to the winner manually by the human player.

Those familiar with the fx-502 will be surprised to know that I have opted to use its Mickey Mouse random number generator in the dealing subroutine. This is not because I am aware of its inadequacies; nor because I don't know any other pseudo-random number routines, which I do (later column?), Frankly it's because the poor distribution gives you better hands!

A word of warning. In the listing I have followed my own preferred format which is to omit all INVs (for 2nd functions) and the commas between steps in the interest of space and readability.

User instructions

1. Clear memories with MAC.
2. Enter playing funds e.g. 1000 into memories 15 and 16.
3. Press PO. This deals the first hand and displays yours.
4. Enter a bet e.g. 2.
5. Press PI. This accepts your bet and replies with calculator's bet e.g. 5.
6. Repeat 4 and 5 until:
   a) You wish to see. Do this by equalling the calculators bet i.e. by not raising. The calculator's bank will be displayed automatically.
   b) You wish to fold. Enter a bet of 0. Your hand will be displayed automatically.
   c) The calculator sees you by equalling your last bet. Press P7 to see calculator's hand and P2 to recall your own. (These may be done at any time but no cheating!)
   d) The calculator folds by a bet of 0.
   7. When a game has terminated by a) b) c) or d) determine the winner.
8. If you are the winner press P3. Your bank balance is displayed. (This may be done at any time). Press EXE and the calculator's hand will be displayed and simultaneously added to your balance.
9. If calculator has won P4 and EXE perform similar functions.
10. Repeat from 3. Note that PO does not clear all memories (this would lose bank balances) so be careful to collect all winnings. Other wise the jackpot carries over to the next game.
11. To allow the calculator to bet first (first betting should alternate) press P6. Then enter your reply and press P1; continue as normal with steps 4 and 5.

Program listing

```
P0  6 Min0
LBL8 GSB P9 IND Min0 DSZ GOTO 8
MR3 Min13 - MR1 Min11 - Min12
MR2 M-11 M-13
MR11 x=0 1 MinF MR12 x=0
2 M+F MR13 x=0 3 M+F
MRF ABS FRAC MinF x=0 GOTO 1
2 x>P GOTO2
3 x>P GOTO3
50
LBL9 MR1 2 - MR2
LBL3 MR2 5 + Min10 GOTO 9
LBL1 MR11 X MR12 X MR13 ABS 2 x=0 GOTO 5
GSB P9 MinF 10 Min14
MR1 + MR2 MR3 = 7 INT
x>P MR14 Min10 GOTO 9
LBL5 MR1 10 Min19
LBL9 SAC MR10 MinF x INT Min0 GSB P2
P1 Min7 M+18 M-15
x=0 GSB P2
MR15 x=0 GOTO 2
EE HLT
LBL2 MR7 8 - MM 9 x=0 GSB P7
2x>P GOTO 3
MR7 + 1 M+6 GOTO 8
LBL3 MR10 3 x=0 GOTO 1
2x=P 0 GOTO 9
MR10 10 = GSB P8
LRL9 MR10 GSB P3
LRL1 0 Min8
LRL8 MR8 M+18 M-16 MR16 0 GOTO 5
EE /+ HLT
LRL5 MR8
* These constants control the 'caution' of calculators play.

PO does not clear all memories
(debits calculator's bank)

SQUARE ROOT VALUE
1. CALCULATORS VALUE
2. YOUR CARDS
3. CALCULATORS BET
4. YOUR RAISE
5. VALUE OF HAND
6. PAIRWISE DIFFERENCES
7. BLUFF VALUE
8. YOUR BANK
9. CALCULATORS BANK
10. JACKPOT
11. YOU RECEIVE
12. DEBTS CALCULATORS BET
13. IS IT SOLVENT?
14. CALCULATORS INSOLVENCY
15. CALCULATORS BET DISPLAYED

DEBTS CALCULATORS BET

YOU HAVE PULLED?
ARE YOU SOLVENT?
INDICATES INSOLVENCY
ARE YOU SEEING?
CALCULATORS STRATAGEM
FOR VERY STRONG HAND
SHALL CALCULATOR FOLD?
SHALL CALCULATOR SEE?
CALCULATOR BETS

DISPLAYS YOUR HAND
YOU RECEIVE JACKPOT
CALCULATOR RECEIVES JACKPOT
DISPLAYS CALCULATORS HAND
DEALS A CARD
```

82 PCW
As more and more microcomputers come on to the British market, so our unique machine listing, In Store, continues to expand at great pace. However, it’s important that in terms of editorial ‘page consumption’, Direct Access strikes a reasonable balance with the remainder of the magazine. Therefore, for the time being at least, we are making the following changes:

**User Group Index**

A complete list of user groups, clubs, societies and associations will be published quarterly. Otherwise, each month the section will include only those groups of which we have been newly notified.

**Diary Data**

PCW’s diary will project approximately two months ahead of publication day. In addition, though, we will continue to give details of particularly interesting events occurring ahead of that date.

### Machine Group Index

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<th>Machine (Price from)</th>
<th>Main Distributor/s (No. of dealers)</th>
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<tr>
<td>ATTACHÉ (£7,000)</td>
<td>R. H. Thorpe Ltd: 0276 29492, R. J. Spiers Ltd: 0603 416573 (TBA)</td>
<td>48K RAM: 8080: dual 8&quot; F/D (616K): 9&quot;, 16x64 b&amp;w VDU: 180 cps printer</td>
<td>ExBASIC: B/P: FORTRAN</td>
<td>S</td>
<td>W/P package available soon</td>
</tr>
<tr>
<td>CBS Mk I (£4,900)</td>
<td>Complelec: 01-636 1392 (n/a)</td>
<td>64K RAM: Z80: dual 8&quot; F/D (1MB): 12&quot;, 24x80 b&amp;w VDU: 132 col, 30 cps printer: 2 S/P: 1 P/P: options — 150cps bi-directional printer, £2,000; 55cps W/P printer, £2,000</td>
<td>CP/M: BASIC: S&amp;H W/P: U: B/P</td>
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<tr>
<td>CBS Mk II (£8,150)</td>
<td>As above</td>
<td>64K RAM: Z80: dual 8&quot; F/D (1MB): 12&quot;, 24x80 b&amp;w VDU: 132 col, 30 cps printer: 2 S/P: 1 P/P: options — 150cps bi-directional printer, £2,000; 55cps W/P printer, £2,000</td>
<td>CP/M: BASIC: S&amp;H W/P: U: B/P</td>
<td></td>
<td>Up to 44MB H/D possible, £4,500 extra. Multi-user system with 250K RAM, £10,150.</td>
</tr>
</tbody>
</table>

### List of Abbreviations

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<tbody>
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<td>C/P</td>
<td>F/1/3/7</td>
<td>G/1/3/7/11/13/15/16/18</td>
<td>H/1/3/5/7/11/13/15/16/18</td>
<td>I/1/3/5/7/11/13/15/16/18</td>
<td>J/1/3/5/7/11/13/15/16</td>
<td>K/1/3/5/7/11/13/15/16/18</td>
<td>L/1/3/5/7/11/13/15/16</td>
<td>M/1/3/5/7/11/13/15/16/18</td>
<td>N/1/3/5/7/11/13/15/16/18</td>
<td>O/1/3/5/7/11/13/15/16/18</td>
<td>P/1/3/5/7/11/13/15/16/18</td>
<td>Q/1/3/5/7/11/13/15/16/18</td>
<td>R/1/3/5/7/11/13/15/16/18</td>
<td>S/1/3/5/7/11/13/15/16/18</td>
<td>T/1/3/5/7/11/13/15/16/18</td>
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<tr>
<td>Machine (Price from)</td>
<td>Main Distributor/s (No. of dealers)</td>
<td>Hardware</td>
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<tr>
<td>COMPELEC SERIES (£2,400)</td>
<td>Compec: 01-636 1392 (n/a)</td>
<td>64K RAM: Z80: dual 8” F/D (512K): RS232 ports, 1 P/P</td>
<td>CP/M: A: BASIC: COBOL: FORTRAN: PASCAL: W/P: PILOT: B/P</td>
<td>S</td>
<td>Also with double density F/D, 1MB: £2,900; 1K EPROM</td>
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<tr>
<td>COMP-CORP 295 (£6,000)</td>
<td>Compacorp: 01-952 7860 (15)</td>
<td>60K RAM: Z80: dual 5” F/D (700K): 9”, 16x80 b/w VDU: 40cps printer, RS232 port: 20”x25”x10”</td>
<td>A: BASIC: U: W/P: B/P</td>
<td>B</td>
<td>Also available, 655 model with 315K F/D capability &amp; 12”x28”x10” VDU — £3,750</td>
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<tr>
<td>COMP WORKSHOP SYSTEM 1 (£1,600)</td>
<td>Comp Workshop: 01-491 7507 (n/a)</td>
<td>32K RAM: dual 5” F/D (700K): 9”, 16x64 b/w VDU: modular</td>
<td>A: BASIC: FORTRAN: FLEX: PASCAL: PILOT: B/P</td>
<td>E</td>
<td>These systems are example configs from a fully compatible modular range</td>
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<tr>
<td>COMP WORKSHOP SYSTEM 2 (£21,000)</td>
<td>As above</td>
<td>128K RAM: 6809: dual 8” F/D (1.2MB): 3 intelligent 20x50 terminals; 80 col, 128cps printer: daisy wheel Sprint 3 printer</td>
<td>A: BASIC: FORTRAN: FLEX: PASCAL: PILOT: B/P</td>
<td>E</td>
<td>As above</td>
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<tr>
<td>COMP WORKSHOP SYSTEM 3 (£36,000)</td>
<td>As above</td>
<td>768K RAM: 6809: dual 8” F/D (1.6MB): 64MB H/D: 10 intelligent 20x50 terminals: 1232 col, 120cps printers: 2 80 col, 125cps printers: 2 daisy wheel Sprint 3 printers: max 16 ports.</td>
<td>A: BASIC: FORTRAN: FLEX: PASCAL: PILOT: B/P</td>
<td>E</td>
<td>As above</td>
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<td>COMP-COLOUR II (£1,058)</td>
<td>Abacus: 01-580 8841 (6)</td>
<td>8-32K RAM: 8089: 13” 32x64 8-bit colour VDU: single 5” F/D (51K): RS232 port: 18”x15”x13”</td>
<td>ExBASIC (ROM): A personal data base: games</td>
<td>I</td>
<td>16K module, £1,134; 24K, £1,137; maintenance &amp; programming manual available.</td>
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<tr>
<td>CROMEMCO SYSTEM 3 (£2,995)</td>
<td>(64K, £3,293)</td>
<td>32-64K RAM: Z80: dual 8” F/D (512K): options as above: extra dual F/D, £1,200</td>
<td>CDOS: BASIC: E COBOL: FORTRAN; multi-user BASIC</td>
<td>I</td>
<td>As above</td>
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<tr>
<td>DURANGO (£7,750)</td>
<td>Comp Ancillaries: 07843 6455 (12)</td>
<td>48K RAM: 8085x: dual 5” F/D (1MB): 9”, 16x64 green VDU: 132 col 16cps printer: N/P: options — add F/D £1,753; aux VDU £875</td>
<td>O/S: DBASIC: S B/P</td>
<td>S</td>
<td>Takes up to 4 workstations: fully integrated system 15”x30”x24”</td>
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<td>DYNABYTE DBS/1 (£1,500)</td>
<td>Dynabyte UK/Europe: 0723 65559 (6)</td>
<td>32-64K RAM: Z80: 5100 bus, 2 RS232 ports: 1 P/P: 20”x18”x7”; option — dual 8” F/D (1MB), £2,000</td>
<td>CP/M: BASIC: H COBOL: FORTRAN: PASCAL: W/P: B/P</td>
<td>H</td>
<td>Expands to multi-user system: also DBS/2 with dual 5” F/D (400K), £3,000</td>
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<td>EQUINOX 200 (£9,995)</td>
<td>Equinox: 01-739 2387 (n/a)</td>
<td>64-256K RAM: Z80: 10MB H/D: 15”, 24x50 b/w VDU: 15cps printer</td>
<td>CP/M: BASIC: S H COBOL: FORTRAN: MVT/ FAMOS</td>
<td>S&amp;H</td>
<td>Up to 1200MB of storage possible (±£400MB, EqcompTridents)</td>
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<td>H11 Kit (£1,844)</td>
<td>Heath: 0452 29451 (n/a)</td>
<td>LSI 11: 16-32K RAM: 24x80 VDU int: up to 16 S/P or P/P: options — dual 8&quot; F/D (512K), £1,295; 12&quot;, 24x80 VDU, £58</td>
<td>O/S: BASIC: FORTRAN: A: games: T/E: U.</td>
<td>S/H CPU and VDU int boards sold as separate items.</td>
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<td>HEATH WH89 (£1,380)</td>
<td>Heath: 0452 29451 (n/a)</td>
<td>16-48K RAM: Z80: 5V4&quot; F/D (102K): 12&quot;, 25x80 b&amp;w VDU: RS232: 3&quot;x17&quot;x20&quot;: options — 16K RAM, £158</td>
<td>BASIC: A: W/P: B/P</td>
<td>I Cassette available instead of F/D, £882; in kit form WH89 is £1,200</td>
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<tr>
<td>IMS 5000 (£1,935)</td>
<td>Equinox: 01-739 2387 (20)</td>
<td>32-64K RAM: Z80: dual 5V4&quot; F/D (320K)</td>
<td>CP/M: BASIC: S&amp;H COBOL: FORTRAN: PASCAL: W/P</td>
<td>3 drives option</td>
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<td>IMSAI VDP 42 (£3,900)</td>
<td>Computermart: 0603 615089. Corner Comp: 03727 41101 (2)</td>
<td>32-64K RAM: 8085: dual 5V4&quot; F/D (400K): 9&quot;: 24x80 b&amp;w VDU: 1 S/P: 1 P/P: 18&quot;x27&quot;x12&quot;</td>
<td>IMDOS (CP/M comp): A: ExBASIC: U: CBASIC: COBOL: FORTRAN</td>
<td>H Can support 8 additional F/D drives; also available. VDP 44 with F/D (786K), £4,400</td>
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<td>MICRO-ENGINE (£2,080)</td>
<td>Pronto: 01-599 3041 (TBA)</td>
<td>64K RAM: MCP 1600: 2 RS232 ports: 2 P/P: 16&quot;x13&quot;x5&quot;: options — dual 5V4&quot; F/D (1MB), £1,500; dual 8&quot; F/D (2MB), £1,200</td>
<td>BASIC: PASCAL: File: Manager: U</td>
<td>H&amp;S</td>
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<td>O/S Operating system: P/P Parallel port: S Software: S/P Serial port: T/E Text editor: T/P Text processor:</td>
<td>CPU has user written word set: PASCAL uses integral P code; available as board, £1,400</td>
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List of Abbreviations:
- C/P Commercial package
- E Extensive
- F/D Floppy disc
- G/C Graphics card
- H Hardware
- H/D Hard disc
- I Introductory int Interface
- I/S Indexed sequen tial
- K/B Keyboard
- M/A Macro assembler
- M/P Numeric pad
- O/S Operating system
- P/P Parallel port
- S Software
- S/P Serial port
- T/E Text editor
- T/P Text processor
- U Utility
- W/L Word length
- W/P Word processor

Please note: Software items listed in italic are not included in the basic price of the equipment. All prices are exclusive of VAT.
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</thead>
<tbody>
<tr>
<td>MSI 6800</td>
<td>Strumech: 05433 4321 (5)</td>
<td>16K RAM: 6800: C: [3&quot;, 16x64 b/w VDU: 1 S/P: option — PROM progr</td>
<td>BASIC: mini A H&amp;S T/E: U</td>
<td>Up to 8 serial or parallel interfaces possible.</td>
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<tr>
<td>SYSTEM 1</td>
<td>As above</td>
<td>32K RAM: 6800: 5 dual 5&quot; F/D (160K): 9&quot;, 16x24 b/w VDU: 1 RS232 port: option — dual 8&quot; F/D (624K), £1,640</td>
<td>DOS: BASIC: H&amp;S U: A: FORTRAN T/E: B/P</td>
<td>As above</td>
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<tr>
<td>RAIR BLACK BOX</td>
<td>Rair: 01-836 4663 (n/a)</td>
<td>32-64K RAM: 8085: dual 5&quot; F/D (160K): 2 RS232 port: 20&quot;x16&quot;,5&quot;: options — dual 5&quot; F/D (520K), £1,000</td>
<td>CP/M: BASIC: H COBOL: FORTRAN: M/A: T/E: B/P</td>
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<tr>
<td>SEMEL 1</td>
<td>Strutt Electrical: 0822 5439 (n/a)</td>
<td>16-48K RAM: Z80: single 8&quot; F/D (250K): 12&quot;: 24x80 b/w VDU: RS232 port: options — single 8&quot; F/D (250K), £500, light pen</td>
<td>BASIC: COBOL: FORTRAN: B/P</td>
<td>Supports up to 8 drives</td>
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<tr>
<td>SHARP MZ-80K</td>
<td>Sharp UK: 01-571 2157 (TBA)</td>
<td>6-34K RAM: Z80: C: 10&quot;: 24x40 b/w VDU</td>
<td>BASIC: A: B</td>
<td>Graphics: loudspeaker: BASIC in 14K RAM</td>
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### Machine

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<tbody>
<tr>
<td>SIMPELEC</td>
<td>Complec: 01-636</td>
<td>64K RAM: Z80: dual 8&quot; F/D (1MB): 12&quot;, 24x80 VDU: 55cps daisywheel printer: 2 S/P: 1 P/P: options - 150cps bi-directional printer, £2,000; 55cps W/P printer, £2,000.</td>
<td>CP/M: BASIC: W/P</td>
<td>S/H</td>
<td>S/H</td>
</tr>
<tr>
<td>SIMPELEC Mk III</td>
<td>As above</td>
<td>64K RAM: Z80: dual 8&quot; F/D (1MB): 1MB H/D: 12&quot;, 24x80 VDU: 55cps daisywheel printer: 6 S/P: 1 P/P: options - 150cps bi-directional printer, £2,000; 55cps W/P printer, £2,000; W/P VDU, £900</td>
<td>CP/M: BASIC: W/P</td>
<td>S/H</td>
<td>Up to 44MB H/D possible, £4,500 extra. Multi-user system with 208K RAM, £12,150.</td>
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<tr>
<td>SOLITARIE/BS</td>
<td>As above</td>
<td>64K RAM: 8085: dual 8&quot; F/D (960K): 14&quot; VDU (with own CPU): 45cps printer: CPU</td>
<td>DOS: W/P: speciali- sed B/P</td>
<td>S</td>
<td>As above</td>
</tr>
<tr>
<td>SOLITARIE/ HBS</td>
<td>As above</td>
<td>64K RAM: 8085: 10MB Fix H/D: 14&quot; VDU (with own CPU): 200cps printer: CPU port: option - up to 40MB H/D</td>
<td>DOS: W/P: speciali- sed B/P</td>
<td>S</td>
<td>Up to 8 interface terminals can be used: also available, HBS900 with 20-80MB H/D.</td>
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<tr>
<td>TANDY TRS 80 LEVEL 1</td>
<td>Tandy: 021 556 6101 (200)</td>
<td>4-16K RAM: Z80: C: 12&quot;, 16x64 b/w VDU</td>
<td>BASIC: games: I A</td>
<td>H&amp;S</td>
<td>16K machines include N/P: 4-16K upgrade, £120; without pad, £85</td>
</tr>
<tr>
<td>TANDY TRS 80 LEVEL 2</td>
<td>As above</td>
<td>4-48K RAM: Z80: C: 12&quot;, 16x64 b/w VDU: RS232 int: 1 P/P: option - single 5¼&quot; F/D (78K), £478</td>
<td>BASIC: games: I M/A: FOR TRAN: B/P</td>
<td>H&amp;S</td>
<td>4-16K upgrade, £380</td>
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</table>

### List of Abbreviations

- **C/P Commercial**
- **C/Commercial**
- **I** Introductory
- **E** Extensive
- **F/D Floppy disk**
- **1/S Indexed sequential**
- **F/P Parallel port**
- **B BASIC**
- **G/C Graphics card**
- **K/B Keyboard**
- **H Hardware**
- **M/A Macro assembler**
- **T/E Text processor**
- **C Cassette**
- **H/DD Hard disk**
- **I/S Indexted sequential**
- **S/P Serial port**
- **O/S Operating system**
- **N/P Numeric pad**
- **U Utility**
- **A Assembler**
- **S Software**
- **W/L Word length**
- **W/P Word processor**
- **B Business package**
- **TBA To be announced**

Please note: Software items listed in italic are not included in the basic price of the equipment. All prices are exclusive of VAT.
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<tr>
<td><strong>TECS</strong> (£1,600)</td>
<td>Technologies: 051 724 2695 (TBA)</td>
<td>16G K RAM: 6800: 8K PROM: RS232 port: C int: option — dual 5&quot; F/D (320K), £800</td>
<td>BASIC</td>
<td>H</td>
<td>256 char graphics; Prestel compatible; plug into standard TV</td>
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<tr>
<td><strong>TEI 212</strong> (£5,067)</td>
<td>As above</td>
<td>32-60K RAM: 8080/8085: dual 5&quot; F/D (630K): 1 S/P: 2 P/P: 20&quot;x17&quot;: option — 150eps printer, £1,250</td>
<td>DOS: BASIC: E</td>
<td>4K PROM</td>
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<tr>
<td><strong>TEI 212</strong> (£5,067)</td>
<td>As above</td>
<td>32-60K RAM: 8080/8085: dual 5&quot; F/D (630K): 1 S/P: 2 P/P: 20&quot;x17&quot;: option — 150eps printer, £1,250</td>
<td>DOS: BASIC</td>
<td>E</td>
<td>With graphics and N/P</td>
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<tr>
<td><strong>AIM 65C (£265)</strong></td>
<td>Pelco: 0273 722155 (4)</td>
<td>1-4K RAM: 6502: 12K ROM: full K/B: 20 char LED display: 20 char thermal printer: Cx2: RS232 port:</td>
<td>A: Dia A: T/E: 8K monitor in ROM</td>
<td>E</td>
<td>Available as S100 system with A or BASIC in ROM (£480) from Portable Micros (0280 702017): they also have briefcase version (£750)</td>
</tr>
<tr>
<td><strong>CROMEM- CO SC (£260)</strong></td>
<td>Comart: 0480 30505 (17)</td>
<td>1K RAM: Z80A: 8K EPROM sockets: RS232 port: 3 P/P: option — $100 bus.</td>
<td>Monitor and control BASIC in EPROM</td>
<td>E</td>
<td>5 program interval timers: can put own BASIC programs in EPROM</td>
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### IN STORE

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<tr>
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<tr>
<td>EXPLORER</td>
<td>Newtronics: 01-739 1582 (15)</td>
<td>4K RAM: 8085: Hex K/B: RS232 port: S100 bus: C int: options - 6 slot S100, £32; 8K EPROM sockets, £60</td>
<td>2K monitor: CP/M: BASIC</td>
<td>S &amp; H</td>
<td>Programmable 14 bit counter: kit</td>
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<tr>
<td>HEWART 6800S</td>
<td>Hewart: 0625 22030 (n/a)</td>
<td>16K RAM: 6800: full K/B: VDU int: 2xC int: 1 S/P: 2 P/P: option — 16K RAM, £90.</td>
<td>1K monitor: A: T/E</td>
<td>H</td>
<td>Can be upgraded with 6809.</td>
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<tr>
<td>HEWART 6800 Mk III</td>
<td>Hewart: 0625 22030 (n/a)</td>
<td>1K RAM: 6800: VDU board: options — single 5¼” F/D (75K), £350; PROM programmer, £32: calculator board, £45</td>
<td>1K monitor: H</td>
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<tr>
<td>Mk 14</td>
<td>Science of Cambridge: 0223 311488 (n/a)</td>
<td>8060: 1/4-2K RAM: Hex K/B: 7 char LED: options — VDU int (32x16 with graphics), £29; C int, £6; PROM prog, £10, 2K memory expansion, £15</td>
<td>Machine code H</td>
<td></td>
<td>Designed for control applications rather than high level computing expansion.</td>
</tr>
<tr>
<td>SBC 100</td>
<td>Airamco: 0294 57755 (11)</td>
<td>1K RAM: Z80: 8K ROM: S100 bus: 1 S/P: 1 P/P: option — voltage regulator.</td>
<td>1K monitor: DOS in ROM</td>
<td>E</td>
<td>Kit: available assembled, £196</td>
</tr>
<tr>
<td>SUPER-BOARD</td>
<td>NBM: 01-981 3993 (n/a)</td>
<td>4-8K RAM: 6520: 10K ROM: full K/B: VDU int: C int: options — RS232, single 5¼” F/D (100K), £316; 8K RAM, £185</td>
<td>BASIC in 8K ROM: games: B/P: Database</td>
<td>S &amp; H</td>
<td>Available with 32K RAM and single 5¼” F/D, £867</td>
</tr>
<tr>
<td>SYM-1</td>
<td>Newbear: 0635 30505 (n/a)</td>
<td>1-4K RAM: 6520: Hex K/B: 244 bps C int: VDU int: 2x6522 ports: option — TV int.</td>
<td>4K monitor: BASIC: A</td>
<td>S &amp; H</td>
<td>Can be expanded to 64K RAM</td>
</tr>
<tr>
<td>TRITON 4.1</td>
<td>Transam: 01-402 8137 (n/a)</td>
<td>2K RAM: 8080: 3K ROM: full K/B: 16x64 VDU or TV int: C int: 1 S/P: option — 2K RAM, £60</td>
<td>1K monitor: 2K S &amp; H BASIC: U</td>
<td>64 character graphics: 8 levels interrupt: kit</td>
<td></td>
</tr>
<tr>
<td>TRITON 5.1</td>
<td>As above</td>
<td>2K RAM: 8080: 4K ROM: full K/B: 16x64 VDU or TV int: C int: 1 S/P: C: options — 8K RAM, £97; 8K EPROM, £97</td>
<td>1K monitor: 2K ExBASIC: U</td>
<td>S &amp; H</td>
<td>Kit: assembled version, £393</td>
</tr>
<tr>
<td>TRITON 6.1</td>
<td>As above</td>
<td>2K RAM: 8080: 4K ROM: full K/B: 16x64 VDU or TV int: C int: 1 S/P: C: options — 8K RAM, £97; 8K EPROM, £97</td>
<td>2K monitor: 7K scientific BASIC in 8K EPROM or A: Dis A: U</td>
<td>S &amp; H</td>
<td>Either firmware package available for extra £110: CP/M compatible disk interface available soon.</td>
</tr>
</tbody>
</table>

### List of Abbreviations

<table>
<thead>
<tr>
<th>Abbreviation</th>
<th>Meaning</th>
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</thead>
<tbody>
<tr>
<td>C/P</td>
<td>Commercial package</td>
</tr>
<tr>
<td>E</td>
<td>Extensive</td>
</tr>
<tr>
<td>F/D</td>
<td>Floppy disc</td>
</tr>
<tr>
<td>G/C</td>
<td>Graphics card</td>
</tr>
<tr>
<td>H</td>
<td>Hardware</td>
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<tr>
<td>H/D</td>
<td>Hard disc</td>
</tr>
<tr>
<td>I</td>
<td>Introductory</td>
</tr>
<tr>
<td>I/S</td>
<td>Indexed sequential</td>
</tr>
<tr>
<td>K/B</td>
<td>Keyboard</td>
</tr>
<tr>
<td>K</td>
<td>Cassette</td>
</tr>
<tr>
<td>L</td>
<td>Link</td>
</tr>
<tr>
<td>M</td>
<td>Macro assembler</td>
</tr>
<tr>
<td>N</td>
<td>Numeric pad</td>
</tr>
<tr>
<td>O/S</td>
<td>Operating system</td>
</tr>
<tr>
<td>P/P</td>
<td>Parallel port</td>
</tr>
<tr>
<td>P/T</td>
<td>Text editor</td>
</tr>
<tr>
<td>S/W</td>
<td>Word processor</td>
</tr>
<tr>
<td>T/E</td>
<td>Text editor</td>
</tr>
<tr>
<td>TBA</td>
<td>To be announced</td>
</tr>
<tr>
<td>U</td>
<td>Utility</td>
</tr>
</tbody>
</table>

*Please note: Software items listed in italic are not included in the basic price of the equipment. All prices are exclusive of VAT.*

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---

PET is the trademark of Commodore.
USER GROUPS INDEX

NATIONAL
Amateur Computer Club — 2650 Library. No meetings, no newsletters, the library serves as a help point for disseminating 2650 related data on demand. Contact Roger A. Munt, 51 Beechwood Drive, Feniscowles, Blackburn, Lancs BB2 5AT (0254 22341).

Minicomputer Users in Secondary Education (MUSE). MUSE is the national organisation for coordinating activity in schools, teacher training institutions, colleges of technology and so on. Meetings are held both a regional and national basis. For full details on MUSE, range of activities, contact the Treasurer, R. Trigger, 48 Chadcote Way, Catshill, Bromsgrove, Worcestershire.

COUNTY DURHAM
Northeast PETS. Contact: Jim Corrigan, 20 Worcest Road, Newton Hall Estate, Durham. They meet the 2nd Monday of each month for software tuition and the 3rd Monday for hardware tuition (both in addition to normal activities). They start at 7.00p.m and meet in the PET L/S, newage of Polytouch, Ellison Building, Newcastle upon Tyne.

YORKSHIRE
Shipley College Computer Group (Sorcerer/6800). They meet Tuesdays (software) and Wednesdays (hardware/advanced) between 7.00 & 9.00 pm. Contact Paul Channell on Shipley 595751.

West Yorkshire Microcomputer Group. Formed following an inaugural meeting on October 23rd, a varied diary of events has been drawn up. For details contact the Chairman, Phillip Clark, Care Computer Services, 16 Selby Street, Leeds LS1 4DE (0532 450667) or the Secretary, Keith Knagggs, Price Waterhouse & Co., Leeds (0532 448741).

DIARY DATA

Birmingham, England
TV MEX. Monthbuid Ltd., 11 Manchester Sq., London W1M 5AB. Tel: 01-486 1951.

Wembley, England
Microsystems '80 Exhibition & Conference. Ifitte Promotions Ltd., Dorset House, Stamford St., London SE1 9LU. Tel: 01-261 8000.

Leeds, England
BEX — Business Equipment Exhibition. Douglas Temple Studios Ltd., 104h Old Christchurch Rd., Bournemouth, Dorset. Tel: 0202 20533

Solihurst, England

London, England

Wembley, England
IMEC — European Information Management Exhibition & Conference. Clayp & Poliak Europe Ltd., 232 Acton Lane, London W4 5DL. Tel: 01-995 4806.

Bournemouth, England

Swansea, Wales

Birmingham, England
IBA — International Instruments, Electronics & Automation Exhibition. Industrial & Trade Fairs Ltd., Radcliffe House, Benlem Court, Solihull, West Midlands, B91 2BD. Tel: 021 729 7076.

Birmingham, England
Computermarket '80, Couchmead Ltd, 42 Great Windmill Street, Birmingham, England TV MEX. Montbuild Ltd., 104b Old Christchurch Rd., Bournemouth, Dorset, Tel: 0202 20533.

Birmingham, England
Conference. Clapp & Poliak Europe Ltd., 232 Acton Lane, London W4 5DL. Tel: 01-995 4806.

Leech, England
IMEC — European Information Management Exhibition & Conference. Clayp & Poliak Europe Ltd., 232 Acton Lane, London W4 5DL. Tel: 01-995 4806.

Liverpool, England
Mersey Micro Show. Online Conferences Ltd., Cleveland Road, Uxbridge UB8 2DD. Tel: 0895 392626.

London, England
Microcomputer Show. Online Conferences Ltd., 42 Great Windmill Street, West Midlands, B91 2BD. Tel: 0202 20533.

Birmingham, England
Computer Graphics '81 Exhibition. Online Conferences Ltd., Cleveland Road, Uxbridge UB8 2DD. Tel: 0895 392626.

TRANSACTION FILE

For sale
MK.14... extra RAM, single key, cassette interface, 2 PSU’s, data streets, manual, Greenwood Programming the SCMP, Sysex Introduction to Microcomputers needs replacement for keyboard, also early articles on MK.14 — will deliver within reasonable distance of Preston, Lancs. Phone Preston 55591 events & weekends.

Teletype KSR33... 20mA current loop, auto sleep/start with full manuals, extra paper ribbons & spares — £110. Trilon Computer... full on-board PSU, working order, full documentation and weekends.

15 Dynamic RAM Chips... MK.4027N. £4.25 the lot. Also expansion for SW79 6800 systems parallel interface board, MPLA and calculator interface board (number crancher). MPN: both built and tested but unused, £30 each. Phone Walsall (0924) 20496 after 6pm or weekends.

Nascom 1... expansion bus, buffer board, 8K memory board, CC Soft

For £100. Phone Jim on Gorton (Herta) 799733, evenings.

CASIO FX-502P... in new, plus Casio FA-1 adapter for laping programs, program library, manuals, keyboard overlay, tape, etc. All boxed and as illustrated in PCW October issue (page 50). I'm buying a larger computer £200 the lot o.n.o. Phone 01-959 1243.

Trilon Computer... including programs, cassette, extended Tiny BASIC. Ready built and tested for only £155 (run at 18 MHz). Phone 01-859 0323.

Nascom 1... built and tested by Nascom and fitted with the latest NAM-SYS I on-board. Program documentation and PSU — £175 o.n.o. Phone Colchester 747891.

Centronics 700 Printer... with RS232 interface, line length programmable to 12 chars, standard and double with character - £400 o.n.o. Phone Dave on 01-460 2580, evenings.

PCW 91
test condition - £435.
IEE/R532 Serial Interface B. input/output for PET, cost £205, sell £140.

Teletype 'AS33', terminal/prINTER R532 is now, not cleared out - £450 (stand available). Phone Medway (0634) 53127, evenings.

Triton... 8080 based machine, built & working, LS1 monitor & upgraded clock, 4K RAM and Tiny BASIC in ROM. All documentation included - £250. Contact John Wheatley at 12 Shakespeare Road, Harpenden. Herts - phone Harpenden 63593.

Mk.14... with RAM 1/0, extra RAM, tape interface, FROM programmer, PET keyboard, full documentation, professionally cased into desk-top unit, size 11"x6½x2¾" (dropped from with room for 2K expansion and VDI Interface) - £63. Phone 08444 4537.

Teleprinter '54... Baudot coded, full instruction KB- and printer 10 baud interface etc. - £55 o.n.o. Mark Whylle on Hertford 59051.

Sinclair Cambridge Programmable... with full instructions, Duracell battery, Sinclair & Personal Program Library £9.99 plus £1 postage, Martin Fisher, 10 Chestworth Lane, Doncaster, S. Yorks DN5 8YL.

SWTP R40 Printer... adapted for Sorcerer, 32K... with all leads, manuals and software-library. Has additional program library for sale; mint condition - £120 only. Contact Terry Cymbalthe, 45 St Leon Road, Edgeley, Stockport, SK3 0TX - Phone 061 652 073, evenings.

Texas TL-59... plus PIC100-C print cradle. Programmable calculator inclu- des programming steps, 50K, electronic circuits, and magnetic card reader. Also latest printer capable of alphanumericics. Both items less than 9 months old - owner is up- grading, Price £199 for the pair, but separate sale considered. Phone 01-368 2762, evenings.

ROM Chips... two MM254Q4 with ETBUC 1 and 2 (for blank), £4 each; £3, DM8678 R6N-£7. Contact S. Ross, 44 Premier Avenue, Grays.

SWTPC 6800... 4K static RAM board (50 bus) - £40. Phone 01-500 8956.

Compcorp 3625 Accountant... learn mode programmer for 256 steps; ten data storage registers; prints up to 14 digits. Complete with card reader for programming (or it can be program- med from keyboard). Phone Telford 3490.

Digital Equipment Corp. RT01 Data Terminal... less display boards and displays (2 available), 110 baud, RS232 and teletype interface, £40 each or £70 the two. Also consolidated computers terminal (inc. VDU), £100 - all with circuits. Details, phone 01-837 8855, ext. 222, weekdays.

Super Nascum 1... extended with 18K RAM, 2400 baud interface circuit, 8K BASIC on tape. Housed in Veroframe with keyboard in professional case. All this and lots of software for £320. Phone Dave Link on 01-340 9682.

ELF 11... system with giant board, 8K RAM, VID, ASL, built heavy duty PSU, in ELF cabinets. Fully socketed and professionally checked in good working order. Also Tiny BASIC, 16 games on tapes, Full documentation, over £200, best offer buys. Phone 01-560 0793.

PET 2001-4K... new, green screen, BASIC BASIC tape, manuals of instruc- tion and various taped games. Ideal if you bought HFV 9 weeks old, perfect condition. Phone 01-668 6155.

Texas 9900... 16-bit micro board, double Eurocard - £100 o.n.o. (see March '79 PW). Contact Mark Wirt, 12 Allies Crescent, London SE21; phone 01-470 4819.

TL58... programmable calculator, 480 steps, 60 memories - £65 o.n.o. including mains adaptor, master and statistics library. Contact Brian Holley on Hoddesdon 66513, evenings or week- ends.

Wanted

Triton Users... help - LA BASIC FROM listing required (18MHz version). Contact Stevenage 62680 anytime.

YOU ARE WITHIN 50m. OF THE FLOOR OF THE TRENCH. WM1CM IS 40M. WIDE AND 100M. IS 20M. WIDE AND 50M. LONG AND IS CENTRED ON CO-ORDINATES (0.01. IF, WHEN YOU NAVIGATIONAL SYSTEMS MUST BE CALIBRATED 2000M. ilium THE VENT BY FLYING OVER A TORPEDO INTO A VENT SHAFT LEADING TO THE DEATHSTAR’S NUCLEAR REACTORS.

YOUR FIGHTER TO A TRENCH IN THE STAR’S SURFACE, FLY ALONG IT AND LAUNCH THE WHICH TO ATTACK THE GIANT ARTIFICIAL PLANET, THE OEATHSTAR, WHICH THE TYRANT, 970

YOU ARE THE PILOT OF A REBEL 0 -WING FIGHTER. CARRYING A PROTON TORPEDO r/Tm INPUT

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YOUR FIGHTER TO A TRENCH IN THE STAR’S SURFACE, FLY ALONG IT AND LAUNCH THE WHICH TO ATTACK THE GIANT ARTIFICIAL PLANET, THE OEATHSTAR, WHICH THE TYRANT, 970
WIN & FUN

ALIEN ATTCK

by Peter Wright

This program, written for PET will work instructions (with one spelling mistake) with or without a sound box. Full are included in the program.

IF$="e0RA$="="THEN43
50 IFM=1THENM=-1:00T050
42 007050
41 IFR$="e0RA$="="THEN43
40 IFXD32806THENN=-1
30 IFX(327G9THENM=1
10 PR1NT":70114INKCP10110101M0101101"
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14 Rathbone Place
London W1P 1DE,

96 PCW

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PROGRAMS

- FB06 10929
- FB06 21 0930 HRV: POP HL ;THROW AWAY TWO RETURNS
- FB07 11 0931 POP HL
- FB08 EB 0932 NOTVAL: EX DE,HL ;WRITE 'DB'
- FB09 36 44 0933 LD (HL),"D"
- FB0C 23 0934 INC HL
- FB0C 35 42 0935 LD (HL),"
- FB0E 11 32 10 0936 LD DE,BUFFER+3;SET FOR OPERAND
- FB0E 21 18 10 0937 LD HL,BUFFER+3;SET FOR OPCODES
- FB0E 36 20 0938 LD A,"
- FB0E CD 17 F9 0939 NULP: CALL DOLLAR ;WRITE 'D'
- FB0F CD 25 F9 0940 CALL COPIE2 ;COPY OVER OF
- FB12 23 0941 INC HL ;PAST SPACE
- FB12 BE 0942 CP (HL) ;IS ANOTHER THERE?
- FB13 CB 0943 RET Z ;NO,DONE
- FB1D CD 11 F9 0944 CALL COMMA ;WRITE ',人的'
- FB1F 18 F2 0945 JR NULP ;COPY IT OVER
- FB45 0946 ;
- FB45 END

CROSS REFERENCE

- ABC3BC PCB9 0842
- ABCDFL PCB0 0131 0795
- ADDR 1003 0047 0072 0185 0167 0541
- AMTH FLX1C 0096 0126 0142
- ARTAB FA3A 0288 0403 0769 0794
- AUTO FB09 0805
- BRM FB0A 0823 0356
- BRSTAB FB0B 0723
- BSF F881 0575
- BUFFER 1012 0060 0066 0050 0214 0530 0562 0559 0174 0717 0821 0936 0937
- BYOUT FB04 0202
- CB8F FB06 0059 0276 0278 0361 0382 0356 0718 0749
- CAJETC FA33 0140
- CB FCWF 0619
- CBWCT FBBF 0135
- CODES FABB 0317 0458 0534
- OCTAB FA88 0472
- CJR FATA 0114 0118 0122 0130 0134 0138 0143 0146 0149 0153
- CORTAB FASH 0448 0537 0873
- COMMA FA91 0275 0294 0335 0462 0535 0508 0526 0687 0551 0596 0703 0742 0944
- COP12 F925 0130 0350 0474 0485 0527 0528 0715 0783 0832 0940
- COP15 F923 0255 0289 0405 0493 0505 0595 0103 0346 0730 0759 0833 0863 0874 0913 0925
- COP16 F924 0459 0471 0495 0485 0512 0595 0582 0837
- COP15 F916 0576
- COP16 F910 0553
- DEC F934 0123 0135 0139
- DECFA F94A 0255
- DECODE F85A 0059
- DL F8B6 0572
- DJNZ FB12 0521
- DJN2M FB18 0511
- DOLLAR F917 0283 0373 0383 0496 0939
- EADDR 1007 0049 0051
- EJ FB88 0621
- EACHART F849 0129
- EXKARY F85F 0552
- EXTND F008 0431
- EX F077 0634
- FXAD F92A 0103 0347 0355 0445 0449 0473 0484 0729 0758 0775 0822
- HALT FA12 0328
- HALT PM 0189
- HEX1 F8C1 0157
- HEX2 F8B8 0174 0176 0195 0374 0384 0499
- HEX8 F800 0074 0284
- HXYFSL F007 0071 0315 0354 0357 0438 0710
- HXTTAB F047 0353
- HX F095 0888
- I FAX9 0338 0597 0507
- IE FB92 0618
- INC F927 0119 0121 0137
- INCM F9C7 0253
- INITB FB27 0056
- INM F9B6 0594 0819
- IR FB99 0904
- LRTAB F8CA 0253
- JPETC FB67 0120
- JFB F826 0549
- LAB F88F 0408
- LABL8A 100C 0282
- LABELL 101 0170 0208
- L01 F2C8 0406 0555 0595 0705
- L016 F920 0115
- L016A F927 0482 0590
- L016B F930 0543
- L016C F245 0674 0650
- L016D F21B 0132
- LASP F8BE 0635
- LEXEA 103C 0073
- LD10B F940 0284 0125 0141

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3D NOUGHTS AND CROSSES
The game is played on the 6x6 cells of a 4 x 6 x 4 cube. Each 10 matchstick moving from one cell to another. The computer marks the empty cells.
MAINTENANCE
The player chooses the difficulty of the game by defining the number of cards to be used (1 to 10) and the width of the cube bars (4 to 6 columns). The scoring is done in the conventional way using a ' 1 ' to denote a black cell and a ' 2 ' to denote a white cell.
MEMCARD
There are no rules as to how many. Yet, MEMCARD will make the game last longer. The program can choose a black cell or a white cell. The longer the game, the slower the computer: £3.00
32Ks
BASED
Professionally made double sided PCB with plated through holes and gold plated edge connector.
Base memory held as to the number of times a card is used. A record is kept as to the number of times a card is chosen. The scoring is based on probability and as the game progresses and the cards become scarce, the bonus increases.
BELL & WHISTLE
PLANET NAME GENERATOR
by Derrick Daines
Recently I was working on a very long and complex program that involved names of planets. As the player was visiting several planets in outer space, it was necessary to generate outlandish but pronounceable names for these planets. I estimated that the following routine will generate around 300 million different names. If you are tempted to change any of the syllables then I recommend that you try them out in private – the results can be acutely embarrassing! My favourite name is AX-TEPAXTEP, don’t ask me why. Incidentally, if you use a PET you need to put an integer in the brackets following RND.
0100 GOSUB 1000
0110 PRINT "YOU ARE ON THE PLANET "; NS
0120 ETC....
0180 REM - NAMING SUB
0190 REM - FIX NUMBER OF SYLLABLES
0200 N=INT(RND(8)+3)+2
0210 NS=""""""
0220 FOR X=1 TO N
0230 REM - FIND SYLLABLE
0240 FOR Y=1 TO INT(RND(8)+5)+1
0250 READ CS
0260 NEXT Y
0270 NEXT X
0280 RETURN

PCW is always on the lookout for original programs.
A very good response to our 'Palindromic' Leisure Lines (over 60 entries) despite the fact that some kind of computerised aid was necessary for the solution — or, alternatively, one hell of a lot of spare time!

In fact, all the answers received were correct ones and the answers are as follows:
1. Alan & Bert's miles are palindromic after 321123 miles.
4. All three miles mutually palindromic after 655666 miles.

Thanks to Dave Tebbutt's ability to generate random numbers with extreme rapidity on a borrowed PET (and with Sue Eisenbach on hand to ensure fair play and no program bugs) we were quickly able to select a winning entry — from S.T.M. Ratcliffe, 105 Fordwater Road, Chertsey, Surrey, KT16 8HH.

Congratulations, Mr. Ratcliffe, £10 worth of stamps are on their way — courtesy of the PO.

**QUICKIE**

Short and snappy for this month, and as usual, no solutions and no prizes.

Which number, when added to 1¼ gives the same result as when it is multiplied by 1¼?

**PRIZE PUZZLE**

Again, fairly brief for this month.

This time I'd like you to find the smallest palindromic number that is also perfect square, and which contains an even number of digits. Thus 121 is a perfect square — and also a palindromic number — but unfortunately it contains an odd number of digits.

**THIS MONTH'S PRIZE**

For the lucky winner, a Paper Mate Pen & Pencil set — finished in olive green and gold.

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**BELLS & WHISTLES**

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**BLUDNERS**

November: FAX (sorry!) contained the following non-facts: The second half of columns 5 and 6 should refer to following non-facts: The second half of columns 5 and 6 should refer to the Po.

December: Page 34 shows a picture of the 68000, not the 6800 as stated.

---

**WHIPPLE**

 robot as 'Your Plastic Pal Who's Fun To Be With'.

The Hitch Hiker's Guide, however, defines the marketing division of the Sirius Cybernetics Corporation as "a bunch of mindless jerks who'll be the first against the wall when the revolution comes". It also has a footnote saying it is looking for someone interested in becoming its robot correspondent.

Douglas Adams also tells us that, thanks to an Encyclopedia which conveniently fell through a time warp in a thousand years in the future, the publication had to eventually record that "the marketing division of the Sirius Cybernetics Corporation was a bunch of mindless jerks who were the first against the wall when the revolution comes."

For those like me who got a taste of the Hitch Hiker's Guide on radio (it was first broadcast in March 1978 and has been repeated a few times since the book is an enjoyable read filling out the airwaves flesh with many rich asides and jokes. I am sure some radio addicts may savour the book with less relish, but for anyone who approaches the book afresh, there is a treat in store.

Books discussed in this month's Bookstore have been:

- The Conquest of Will by Abbe Moussouzi (Addison-Wesley, £8.20)
- Inside Information by Abbe Moussouzi (Addison-Wesley, £7.35)
- The Hitch Hiker's Guide to the Galaxy by Douglas Adams (Pan 80p)

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14 = PRINT SUPPLIER STATEMENTS
15 = PRINT AGENTS STATEMENTS
16 = PRINT QUARTERLEY TAX STATEMENTS
17 = PRINT WEEK/MONTH SALES
18 = PRINT WEEK/MONTH PURCHASE
19 = PRINT YEAR AUDIT
20 = PRINT PROFIT/LOSS ACCOUNT
21 = UPDATE ENDMONTH FILES
22 = PRINT CASHFLOW ANALYSIS
23 = ENTER PAYROLL
24 = *PRINT CUSTOMER STATEMENTS
25 = *PRINT SUPPLIER STATEMENTS
26 = *PRINT AGENTS STATEMENTS
27 = *PRINT QUARTERLEY TAX STATEMENTS
28 = *PRINT WEEK/MONTH SALES
29 = *PRINT WEEK/MONTH PURCHASE
30 = *PRINT YEAR AUDIT
31 = *PRINT PROFIT/LOSS ACCOUNT
32 = *UPDATE ENDMONTH FILES
33 = *PRINT CASHFLOW ANALYSIS
34 = *ENTER PAYROLL

WHICH ONE (ENTER 1 TO 24)

EACH PROGRAM GOES IN DEPTH TO FURTHER EXPRESS YOUR REQUIREMENTS.
FOR EXAMPLE (9) ALLOWS:

a. list all sales; b. monitor sales by stock code; c. invoice search;
d. amend ledger files; e. total all sales

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<table>
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<tr>
<th>Configuration</th>
<th>Base Price</th>
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<td>4K RAM</td>
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<td>16K RAM</td>
<td>£ 865</td>
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<table>
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<td>32K RAM</td>
<td>£ 1790</td>
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</table>

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- **C3-C** – 29 million byte Winchester disk based system

<table>
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<th>Configuration</th>
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<td>48K RAM</td>
<td>£ 6320</td>
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<tr>
<th>Description</th>
<th>ex. VAT</th>
<th>inc. VAT</th>
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<td>4K Level 2</td>
<td>434.78</td>
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<td>16K Level 2</td>
<td>500.00</td>
<td>575.00</td>
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<td>0K Interface (to add printer &amp; disk drives)</td>
<td>195.66</td>
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<td>16K Upgrade kits (for Kbd or interface)</td>
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<td>Disk Drives, single (up to 200K)</td>
<td>260.88</td>
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<td>Disk Drives, dual (up to 400K)</td>
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<td>Disk Drives, dual (up to 2000K)</td>
<td>1521.74</td>
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<td>Disk Drives, cable 2 &amp; 4 way from Anadex Printer, Tractor feed</td>
<td>21.74</td>
<td>25.00</td>
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<td>Printer cable for Anadex/Centronics</td>
<td>456.63</td>
<td>525.00</td>
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<th>Description</th>
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<tr>
<td>Listing Paper, Continuous Forms. Labels.</td>
<td>£782.61</td>
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<tr>
<td>Post/Packing/Insurance extra. Delivery by Registered Post, Securicor, etc.</td>
<td>£40 inc VAT</td>
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<tr>
<th>Type</th>
<th>Description</th>
<th>Price</th>
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<tbody>
<tr>
<td><strong>Type B</strong></td>
<td>Bidirectional serial interface is fully addressable and can have split BAUD rates</td>
<td>£186</td>
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<tr>
<td><strong>Type C</strong></td>
<td>Serial interface - output only</td>
<td>£120</td>
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<tr>
<td><strong>Type CS</strong></td>
<td>Serial interface output only with switchable character sets to match the new PET's lower case Screen mode</td>
<td>£132</td>
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All interfaces are crystal controlled and are available with Special code conversions (ASCII/EBCDIC etc) by return (P.O.A.)

Small Systems Engineering Ltd in the UK and do not exhibit any of the anomalies that are found in certain imported devices.

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<th>Type</th>
<th>Description</th>
<th>Price</th>
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<tr>
<td><strong>Type G.P.I. A.P.</strong></td>
<td>Micro-based, bidirectional with buffering. The General Purpose Interface allows free use of PET's INPUT # statement without hangup problems. Software changeable BAUD rates and many other useful features</td>
<td>£249</td>
</tr>
</tbody>
</table>

| Addressable parallel (disk compatible) | £106  |
| Non addressable parallel              | £45   |
| TV/Video monitor interface            | £35   |

**PET MEMORY EXPANSION BOARDS INTERNALLY MOUNTED**

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<tr>
<th>Size</th>
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<td>24K</td>
<td>£328</td>
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<td>32K</td>
<td>£432</td>
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**S100 BOARDS**

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<th>Dynamic Memory Boards</th>
<th>Description</th>
<th>Price</th>
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<tr>
<td><strong>IEEE-S100 Specification Timing</strong></td>
<td>Transparent on Board Refresh 4Mhz Z80 Operation with no wait states. Fully tested and Burned In Bank Select versions available - North Star, Cromemco and Alpha Micro Port Bank select. Bank Size to 64K in 16K increments</td>
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<th>Size</th>
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<tr>
<td>64K</td>
<td>£487</td>
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<td>48K</td>
<td>£397</td>
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<tr>
<td>32K</td>
<td>£304</td>
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<th>Description</th>
<th>Price</th>
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<tr>
<td><strong>Incomplete Record Accounting</strong></td>
<td>£450</td>
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<tr>
<td><strong>Time and Cost Recording</strong></td>
<td>£300</td>
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<tr>
<td><strong>Job Costing</strong></td>
<td>£300</td>
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<td>£250</td>
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<td><strong>Sales Ledger</strong></td>
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<td><strong>Purchase Ledger</strong></td>
<td>£300</td>
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<tr>
<td><strong>Selective Name/Address Reporting</strong></td>
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