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At the heart of any Cromemco graphics system is Cromemco's "SDI" board, the most versatile video interface in the microcomputer industry today. The Cromemco SDI is designed to meet the challenge of professional and industrial environments where uncompromising performance, reliability, and continued compatibility are essential. With its high point resolution, colour map selection, dual-page windowing function, automatic fill mode, and NTSC or PAL broadcast compatibility, the most demanding requirements for a video interface can be met. The SDI provides a choice of 4096 individual colours and up to 754 by 482 point resolution. Its different modes of operation include bit or nybble mapped displays with varying levels of resolution, and window effects requiring as little as 12k data storage.

**RGB-13 Colour Monitor**
The Cromemco RGB-13 Colour Monitor has been specially designed for optimum colour graphics performance when used with Cromemco's SDI video interface. It includes a fine-pitch 13" CRT with a high-precision electron gun, internal magnetic shielding, and implosion protection band. The monitor combines alphanumeric character generation with colour graphics and high resolution, to give an overall performance vastly more superior than conventional colour TVs or CRT terminals.

**Graphics Software**
Cromemco's graphics software package provides an interface to Fortran IV, Rattr, Macro Assembler, 16K Extended Basic and 32K Structured Basic. It is written for ease of use and takes full advantage of the RGB-13 monitor's special graphics facilities. Thus it is efficient, flexible and extremely fast. The package contains routines to change the colour map, scale the display area, draw dots, lines and circles, display text, and fill areas with colour. Screen addressing can be by absolute or relative co-ordinates.

**Model Z2H/GS Graphics System**
The Z2H/GS is a special configuration of the Z-2H Hard Disk computer which includes full graphics capability and software. Yet at under £8,000 it's a fraction of the cost of comparable systems. It is ideal for applications in medical imaging, computer-aided instruction, pattern recognition, and the television industry.

The Z2H/GS includes a Z-80A processor, 64k of RAM memory, integral 11 megabyte hard disk, RGB-13 colour monitor, 2 floppy disks, printer interface, RS-232 serial interface, and graphics software package.

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Ordering and pricing information:  
(applicable to Z80, 8080 and 6502 versions)

HDBS...MDBS...DRS...QRS...MDBS-DRS...MDBS-RTL...MDBS-QRS

<table>
<thead>
<tr>
<th>Package</th>
<th>Price</th>
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<tbody>
<tr>
<td>HDBS</td>
<td>£235.00</td>
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<tr>
<td>MDBS</td>
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<td>DRS</td>
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<td>RTL</td>
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<tr>
<td>ORS</td>
<td>£300.00</td>
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<tr>
<td>HDBS upgrade to MDBS</td>
<td>£400.00</td>
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<tr>
<td>MDBS with DRS, RTL and ORS</td>
<td>£560.00</td>
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<tr>
<td>HDBS/MDBS Manual</td>
<td>£30.00</td>
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<tr>
<td>DRS Manual</td>
<td>£5.00</td>
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<td>RTL Manual</td>
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<tr>
<td>ORS Manual</td>
<td>£5.00</td>
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<tr>
<td>System Specific Manuals each</td>
<td>£5.00</td>
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</tbody>
</table>

Within a given operating system, add £240 for each additional language selected.

When ordering, specify intended use with...  

1. North Star DOS and BASIC
2. CP/M - Microsoft BASIC 4.XX
3. CP/M - Microsoft BASIC 5.XX
4. CP/M - Microsoft Basic Compiler or FORTRAN 80
5. CP/M - Micro Focus CIS COBOL
6. CP/M - TRSDOS/NEWDOS and TRS-DOS BASIC (Models I and II)
7. CP/M - InterSystem PASCAL/Z
8. CP/M - Digital Research PL/I
9. CP/M - Micro Focus CIS COBOL
10. TRSDOS/NEWDOS and TRS-DOS BASIC (Models I and II)
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<th>5¼&quot; SINGLE SIDED SINGLE DENSITY</th>
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<th>LOW PRICES</th>
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<td>DOUBLE SIDED DOUBLE DENSITY</td>
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<td>Refill Pack</td>
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For use with our Polymer Plastic Boxes

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<th>8&quot; Saver Kit</th>
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<tbody>
<tr>
<td>Refill Pack</td>
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Each program takes no more than 35 seconds per employee for build up to gross, net pay calculation, and printing a payslip in duplicate.
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Since its introduction the Sharp MZ-80K has proved to be one of the most successful and versatile microcomputer systems around. Sharp now have a comprehensive range of products ready to make the powerful MZ-80K with its Printer and Disc Drives even more adaptable.

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(state which)

<table>
<thead>
<tr>
<th>Matrix 1 = Matrix 2</th>
</tr>
</thead>
<tbody>
<tr>
<td>2 Matrix 1 = Matrix 2 + Matrix 3</td>
</tr>
<tr>
<td>3 Matrix 1 = Matrix 2 − Matrix 3</td>
</tr>
<tr>
<td>4 Matrix 1 = Matrix 2 ★ Matrix 3</td>
</tr>
<tr>
<td>5 Matrix 1 = Expression ★ Matrix 2</td>
</tr>
</tbody>
</table>

1 Matrix Functions on a chip see detailed panels
2 Fully integrated with Basic
3 Does not interfere with toolkit
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<table>
<thead>
<tr>
<th>Model</th>
<th>User Ram</th>
<th>exc.VAT</th>
<th>inc.VAT</th>
</tr>
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<tbody>
<tr>
<td>Sharp MZ80K 20K RAM</td>
<td>375</td>
<td>431.25</td>
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<td>Sharp MZ80K 36K RAM</td>
<td>420</td>
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<tr>
<td>Sharp MZ80K 48K RAM</td>
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<td>529.00</td>
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<td>Sharp MZ80FD Floppy Disk</td>
<td>576</td>
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<td>Sharp MZ80P Printer</td>
<td>372</td>
<td>427.80</td>
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<tr>
<td>Sharp MZ80I/O Input/Output Unit</td>
<td>87</td>
<td>100.05</td>
<td></td>
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</tbody>
</table>

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<table>
<thead>
<tr>
<th>Model</th>
<th>User Ram</th>
<th>exc.VAT</th>
<th>inc.VAT</th>
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</thead>
<tbody>
<tr>
<td>3008 (4008) 40 Col. PET 8K Mem.</td>
<td>378</td>
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<tr>
<td>3016 (4016) 40 Col. PET 16K Mem.</td>
<td>462</td>
<td>531.30</td>
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<tr>
<td>3032 (4032) 40 Col. PET 32K Mem.</td>
<td>585</td>
<td>672.75</td>
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<tr>
<td>8032 80 Col. PET 32K Mem.</td>
<td>755</td>
<td>868.25</td>
<td></td>
</tr>
<tr>
<td>3040 (4040) 347K Disk</td>
<td>585</td>
<td>672.75</td>
<td></td>
</tr>
<tr>
<td>8050 1M Byte Disk</td>
<td>755</td>
<td>868.25</td>
<td></td>
</tr>
<tr>
<td>4022 Printer</td>
<td>357</td>
<td>410.55</td>
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<tr>
<td>8024 Printer</td>
<td>975</td>
<td>1121.25</td>
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<tr>
<td>C2N Cassette</td>
<td>47</td>
<td>54.05</td>
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<th>TTL 74 (TEXAS) Series</th>
<th>74LS Series</th>
<th>74 Series</th>
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<tr>
<td>7400</td>
<td>74LS04</td>
<td>74HC04</td>
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<tr>
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<tr>
<td>7405</td>
<td>74LS10</td>
<td>74HC10</td>
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O' Connectors (Gidget type):
- 9 way: 590
- 10 way: 1020
- 11 way: 1150
- 12 way: 1280
- 13 way: 1410
- 15 way: 1870
- 20 way: 3780

DIL Plugs (clear socket):
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- 18 pin: 1640
- 20 pin: 1980
- 22 pin: 2320
- 24 pin: 2660

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It is time somebody seriously started thinking about the idea of having a licence sold with every computer and it is time we worked towards the idea of this law being strictly enforced.

No, this one will not go down easily. People hate being monitored, being licensed, being checked up on, given permission, but I'm not really worried about ordinary people: I'm worried about the Home Office.

All things equal, some people believe that the computer is coming into our lives as fast as the car did. Possibly faster, although we won't really know that until today's primitive toys give way to something capable of actually remembering apparently trivial facts stored in a totally different context a year or two before.

Real computers make a mockery of the idea that we have a right to privacy. One might as well talk of a right to walk the streets; try it and see what the next juggernaut driver says. We give up certain rights in exchange for our toys. Afterwards, we may regret the bargain but with the phone and the computer, the price paid is privacy.

If we can't have privacy, we ought to see what it is that makes privacy precious and try a substitute.

One thing that makes privacy precious is that nobody can go around telling our friends what we do, if we 'keep ourselves to ourselves'. They can imply, cast slurs, refer sarcastically to the goat-skin rug with padlocks but nobody need believe them and we can go on painting daffodils red and spreading the Collected Works of Paul Neil Milne Johnston on the floor of the larder, without anybody knowing. And people forget.

Computers don't; you may not remember entering in your computer diary the observation that 'the Joneses have just installed central heating' but the hardware will. It probably won't realise that you didn't mean it at the time but be referring to the amount of brandy consumed at the party the Joneses threw:

It probably won't realise that you don't know that until two years later, you may have forgotten. When, therefore, the Joneses install central heating, your computer may, if you ask it how their home is heated, say, 'They installed central heating two years ago' and you, trusting the machine more than your memory, will ask them if they've gone potty.

The Home Office, however, believes that all records are clearly open. If I may quote the person who set up the Australian Special Branch (and got it kicked out of Australia by an enraged Government, for a system which was a lot less prying than the UK's system) if a chap doesn't want a file kept on him, then he's got something to hide and I'd say that is exactly the sort of chap you ought to have a file on. We certainly ought to have a file on the Home Office.

If, one day, we should get such a law, I know exactly what the Home Office will do.

In its customary, paranoid, megalomaniac belief that only employees of the Home Office are to be trusted with false facts about those of us not qualified to be in the Home Office, the Home Office will secretly tell its employees that they may have a personal computer. And clerks will be encouraged to make themselves 'more efficient' by keeping personal facts in a personal computer. Personal facts will be such things as you and me installing central heating, or failing to pay for something we didn't buy, or attending a Home Office Meeting, or Writing Rude Things in PCW About the Home Office in a Subversive Tone, or whatever. And there won't be an 'official file' on you and no record of the 'personal' computer which actually holds it.

Just to enhance your paranoia, the Metropolitan Police is rumoured to be starting up a Personal Computer Users' Club, meetings of which will not be open to the public...
Sinclair does it again

By the time you read this, there will be more Sinclair computers around than PETs. A year ago even ZX80 stone dead, you may think, by launching the ZX81. But this is a different world from that. The new machine may be cheaper than the old (£70 instead of £100) and it may be prettier (hence more popular, white instead of white) and it may be a lot better at BASIC, having finally learned about fractions and mathematics and it may be a lot easier to use (with extra features such as one to see if something is being printed and 'most important of all, it may even have overcome that ancient failing - flicker, but really, it has killed the MicroAce stone dead. The flicker on the ZX81, for those of you who have one, was caused by the fact that the computer chip had to stop its ceaseless and remorseless generation of television image every time the machine's owner pressed a key on that keyboard. It had to recognise the key and decide what to do about it before coming back to the video display and finding the frame sync had gone out of sync.

The new machine normally runs a lot slower than the old ZX80. This is because it is a lot more trouble to keep it running than the old BASIC instruction so that the screen image is being generated.

The new machine can, however, run around the same speed as the old if it is in the BASIC instruction. FAST then it forgets all about the screen until either it is told NORMAL, or it isprocessor running and returns to command mode.

Of new instructions, there are quite a few. The one I’m most pleased to see is INKEY$ which is not a dollar with a smudge, but a single character string read from the keyboard.

INKEY$ instruction makes it possible for people who don’t have a good grasp of 808 machine code to get a function from the keyboard without stopping the program with an INPUT statement. On the screen, a KIlongon war charger is nearly centred in the cross-hairs of your pilot’s attack bridal and naturally darts away to the left but the pilot quickly shifts his fingers on that keyboard back onto target and POW (or, more prosaically, a string of numbers races past, fast if you press the number nine, slowing down as you get nearer the scene you want but not at all if you type 6 or 5, and finally creeping along at one a second, when the number 0 is pressed). You can’t do that in most BASICs except on the Tandy TRS-80 and its INKEY$ instruction. The drawback is that one can only use it once. No matter how long you hold it down it won’t repeat, which is a pity, because the INKEY$ will spout a fountain of key codes and SINCLAIR informs you if the key has been kept down, or has been lifted and pressed again.

No doubt people will fuss about the appearance of graphics with a PLOT statement and an UNPLOT to match it but frankly, with only 64 by 44 pixels, this won’t give the world much more than Android Nim and a few histograms, and, prettier chess pieces. Inside the machine, the first thing you notice is that 18 of the chips that were in the ZX80 have vanished and in their place in the ZX81 is a single, big. Ferranti-built special. That chip, based on a technology called collector diffusion isolation, is important because it cuts the number of chips down, which cuts the amount of work down in making it. More to the point, it is not going to be a simple job copying it.

Last year, the Barnet-based Comp Shop was able to study the ZX80 and have an imitation ready to market almost before Clive had the original available because all that was really needed was to reproduce the ROM chip which understood Basic. And the Barnet Mafia, as they have come to be called, could do that quicker than Uncle Clive could.

It is worth remembering that Sinclair is rumoured to have got something like £10,000 or £15,000 cash from Chris Cary of Comp when they signed a deal giving the Cary MicroAce the US kit market, and it will be remembered, too, that the Cambridge Cosa Nostra (as Clive himself phrased it at the time) commented, ‘We mustn’t waste time arguing in the courts - this product is a nine months’ wonder and we have to use every month. That was nine months ago.

Apart from preventing copying, the big chip improves tape recording quality. The Fanti chip is rumoured to be almost unique in semiconductor circles in that CDI is just as good at producing linear quality (as opposed to digital switches). Clive has included automatic amplifiers in the design and software for tape handling has also been improved and now the machine will actually look along the tape for the right program, by name.

The other thing that one notices, inside the case, is a bigger radiator fan. Sinclair still insists that the number of people who suffer from overheating on the ZX80 was very small and the problem was almost certainly due to faults in chips but one legend that old faults can be cured by putting the right ’flicker-free’ type of standing on a carton of ice cream on the case has taken hold. A big chunk of metal under the voltag regulator may only work on user psychology but it will also dissipate heat a bit better, even if that isn’t truly necessary.

So that’s a good move. As a pocket next year has been announced - at £50.

The photograph shows that nobody is going to use it (when it appears on schedule in June) for sending type- scripts to the printers, or for preparing company reports. It works on the principle of taking silvered paper and vapourising the aluminium with a spark, disclosing black paper underneath. This may be quite legible but it’d never replace the typewriter.

The design is new, by the way. Most printers using electrosensitive paper have some kind of wire matrix to scrape the paper, sparking away at the black points. This one has a single point, which scans like the electronic beam in a television. It is on a band, and when it reaches the edge of the paper it passes round behind and a second point starts on the next line of the letter matrix immediately.

The new memory chip controls the printer, too, and all its facilities can be plugged into the old ZX80 (all except flicker-free graphics and better tape handling) for £20 including a new key-board overlay.

Nothing about the new computer gives the slightest hint of the fact that Clive has produced a new type of television screen around which he will be building a £50 television set to go in your pocket next year and the screen has attracted much more attention in the world’s press than
the computer, despite the fact that it was the computer which gave Clive the money to develop his screen from the point where the National Enterprise Board told him to take it away because there was no future in flat television screens in the UK. The flat Sinclair screen is minuscule and will almost certainly not be used for computers without a lens in front of it, either as a magnifying glass or projection lens, because even the amazing Scrumpi computer produced two years ago by the late John Miller Kirkpatrick, given 12 characters per line, wouldn't have been legible on this. By the time a bigger version is available for computer output use, computers will have changed so much that it's pointless to guess what Sinclair will do with it. He agreed that it obviously has a computer application, because it uses so little power that it can be run off dry batteries.

Finally, software. Clive has released his first few cassettes of 'Advanced', 'Standard', and junior education, business and household programs, and set around £3 per cassette with six or seven programs per tape, the quality is superb but when one looks at the Game of Life, for instance (it's a very nice game, if you like life) it compares its 400-odd cell screen with the thousands of cells on the Acorn Atom Life, one does realize that the ZX80 isn't in the same market as any other machine available. Then again, at £70 to get started, who cares?

Distant relations

Nobody would believe me if I went into print saying sorry for 'lose' Kit Spencer of Commodore who's just had a job incidentally charged of PET sales in the 'rest of Europe' - that is, not Britain and not Germany. He was sales boss for Commodore Electronics and letters complaining about the unfair treatment of Commodore will now have to be written by his colleague Bob Gleadlow. When any product sells as well as the PET has done, it attracts attention and criticism. Not all the criticism is fair but it deserves to be reported, just in case - after all, how can a journalist tell which retailers have found a genuine problem and which are just griping? So it's easy to see why a committed company executive like Spencer should occasionally have to be dragged into a restaurant by mutual friends and publicity agents in order to try to explain 'no knwo Guy Kewney better'.

In my own defence, it

should be said that time has proved a lot of criticism which was reported was justified. Kit Spencer never failed to accept this (his loyalty to Commodore isn't any half-hearted affair), with the result that I often found myself reluctant to accept his statements as objective evidence.

Never mind; it has always struck me that we ought to get on - after all we have a large number of mutual friends who seem to actually like both of us. Perhaps all we needed was for the circumstances to be right - like, for instance. Kit over in Switzerland selling into a different market, and me over here in London, with neither of us required to listen to a word the other says.

Joy of chess

Philip Joy has written a chess program for the ZX80 which costs £10 and needs the 16 kbyte add-on memory. You play it at three levels: 'Beginner', which spends around 20 seconds thinking and by all accounts doesn't get further than checking for attack; 'Standard', which spends almost twice as long and actually looks for the consequences of its moves; and 'Advanced', which can spend two minutes looking two moves ahead. Details from 130 Rush Green Road, Romford, Essex RM7 8QA.

Bobs booty

Anyone need £4 million? If Bob Smith likes you and your ideas, that is what you can have. Bob Smith was once the boss of Newbury; he now works for Grundy Terminals, and has been told to use his own judgement in selecting good ideas in computers and electronics and to back them to a maximum of £250,000. In his own words: 'Any decision to back somebody will be based equally on the technical merits of the project and intuition about the person's ability to run a company.' The ideas, he says, will be British and may come from universities, individuals, or from existing companies. His first project will be a new hard copy graphics terminal. Then, in the pipeline, he forecasts a new single board microprocessor, with 'unique design facilities'.

Two other points worth highlighting: Smith has electronic plant available within his Electronics Division of Grundy together with administrative support (he is prepared to buy your company with you if he likes it), and second, he has an American outlet through Grundy's US subsidiary which is called Grundy Environmental Systems, in San Diego.

Why's Guy cross?

People living in the Bristol area are receiving a monthly newsletter - actually a self-advertising sales sheet - from a company which sells Apple. The company is Datalink Microcomputer Systems and it uses its monthly newsletter with Apple owners to sell new hardware and software developments, such as the

printed entirely independently by Timedata.

What makes it worth recommending is that it supplies a lot more than the normal collection of funny programs (from biorhythm to lunar landing) that inevitably emerge from users soon after a machine becomes popular. It also includes programming hints.

For example, one of the nicer things about Lindon's method of saving programs or data onto a cassette tape is the way you can see what is going through the system and control what happens. The book, enlarging on the standard manual, gives the way to save a program in order to be able to load it and RUN it automatically and how to have one program actually load and run a second program from it. Again, the Atom has by far the best system of allowing the user to put assembler language instructions into programs, the book goes further and shows ways of putting Basic routines (such as the generation of random numbers) into assembler programs. There is also a little routine to notice a single key pressed on the keyboard (you don't have to hit 'return') and a way round a minor bug in the FOR NEXT statement in Basic. Most important, there is a really useful section on how to convert more standard versions of Basic into Atom Basic.
A NASCOM-2 BASED SYSTEM FOR £1549 + VAT

The proven Nascom-2 microcomputer can now be bought as a complete system for £1549 + VAT. For this price you get the Nascom-2 kit, 16K RAM board kit, Kenilworth case with 2 card frame, Centronics 737 printer, 10 inch monitor, and the Gemini Dual Drive Floppy Disk System. The CPU and RAM boards are also available built - the additional cost is available on application.

GEMINI G805 FLOPPY DISK SYSTEM FOR NASCOM-1 & 2

It's here at last. A floppy disk system and CP/M. CP/M SYSTEM. The disk unit comes fully assembled complete with one or two 5 1/4 drives (TD250 double sided, single density), giving 16K per drive, controller card, power supply, interconnects from Nascom-1 or 2 to the FDC card and a second interconnect from the FDC card to two drives. CP/M 1.4 on diskette plus manual, a BIOS EPROM and new N2MOD PROM all in a plastic enclosure.

Nascom-2 Single drive system, £450 + VAT
Nascom-2 Double drive system, £640 + VAT
Nascom-1 Single drive system, £450 + VAT
Nascom-1 Double drive system, £650 + VAT
Additonal FTD250 drives, £205 + VAT

D-DOS SYSTEM. The disk unit is also available without EPROM to enable existing Nas-Sys software to be used. Simple read, write routines are supplied in D-DOS. The unit plugs straight into the Nascom PIO. Single drive system, £395 + VAT (plastic case which nascom user will need). Certain parts of the CP/M and D-DOS disk systems are available in kit form. Details available on request.

KENILWORTH CASE FOR NASCOM-2

The Kenilworth case is a professional case designed specifically for the Nascom-2 and up to four additional 5 1/4 drives. It has hardwood side panels and a plastic coated steel base and cover. A fully cut-out base will accept a fan, UHF and video connectors and up to 8 A-C connectors. The basic case accepts the N2 board, PSU and keyboard. Optional support kits are available for 2 and 5 card expansion. Kenilworth case, £49.50 + VAT
2 card support kit, £57.50 + VAT
5 card support kit, £95.00 + VAT

GEMINI EPROM BOARD

This Nasbus compatible EPROM board accepts up to 16,2716 or 2708 EPROMs. It has a separate socket for the MK36271 BK BASIC ROM for the benefit of Nascom-1 owners. And for Nascom-2 users, a wait state for slower EPROMs. The board also supports the Nascom Page Mode Scheme. EPROM Board (kit), £55 + VAT
EPROM Board (built and tested), £70 + VAT.

CASSETTE ENHANCING UNIT

The Castle interface is a built and tested add-on unit which lifts the Nascom-2 into the class of the fully professional computer. It makes spurious output from cassette recorder switching, adds motor control facilities, automatically switches output between cassette and printer, simplifies 2400 baud cassette operating and provides true RS232 handshaking.

Castle Interface Unit, £17.50 + VAT

A-D CONVERTER

For really interesting and useful interactions with the "outside world" the Milham analogue to digital converter is a must. This 8-bit converter is multi-purpose: between four channels - all software selectable, sampling rate is 4kHz. Sensitivity is adjustable. Typical applications include temperature measurement, voice analysis, joystick tracking and voltage measurement. It is supplied built and tested with extensive software and easy connection to the Nascom PIO. Milham A-D Converter (built and tested), £49.50 + VAT

PROGRAMMER'S AID

For Nascom ROM BASIC running under Nas-Sys. Supplied in 2 x 2708 EPROMs. Features include: auto line numbering; intelligent renumbering; program appending; line deletion, hexadecimal output; recompression of reserved words; auto repeat; and printer handshake routines. When ordering please state whether this is to be used with Nas-Sys 1 or 3. Price £28 + VAT.

DUAL MONITOR BOARD

A piggy-back board that allows N1 users to switch rapidly between two separate operating systems. Price (kit) £65.50 + VAT.

CENTRONICS 737 MICRO PRINTER

A high performance, low price, dot-matrix printer.It runs at 80cps (propotional) and 50cps (monospaced). This new printer gives fast processing quality print and can print subscript and superscript. It has 3-way paper handling and parallel interface (as standard). Serial interface is optional. Price £425 + VAT. Formatted paper (2000 sheets) £18 + VAT.

GEMINI 'SUPERMUM' 12 x 8 piggy-back board for Nascom-1 offering five single motherboard, quality 5A power supply and reliable buffering with reset function. Price £35 + VAT.

BITS & PC'S PCG

5 x board which plugs straight into Nascom 2.0. Operates on cell structure of 128 dots, producing 64 different cells. Once defined, each cell may be placed anywhere, any number of times on screen simultaneously. Max screen capacity: 768 cells. Dot resolution: 384 x 256 = 98,304. Many other features including intermixing of alpha-numeric characters and printer. Price (kit) £40 + VAT.

DISK PEN

The powerful text editor written for the Nascom is now available on a 5 1/4 inch floppy disk with a number of new features. Price £43.25 + VAT.

PORT PROBE

Allows monitoring of input and output of Nascom PIO. This board can generate interrupts and simulate handshake control. Price (kit) £17.50 + VAT.

HEX & CONTROL KEYPADS

Hexadecimal parallel keyboard kit for N1/2. Price £34 + VAT.
As above but including (on the same board) a control key pad to add N2 control keys to N1. Price £40.50 + VAT.

BASIC PROGRAMMER'S AID

Supplied on tape for N1/2 running Nas-SYS and Nascom ROM BASIC. Features include auto line number/full cross-reference listing, shaded lines, fast prompting command, plus a comprehensive re-numbering facility. Price £5 + VAT.

GEMINI EPROM-PROG

2708 (multi-rail) and 2716 (single-rail) EPROM programmer kit controlled by N1/2 PIO. Supplied with comprehensive software for use with Nas-Sys. Price £55.95 + VAT.

WE STOCK NASBUS COMPATIBLE COMPUTER PRODUCTS

All the products are available while stocks last from the Nascom dealers below. (Mail order enquirers should telephone for delivery dates and post and packing costs.) Access & Barclaycard welcome.

BITS & PC'S

4 Westgate, Wetherby, W.Yorks.
Tel: (0937) 63774

BUSINESS & LEISURE

16 The Square, Kenilworth, Warwick.
Tel: (0926) 512127.

BUDGET & LEISURE

16 The Square, Kenilworth, Warwick.
Tel: (0926) 512127.

ELECTROVA LTD

680 Bumage Lane, Bumage, Manchester M19 1BA.
Tel: (061) 432 4945.

28 St Judes, Englefield Green, Egham, Surrey TW20 OHB.
Tel: (0784) 33603. Tlx: 264745.

ENHANCING UNIT

A piggy-back board that allows N1 users to switch rapidly between two separate operating systems. Price (kit) £65.50 + VAT.

NASCOM-2 Microcomputer Kit £225 + VAT
Nascom-1 Microcomputer Kit £145 + VAT
Nascom-2 Board Kit £215 + VAT
Nascom-2 Board Kit £140 + VAT
IMP Printer. Built & tested £325 + VAT

NASCOM-2 Microcomputer Kit £225 + VAT
Nascom-1 Microcomputer Kit £145 + VAT
Nascom-2 Board Kit £215 + VAT
Nascom-2 Board Kit £140 + VAT
IMP Printer. Built & tested £325 + VAT

CENTRONICS 737 MICRO PRINTER

A high performance, low price, dot-matrix printer. It runs at 80cps (propotional) and 50cps (monospaced). This new printer gives fast processing quality print and can print subscript and superscript. It has 3-way paper handling and parallel interface (as standard). Serial interface is optional. Price £425 + VAT. Formatted paper (2000 sheets) £18 + VAT.

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NEWS

More great deals from 6 Nascom Dealers

PCW 45
latest 'special discount' offer from Apple to schools (20 percent off until 29 May) through dealers. Careful readers will have noticed that the compiler of 'Newsprint' (me) is credited as being 'editor of Nascom' and most of you will recognise that as a reference to a weekly news and evaluations magazine for programmers. However, writing down 'Datalink Microsystems Systems Limited' in small print like that doesn't quite do justice to the actual presentation of the newsletter printed in Bristol. It actually has the word DATALINK in enormous letters, then (microcomputer systems ltd) in teensy weeny ones with the address and telephone number and under DATALINK, in almost as enormous letters, the words MONTHLY NEWSLETTER. Nobody getting this sale sheet might be forgiven for thinking that Data-link is a dubious outfit, but if you can't dispel any possible confusion. Dear me.

And since there actually is a real newspaper called Data-link and people in the micro business who are used to enthusiastic salesmen think it would be ethical of DML to make some effort to dispel any possible confusion. Forgive my scepticism, but the impression given by the sale sheet is not unbiased news that sheet, but a hard-sell, 'we-are-the-greatest' promotion giveaway.

Nascom Pascal
The nicest thing about understanding Basic is that you are qualified to learn Pascal, a programming language with much more prestige attached to it. Not content with wanting to write programs in it, you can actually start designing your own computer by writing a Pascal compiler. How do they do it? Surely it comes as no surprise to find that £5000 can buy a complete full scale Z80 business micro with 64 kbytes memory, half a megabyte of floppy disk storage, screen, keyboard, printer, and word processing software.

Apple eye
A startling new product from Bill Unsworth's company, U-Microcomputers, gives an Apple the ability to see. It contains a video camera; it takes the electrical signals from the camera and feeds them into the high resolution graphics of the Apple memory. There, theoretically, you can start doing digitiser work.

The cleverest thing about this iAPX 432 (it's a 32-bit micro) from Intel is that it has to be programmed in iAPX 432 assembly, Basic, Cobol or Fortran, says Intel; instead, you manipulate 'objects' of code through the newest, trendiest programming language, Ada. It may well be slower for the reasons that Intel says but the cleverest thing about it nobody has ever heard of objects and will have to study the iAPX 432 to find out about them. No rush though, it will be at least two years before anyone has a compiler, and even then development companies can get one to develop software on and many years before we see it in the shops.
You’re never alone with a Commodore PET

If you buy just any make of microcomputer you could find yourself on your own. And that’s serious. Because without first class software and support, all you’re left with is a box of wires.

On the other hand, when you buy Europe’s No.1 microcomputer, the Commodore PET, you have access to the largest and finest range of software in the UK today; the most experienced dealer network; 24 hour field maintenance service; plus our very own training courses and user’s club — all to ensure that you get the best from your system.

LONDON AREA
Adox Computers Ltd., W13, 01-979 5845
Advanced Management Systems, EC2, 01-389 2131
C.S.S. (Business Equipment) Ltd., E8, 01-254 9293
Caterings — London Ltd., SE13, 01-318 4213
Computer Sales & Software Centre Ltd., KFORD, 01-654 3344
Cream Computer Shop., HAMMON, 01-961 0833
De Vere Computer Shop., SHEE, 01-205 2856
Henderson Bennett., SE13, 01-318 4213
Mega Home & Business Computers., EC12, 01-752 5107
Micro Systems Centre., SW1, 01-222 1122
N. Ireland Business Systems Ltd., BS25, 01-504 5629

HARROW, 01-863 0833
Kingsley Computers Ltd., SE25, 01-318 4213
Logic Box Ltd., EC2, 01-638 9319
Merchant Systems Ltd., W13, 01-579 5845
Mercifac Systems., EC4, 01-878 7044
Micro Business Centres., ILFORD, 01-554 3344

HAMPSTON HILL, 01-979 4546
Sumlock Bondain Ltd., EC1, 01-250 0552
Sumlock Bondain Ltd., EC4, 01-628 0487

HOME COUNTIES
Alpha Business Systems., ALTON, 01-845 17
Micro-Facilities Ltd., BRIGHTON, 01-214 168
Micro Computer Centre., BURTON-ON-TRENT, 01-496 3698
Merchant Systems Ltd., CAMBRIDGE, 01-318 4213

Marchant Business Systems Ltd., CARDIFF, 01-248 6921
Sumlock (East Anglia) Ltd., CATERHAM, 01-492 35
Dyson Instruments., CHESTER, 01-463 274
Fiddes Marketing Ltd., CRAWLEY, 01-264 932

Impei., CRAWLEY, 01-264 932
S.M.G. Microcomputers., CRAWLEY, 01-264 932

Jondane Associates Ltd., CRICKLEWELL, 01-626 0487
Micro Associates., CUMBRIA, 01-318 4213

Marchant Business Systems Ltd., DARTMOUTH., 01-863 0833
C.S.S. (Bristol) Ltd., DESMOND, 01-261 268

The Computer Room., DUNDEE, 01-222 1122
Marchant Business Systems Ltd., DUNDEE, 01-222 1122

REAS, 01-472 5107

PCW 47
ware, to understand what it saw.

Unsworth offers the intriguing idea that it might be able to read musical scores. If this can be done, of course, it won't be long before some lunatic connects this to the already existing synthesiser boards and the Apple replaces the symphony orchestras as we know it. (Only kidding, but somebody is bound to try it.) The new board, however, only offers 256 by 256 pixels and costs £265. Details from Long Lane, Warrington, Cheshire WA2 8PR.

Learning WP

Yet another piece of software to turn a computer with CP/M into a word processor; this time from Almarc, to run on the Vector Graphic machines which Almarc distributes. The claim is that it is the only word processing system designed to let experts improve on it suit themselves. Details from David Swain, marketing director, on 0602 625035.

PETshow

Commodore has promised 'a new announcement' for its PET Computer Show, 18-20 June. The new program could well be the new video interface board, VIC, but don't bet too heavily on that, because VIC could easily appear elsewhere first. Certainly, if all goes to plan, VIC will be generally available by the time of the show; but other products are known to be in the pipeline.

New methods of overcoming the now obsolete ZX80's 'flicker' are becoming available from several sources. Latest is Bug-Byte, a company which also supplies software for the Acorn Atom — the illustration shows Atom Invaders. Most sophisticated game for the ZX80 is a version of breakout, using flicker-free animation (it needs 4 kbytes of memory, costs £5) and the programming course, including cassette, for £9 looks interesting. If I get a chance to review these, I will, catalogue from 251 Henley Road, Coventry CV2 1BX.

Last year, with around 25,000 PETs sold, nearly 9000 visitors came to the show. This year, with 45,000 sold, the Cafe Royal should be crowded. It would be worthwhile getting a trade ticket somehow and staying on the 19th. Exhibitors will include many of the UK and overseas builders of add-on hardware, plus a vast amount of software writers and publishers.

Process control

Put an Apple in a factory and keep it busy monitoring things like temperature and pressure. It's always been theoretically possible: now a new add-on card from Datex-Micors has appeared, which makes it theoretically easy. Datex has adapted a remote data acquisition and process control system called REMDACS, made by chip-maker Intersil, for the Apple. This allows up to 500 remote analogue or digital 'stations' (items of equipment for reading meters) to be connected to the Apple II with up to a mile of twin flex. A complete system including 48k Apple, video, controller card, sample programs and documentation costs nearly £2000. Remote cards are under £300 and each card can contain digital or analogue channels. That's cheap. Details on 0903 39290.

Basic tape

Any course on programming that doesn't involve using a computer has to work hard to convince me it is worth the money. The new Guild Sound and Vision video course doesn't use a computer. Tell you what: donate Basic, an introduction to Computer Programming to Computer-Town UK and prove me wrong (0733 63122).

Power package

These days, not too many micro users want to build their own systems, so the idea of a five percent discount on power supplies won't seem quite as wonderful as it would have three years ago. You have to buy 20 supplies and, not surprisingly, this applies to members of a bona fide computer club only who else would want 20 supplies? They come with varying specifications — £29 for an unregulated 8 V at 8 A plus 15 V at 1 A, and minus 5 V at 1 A or £30 for the same supply regulated to plus 5 V, plus 12 V and minus 5 V. There's a plus and minus 16 V supply giving 3 A, regulated to plus and minus 12 V at similar prices. And there's big fat 8 V 10 A which you can regulate to 5 V, for a bit less. Supplier IMAC will keep this offer open for one month from our publication hitting the streets; phone Newport (IoW) 0983 524983.

Letter quality

All typewriters should be computers, to save money in building time. If Commodore made its new 'letter quality printer' (that is, typewriter) in enough volume, it should be able to make 3 A, regular electric typewriters look ridiculously pricey. As it is, this product, which costs over £1000 (£995 plus VAT), compared with anything remotely similar, is that's not bad value and it will serve as a terminal for word processing. It is all that fast; in fact, at 16 characters per second, it counts as slow. Details from stockists.

Cheap developing

Having laid out a small fortune for a genuine Intel Intellec microcomputer to develop genuine programs for genuine microprocessors, it suddenly dawns on the buyer that there are other micros around and he certainly can't afford another development system. That's why Rapid Recall, which sells genuine Intel development systems, is now selling software which allows the users of those systems to develop software for the Zilog 280 (and also such micros as the 6502, 6800, F8, 6809) on their genuine Intellecs. It's a lot cheaper just buying a little add-on hardware and software. Details 0494 35634.

Micro muffler

Anybody who has just enough money to buy a computer hasn't actually got enough money to buy a computer because of all the other things he's going to need afterwards — printers, paper for the printers and now, little boxes to put the printer in to stop the noise driving your office colleagues potty. For £60 plus VAT, Bestobel Acoustics has produced a sound-deadening box measuring 25cm x 15in by 8in, which the company says reduces noise to acceptable limits. If your printer will fit in the box, details are on 0734 661432.
Amazing Value – compatible with TRS-80 16K level II

VIDEO GENIE

Fully Supported Hardware

Microdigital are the hardware experts, here’s why you should buy your Genie from us:
- Low Price of £280 + VAT
- Each computer tested by our engineers before dispatch
- 12 month parts and labour guarantee
- Free delivery within mainland U.K.
- Bona fide official orders welcome
- Latest version of Genie.

The Video Genie is a complete computer system, requiring only connection to a domestic 625 line TV set to be fully operational, or if required a video monitor can be connected to provide the best quality display.
The system case contains the Central Processor Unit (CPU), 16,000 bytes RAM memory, the cassette system, a 12,000 byte operating system and BASIC interpreter in ROM, and a full size keyboard, in a stylish case, at a price that makes the Video Genie better value than some “kit” computers.

Applications

The Video Genie System has many uses in all spheres of life, the easy to use BASIC language means that programs are easily written for specific applications, and pre-recorded program tapes are available in great variety.
The system has great scope in the home, sophisticated games programs can introduce the computer age to all the family, who can then progress to writing their own programs in BASIC or even machine code. Software is continuously being developed to aid home budgeting and education.

In a school or college the machine can be used with a large screen TV to allow a whole class to be taught at once.
The powerful Extended BASIC interpreter makes the solution of complex scientific problems simple, and the graphics allow pictorial displays of results.

Prices

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<th>Product</th>
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7 Years Microprocessor Experience!

Send large SAE (44p) for our current Catalogue of TRS-80/Video Genie software.

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MICRODIGITAL

MOLIMERX LTD
Modern microcomputer technology has many applications, but one where it has so far had little impact is in reducing the problems of disability.

To mark the designation by the United Nations of 1981 as “The International Year of Disabled People”, PCW, in conjunction with the IYDP Technology Working Group, is holding a competition for the best article on the subject:

“The application of micro-computer technology to the problems of disability”.

There must be many possible applications for microtechnology in the fields of physical and sensory disabilities—remember, these include handicaps such as deafness, blindness, diabetes and epilepsy, as well as the more obvious physical impediments.

1st Prize
DAI PERSONAL COMPUTER

2nd Prize 3rd Prize
£100 £50

Articles of around 2500 words are invited, which can be either theoretical or a description of an actual application (with photographs, if possible), and which we will print in PCW later in the year. Entries will be judged by PCW’s Editor, David Tebbutt, Adrian V Stokes, Chairman of the IYDP Technology Working Group and Judith Hann, presenter of Tomorrow’s World and science writer.

Please send your entry to IYDP Competition, 14 Rathbone Place, London W1P 1DE, enclosing a suitable SAE if you would like it returned.

Data Applications Ltd has kindly donated the first prize of a 48K personal computer worth £595. Plugging into the domestic TV, it provides sound, colour and high-resolution graphics.

Sharp Electronics (UK) Ltd has kindly donated the third prize of £50.
Adam Osborne, well-known publisher and lecturer on the personal computer scene, has begun manufacturing his own line of microcomputers. The Osborne 1 computer system, which was announced at the West Coast Computer Faire, is revolutionary in that it incorporates nothing revolutionary—except size and price. Osborne has based his product on the premise that, "We do not need the abundance of more powerful, more expensive microcomputers which the industry has been producing. We need a microcomputer with the capabilities of existing products but with a much lower price tag. We need a portable microcomputer capable of performing a large number of straightforward tasks, using industry standard operating systems and programming languages."

As a result, he has introduced the Osborne 1, which is immediately impressive by virtue of its compactness and portability. It was purposely designed to be able to fit under the seat of a plane and yet it incorporates features that have come to be standard only in systems of much larger size and price. The basic unit includes a Z80 CPU, 64 kbytes of RAM, two minifloppy disk drives, CRT and keyboard with numeric pad and a host of system and application software for $1795. The CRT measures 5in diagonally and provides 24 rows of 52 characters. The display, however, is a window on a screen of 34 rows of 128 characters including upper and lower case, two screen intensities and underlining, with limited graphics capabilities. The display is implemented in 4k x 9 bit RAM.

The keyboard is a standard typewriter style with a 10-key numeric pad and snaps together with the computer to form a weather-proof carrying case. There is even room enough in the face of the unit for pockets in which up to 20 disks can be stored.

Of the 64 kbytes of RAM, 4k are used by the display, leaving about 60k available to the user. System software in ROM is held in a separate address space. Two standard interface ports are provided with the Osborne 1, an IEEE 488 interface useful for instrumentation and control and a standard S253 port, useful for attaching a printer. The two 5'/4in disk drives hold about 100k each, but double density, double-sided drives will soon be offered as an option. Alternatives to the relatively small display will also be offered in the near future. These include a 3in monitor which reproduces the 5in display, and a 12in monitor which will show a standard 80 column, 24 row display.

But as if all this hardware were not enough, the Osborne 1 also comes with a whole pile of ready-to-run software. At the system level, it provides CP/M, CBasic and Microsoft Basic, probably the most popular general-purpose software packages available for personal computers. But there's still more.

The base price of the system even includes two applications packages: the Wordstar word processing package by Micropro, with the Mail-Merge option, and what Osborne calls a 'CP/M-compatible electronic worksheet'. By this we can presume he means a system similar to, but not identical with, the VisiCalc program that has proven to be such a boon to the personal computer industry.

And I haven't finished yet: there are even options in addition to the double density disk and CRT variants mentioned above. The user can also obtain modem electronics with a 300 baud acoustic coupler and a battery pack which can provide from three to five hours of operation away from an electrical outlet.

In introducing the Osborne 1, Adam is really doing nothing more or less than practising what he has been preaching for a number of years: that microcomputers should be general-purpose, price effective, compatible tools that are accessible to a broad range of users who are not computer people but who have a vast variety of problems to solve and jobs to do. The emphasis is not on fancy bells and whistles but on the 'vanilla flavoured' practical machine that so many people need and at a price that is going to be the talk of the industry for some time to come.

This observation naturally raises the question, 'What if it's good, then, are the new 16-bit and now (God help us) 32-bit systems that will fit on a desktop and directly execute high-level languages?' The answer, obviously, is that they are good for a lot of things such as real time simulations with colour graphics and voice I/O, and these are things that will soon be within the reach of the interested individual.

But the point of the Osborne 1 is that you don't go rabbit hunting with a buffalo gun. Neither do you venture into exotic places where you can't get standard calibre ammunition—or the Jabberwock might eat you. The average user does not need the fast- and flashy and the sexiest; he needs reliability. Adam Osborne has renewed a focus on that need and at a price that is going to be the talk of the American side of the microscene. So do we—Eds.
NOW YOU CAN PLAY

SUPER INVASION
ON YOUR ZX80!

• TOTALLY FLICKER FREE
  Absolutely no flicker. You don’t need to press anything for the display to move!

• 3 LEVELS OF PLAY IN EACH GAME
  From easy to dangerously difficult – you’ll find it hard to resist the challenge time after time!

• MOVING GRAPHICS
  No hardware modifications are necessary to get moving graphics. Just follow the instructions for cassette loading and off you go; no extra memory needed, uses the 4K ROM.

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  These programs are written in the computer’s own language – only this way is it possible for continuous, flicker free action to occur.

• ALL PROGRAMS ON CASSETTE
  Loads just like any other program on cassette. Each tape contains instructions on how best to load the cassette.

• FITS IK BASIC MACHINE
  Amazing as it is, all these moving graphics programs fit into your basic IK Sinclair!

IK SUPER ZX80 INVASION

SUPER ZX80 INVASION is the machine language game you and your Sinclair have been waiting for. Cruel and crafty invaders have been spotted in battle formation ready to attack with your ship just below them! Quickly and skilfully you shift right and left as you carefully fire your lasers at them. But watch out – they are accurate! 3 levels from easy to almost impossible to beat. Added bonus – each cassette also has more sophisticated 2K version which will automatically reset and challenge you for hours! £8

DOUBLE BREAKOUT

You’ll be amazed to see how difficult it is for you to break through the £8 ZX80 DOUBLE BREAKOUT – and even more astonished to see this exciting game fit into your IK Sinclair ZX80! Try your skill on the easiest level because even with the most skilful bat control you’ll find it hard to catch at the fastest level! Breaking through the first barricade is easy but don’t be fooled for the second – it’s much harder than you think! Two ball angles and curved bat will keep the excitement going for hours!

ORDER NEW ROM VERSIONS NOW!

NOW!
It's good news again this month with Retford and Ealing getting off the ground. Retford is in Nottinghamshire, several miles away from the existing ComputerTown at Sutton in Ashfield, and has been started by Bill Gibbings. Bill bought his first copy of PCW just a couple of months ago and the idea of ComputerTown rather caught his imagination; he promptly set about finding appropriate premises for his own ComputerTown. He tried the library, thinking that they might be prepared to buy an Atom or something for permanent installation, but this foundered on the usual library budget problems; and permanent installation, but this foundered unfortunately the owner couldn't come along and no-one else attended - unfortunately the owner couldn't come along and no-one else was able to use the machine.

A variety of people were demonstrating their systems: a doctor, an engineer and a businessman were demonstrating their own business applications while an education expert was showing how he handled a village census on his micro. Thanks go to 'John' who came all the way from a computer club in Doncaster - a distance of 20 miles - just to lend a hand. Games were in evidence, too, and while the whole event had been planned as a series of demonstrations, by the middle of the evening it was clear that the 60 or so visitors wanted to get their hands dirty. The evening was a roaring success and everyone who participated had a great time. It was an extremely practical way of getting people interested in microcomputing.

Before I move on to other ComputerTown News I must just say that the first we knew of these activities was when a poster announcing his event dropped through the PCW letterbox a few days before the big night itself! Anyone wanting to contact Bill (with offers of help, maybe?) should telephone Retford 706923. Thanks Bill, you're doing a grand job.

Mike Baker wrote from Hanwell to tell us about his progress with the Ealing ComputerTown. He'll be started sessions at Acton Library on Tuesday afternoons and would very much appreciate some volunteers to help him out. So far he's been unable to find anyone else free at that time. All offers to Mike please at 5 Edinburgh Road, Hanwell, London W7 3JY.

Vernon Gifford rang with news of ComputerTown Croydon. It has run a couple of sessions so far and Vernon is very encouraged by the results. He is extremely grateful to two companies, Encotel and Wego, for their loans of equipment to his project. Croydon ComputerTown is sponsored by the Croydon Computer Club in collaboration with the local library and sessions are run every Monday in the children's library, Katherine Street, between 4pm and 7pm. Like everyone else running ComputerTowns, Vernon could really do with some help for the sessions. If you'd like a tipp, Vernon lives at 111 Selhurst Road, London SE25. Soon a Saturday session will be opening as well and for this Vernon will be looking for the loan of more machines. Any offers?

Now a few words about something which could become a problem for all of us running ComputerTowns. I have started to get phone calls from people in business who feel that by associating themselves with ComputerTown they can somehow enhance their credibility and, presumably, increase their sales. We must be extremely careful when confronted with this situation that we do not lend our name to any commercial activity. I do not exaggerate when I say that this will kill ComputerTown. It will be seen as a marketing organisation, which it clearly is not. If you're in any doubt about ComputerTown's position on this I suggest you read the ComputerTown launch article in the November 1980 PCW. We welcome help from people in the industry — indeed it is unlikely that ComputerTown could have got off the ground without help from people like Leasalink, Supersoft and Encotel to name but three. And it is even possible that these companies will receive some business as a result of their involvement, but the fact is that companies like these offered their services to ComputerTown freely. I'm sure that they would all welcome some spin-off business as a result but none of them is expecting to get a special relationship by treating ComputerTown as a sales pitch. If you are in any doubt about lending ComputerTown's name to an activity, we'd always be happy to discuss this problem with you. Leave your phone number and a brief note of the problem with PCW and we'll ring you when we get home.

John Bone wrote from ComputerTown North East to say that things are going well for the project in Newcastle. They chose the name CTNE! because more than one ComputerTown is involved and the team want to help the whole of Tyneside. At the moment they're apparently renting rooms from a local political party at £4 per day, although by the time you read this they may have shifted their centre of operations to a community centre.

We can set up a register of software which we are prepared to swap around within ComputerTown? Obviously we are only interested in public domain stuff unless it is with the express and written permission of the author and distributor. Perhaps you might think as to how the stuff can be copied and distributed as cheaply as possible for everyone involved and send your suggestions to us as well.

Alan Northcott writes from Winnersh to offer his services to ComputerTown. Anyone in the Reading area who feels like joining in should contact Alan at Runnymoor, 464 Selborne Road, Winnersh, Wokingham, Berkshire RG11 5ET. We look forward to great things from this area — it is, after all, Britain's answer to Silicon Valley!

It's only a couple of weeks since I wrote the last ComputerTown piece so we have had relatively few letters. Other than the above we have received interest from Sheffield, Aberdeen, Aylesbury and Worcester. If you feel you'd like to help, then send a letter to CTUK!, 14 Rathbone Place, London W1P 1DE and we'll pass your details on. If you want to write to us and you need a reply then please enclose an SAE. Please don't try to telephone the PCW offices since we do ComputerTown work in our own time.

Thanks to all of you who are helping to make ComputerTown a success. It is attracting the attentions of all sorts of interesting people: the media, the retail sector, the IT consultants, the educational sector, the staff of the various National Computer Centres, the home computer enthusiasts and so on. We certainly don't want to be side-lined.

Keep writing in with all news of your progress and particularly with advice which you can offer other ComputerTown organisers as a result of your own experience with them. We look forward to hearing from you.
PCW welcomes correspondence from its readers but we must warn that it tends to be one way! Please be as brief as possible and add "not for publication" if your letter is to be kept private. Please note that we are unable to give advice about the purchase of computers or other hardware/software — these questions must be addressed to Sheridan Williams (see 'Computer Answers' page). Address letters to: 'Communications', Personal Computer World, 14 Rathbone Place, London W1P 1DE

Pricey Pascal
As a newcomer to the world of personal computers, I'm ashamed to admit that it seems to be lagging so far behind mainstream computing. Full marks to David Liddick for his anti-Basic campaign.

These pathetic, slow, interpretive Basic systems are fine for beginners, but surely the road to good programs must be to wean the serious programmers and get them onto some high level language that will support files, procedures, parameters and recursion.

As far as I can see the main drawback to widespread use of Pascal is the high cost of compilers, so come on soft developers, how about a 'Pascal Starters' Kit' for under £30?

Keep the Pascal and assembly language programs coming!

What is the most efficient keyboard layout, if qwerty was designed to slow typists?
R L Barbour, South Queensferry, West Lothian

Easy loader

With reference to Hasse Taub's letter in the January issue, I had similar problems but found that SAV/LOADing of the ZX80's ROM is trouble-free if the plug not in use (ie 'Earphone' socket during SAV and 'Mic' during LOAD) was removed at the recorder.

Incidentally, the tape I use is sold in the local market at three C60 cassettes for 45 pence!
O L Harding, Lincoln

Wrong Tiger
Thank you for publishing our press release on our Model 560 Paper Tiger (PCW February) — however the picture you show is that of the 460.

The 560 is not aimed at the typewriter market. It gives good quality printing with proportional spacing, right hand margin justification, high speed (150 cps) printing, enhanced printing, full range of punctuation and many other features. If you know a Daisywheel with all these features for under £6000 end user, I would be delighted to hear of it and to add it to my product range.

Richard Kent, Director, Telegraphic Equipment Ltd

What a bind

Ring binders suitable for American documentation are available from commercial stationers in this country. I use 'Twinnlock Ref V311 capacity 10 x 8½" fitted with a PVC variform ring'. I hope this helps Don Finlay as well as your readers.

Steve Willers, Coventry

Super Superboard

Ever since I took up the computer hobby, I was always interested in producing 3D effects on my Superboard. In this program, although I have not used a utility for high screen resolution, the effects are very satisfactory. The secret is the revolution of some form of sine-wave about a 'Y' axis. The steps of revolution depend on the value of 'A' depending on the steps of 'Y' axis. So if the steps of 'A' to be counted is small, then this would result in closer steps of revolution.

As you see from the listing there is not a great deal involved but the run time for this program would be a great deal!!

The program is self-explanatory and it can be used on any machine and it is a lot of fun! Line 50 can be changed to produce rectangular shapes and line 60, the steps decide on the number of cycles, so the greater the steps, the more cycles you would get.
A Sarafian, London

Zx80 memory

I read Mr Kirkland's letter about finding how much memory is free on the ZX80 and thought that you might like to see my solution to this problem.

The number of free bytes is returned by the function USR(2383), which gives a negative result. The result is the number of free bytes between the end of the display file and the top of stack so no estimation of the size of the display file or stack is required.
J D Slodzisz, Maldon, Essex

Where are they?

In your March issue in 'Yankee Doodles' you mentioned a company called Giltronix from Palo Alto who specialised in RS232 automatic and manual switching equipment at very reasonable prices.

I need this facility for sending my Microwriter keyboard information down the line to a bureau for processing. Could you send me Giltronix's address, or is there anyone in the UK who could supply my needs?
F Clifford, Blackheath

The address is: 450 San Antonio Angelo, Palo Alto, CA 94306 and the phone number is 010 (415) 493 1300 — Ed.

Hooked but not hired

About ten months ago I was introduced to computing by a friend with access to an 8k PET. Inevitably I became completely hooked on computers and their application, even to the extent of spending all my spare cash on magazines and books on the subject.

Computing and programming in particular, became my tool to the extent that I gave up my established vocation (after ten years as a research microbiologist), determined to become a full-time programmer. The thought of being paid to do what I considered to be an all-time favourite hobby seemed too good to be true. I therefore applied, and gained entry to, a TOPS course in commercial computer programming for those who wished to turn students into Cobol programmers.

I completed the course and now, three months later,
I am still unemployed despite sending out over 150 applications for jobs. I have yet to obtain a single interview! What can be done to dispel this Catch-22 situation in which people with less than 12 months' experience cannot get a job? Just how do you get that first 12 months' experience when nobody is willing to take on a trainee with all its associated risks? I am going to become a programmer, even if I have to start as a teaboy or a lavy attendant in order to get experience. If any one out there wants to employ a computer 'junkie' with limited Basic and Cobol experience tempered with lots of enthusiasm then I'd really like to hear from them. Rod Mansell, 43 Ladybank, Birch Hill Road, Bracknell, Berks RG12 4HA

Mr Mansell's problem is shared by many others and PCW would like to do something about it. We know that investment in trainees is expensive and doesn't always pay off. If the industry is to expand then it is absolutely vital for fresh people to join it. We therefore are going to make an offer - any company prepared to employ a trainee programmer should write to us giving name, address, nature of company and type of vacancy. We, in turn, will publish a list of replies received in the August PCW.

Since I regard your publication as the basic magazine of Commodore (we don't - Ed), maybe you would be interested in the following true story. The head release lever on my Tandy Lineprinter II recently suffered a fracture in the shaft and I phoned the Manchester Tandy Computer Centre to enquire about a replacement. They got in touch with their repair department nearby and rang me back with the information that it would cost £2.50 for the part and about £15 for service charges.

I wrote to Centronics in Burgess Hill, Sussex, and later they phoned me back to confirm which part I needed, since they had the component a cam head gap adjuster. They decided the cost would be £2.50 plus postage and packing. On receipt of my cheque they dispatched the part within a week and it took me exactly two seconds to fit. Dr Norman A Law, Manchester

HP source too costly

It is heartening to read that MPs are at last getting computerised Commons Report by Ian Lloyd, PCW March 1981 and have their own online information storage and retrieval system.

I have grave doubts, however, if there will be many takers outside the House of Commons, as prices currently quoted by Scicon for online service to non-parliamentarians include a £1990 annual subscription charge, plus £1.50 per hour connected. At present this covers Parliamentary Questions only, although there are plans to extend the database.

Compared to established American systems such as Lockheed's Dialog or SDC, for which there is no advance payment and you pay only for connect time, the English system represents very poor value for money and is grossly overpriced. Using the system with quotes paid and without advance payment, it is possible to have access to some 100 million references, bringing these systems within the range of even the smallest user.

So unless you are an MP and can have your service paid for by the taxpayer, I suggest the rest of us stay away from POLIS until a) the database is greatly enlarged and b) the price is drastically reduced.

Peter Douglas, London SW1

NewBrain? Not yet

I would appreciate it if you could let me know if PCW will be running a Benchtest on the Newbury NewBrain in the near future. If so can you say in which issue? H J Stovold, Exeter, Devon

When NewBrain goes into production later this year we fully expect to bring you a Benchtest. We're sorry but we are not in a position to give any further details.

Black mail?

Have you ever wondered who gives your name to these people who send offers and such through the post to you? Well, there is a way of working out the answers.

Many of these people now employ mailing lists, printing the address out onto sticky labels. This method has two useful consequences. One is that one particular mailing list will repeat the name exactly each time it is run, it may add extra information sometimes such as rank in company. Since there are many different ways of phrasing a name, plus the ease of errors, this means that different lists will have slightly different entries for the same publication. For example, I have been addressed as: R. Poynter, R A Poynter, Roy Poynter, Roy Poynter and a whole host of more obscure variations.

Then we have the address which again throws up inconsistencies. All of this gives us our chance to watch the watchers. What I do is to keep copies of the labels on my mail, making a note of whom the mailing was from. Then from time to time I find a match, sometimes the bedfellows prove to be quite interesting. However this method is not proof, so in self-defence I think it's better that I do not publish my suspicions. But as a pastime it is very rewarding.

Rd Poynter/R A Poynter/Mr Poynter, Nottingham

Cowboy sort out

I own a ZX80 computer and, not being able to master the art of programming myself, I began collecting and buying some of the bewildering amount coming onto the market. I didn't realise until recently that program quality differs so widely between suppliers. Is there any way that your magazine could help other readers like myself from wasting their money on rubbish and being taken for a ride by software cowboys?

John Joseph Oxley, Bessacarr, South Yorkshire

We'd like to help but, short of reviewing every software product on the market, we suggest that the best approach is to invite readers to write to us with their experiences. If sufficient evidence builds up for or against a supplier then we'll start investigating and publishing our findings. Write the name of the supplier on the back of your envelope and send it to Investigation Department, PCW, 14 Rathbone Place, London W1P 1DB - Ed.

Cuck op

Here is a misprint from last Saturday's Guardian which might amuse you.

Frank Little, Swansea

Dr Micro

I would be very pleased to hear from anyone who has information or ideas about using microcomputers in general hospital wards for teaching or for management. I own a Sinclair ZX80 with a 16k RAM pack and would like to be able to put it to use in an on-ward teaching situation.

Valerie Garland, 12 Park Hill Crescent, North Hill, Plymouth
DATABASE MAINTENANCE—
- Uses sophisticated screen formatting & data entry, like on IBM 3270!
- Generates its own screens automatically!
- Handles records up to 4K in length, using multiple screen "Pages"!
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- Provides extensive search capabilities
- Search arguments can include arithmetic/boolean functions, multi-field comparisons
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- Any number of fields can be queried concurrently
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DATABASE REPORTING—
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- LOGICAL RECORDS (KEYS MAY BE NON-UNIQUE) — Records added to the KRAM files are immediately accessible by any of the defined keys for the file (Automatic Upgrade).
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The Pasca 640 is a large machine, being a single integrated unit including two 8in disk drives. It measures 26in wide by 28in deep and is 18in high; thus, while it fits comfortably on a desk, there is little room for much else, except for working documents. It is sufficiently heavy to require two people to carry it safely. In view of the current trend for Japanese companies to produce miniature hi-fi systems and pocket computers, I found the Pasca's bulk surprising.

Hardware

A 12in monitor display 24 rows of 80 characters in green on black. A plastic cover is fitted, giving excellent contrast and preventing reflections, even under adverse lighting conditions. The contrast control is mounted immediately below the screen, next to the on/off switch, so there is no need to fumble around the back of the machine. In addition to the usual upper and lower case character set (with descenders), there are a number of special characters including some maths symbols, a '£' sign (replacing the 'hash' character) and various graphics. Cyrillic and Arabic character sets are available as options but as the character generator is a 2716 EPROM, custom character sets may be installed by programming a replacement, following the instructions in the manual (the Pasca has no provision for EPROM programming itself, however).

The appearance of the cursor may be varied — either a solid block (steady, slow or fast flashing), or a flashing underline may be used, or the user can select an invisible cursor. Whichever is chosen, the cursor may be addressed to any screen location by using a subroutine provided by the system software. A second routine returns the cursor's current position.

The display itself is not completely steady, having a tendency to wiggle slightly. This is particularly noticeable when reverse video is used but it is not so bad as to be irritating in normal use. In common with most machines with integral disk drives, the display jerks disconcertingly during disk accesses.

The keyboard has a pleasant snap action giving a very positive feel, backed by a 'peep' accompanying each depression. I found this extremely irritating but it can only be disabled by removing a link on the circuit board. Since you will either like or loathe this feature, the absence of a switch is unlikely to be noticed. A reset key is positioned on the keyboard well away from the other keys, so accidental resets should be uncommon.
The arrangement of the keyboard is slightly unusual, with the control key in the top left-hand corner instead of its more common position at the bottom left. A CANE® key is provided next to 'Q', on the left. Although this might take some getting used to, I found it was a help in the more usual position of the space bar. I would have been much happier with a C-APS LOCK in place of SHIFT LOCK, especially as the system responds differently to shifted and unshifted control characters. In fairness, a row of 13 function keys and a set of cursor keys provide one-key alternatives to the common control functions but this restricts the transfer of skills learned from other machines. In production models these function keys will be inscribed with their CP/M and WordStar functions. My final complaint is that there is the arrangement of the cursor control keys. Considering the amount of space available on the keyboard, a cursor cluster arranged like the points of the compass would be practical and much nicer to use.

According to the manual, pressing a key causes a processor interrupt to execute, and the keystroke is recorded. This may be so but as the keyboard buffer contains only one character, there is still a chance of losing characters during periods of intensive processing.

The unrewarding electronics are mounted in two 13in x 11in circuit boards which slide out from the rear of the machine after a small panel has been unsnapped. Access to the monitor, disk drives, etc. is very easy, as the whole top section of the cabinet lifts off after removing two small screws on the back panel. Two fans are used to keep things cool but they do contribute to a noise level which is higher than I consider comfortable.

The processor used is the Z80, made in Japan by Sharp, with LSI support chips controlling the video display and disk drives; 64K of 4116-equivalent dynamic memory is fitted as standard, with 266 used as the screen refresh RAM. This is the only intrusion into memory space, as the bootstrap ROM is disabled once CP/M is loaded.

A built-in 8 in drives giving 243k user capacity per disk. This format is the 'standard' for CP/M and so makes program and data transfer to and from different machines a possibility, although the plethora of other formatting standards (and the popularity of 5¼ in disks) prevents it being a certainty. The disk drives themselves are manufactured by another Japanese company, Toshiba. To reduce disk wear, the heads unload almost immediately after reading or writing a sector but this has the disadvantage of generating a noise like a demented fruit machine when several operations are carried out in quick succession. This was particularly noticeable when running the disk test program and when listing the directory, but Westrex has solved the problem by slightly modifying the drive.

One serial RS232 port and one Centronics-compatible parallel interface are provided to allow connection of printers or other external devices. Unfortunately, the serial port baud rate is set by a jumper on one of the main circuit boards, so it would seem wise not to plan to use the port for both a 300 baud modem (assuming BT approval) and a 9600 baud printer. Westrex supplies a selection of printers as optional equipment for the Pasca, including the Epson MX-80 provided with the test machine. Provision has been made for two additional connectors on the back panel and a second RS232 interface may be available in the future.

A bottle-green dust cover bearing the Pasca logo is supplied at no extra charge.

Software

In common with most disk-based 8080 systems, CP/M is supplied as the standard operating system. In addition to the usual utilities, some machine specific programs are provided: DEFLP allows the user to specify the serial or parallel port as the list output device; MEDIA is used to format a new disk, or to copy whole disks (with or without the system tracks); MX80 sends a hex string in character form to the printer (eg MX80 OC- cer- causes a form-feed); CURSOR changes the appearance of the cursor. The public domain Basic-E pseudo compiler with three games programs completes the package.

Since Westrex is a hardware-oriented company, they have assumed responsibility for software to Phipps Associates, a small consultancy firm. Phipps has already produced MONITOR, a set of machine code routines to provide Microsoft Basic-80 with the type of forms oriented input/output routines advocated in 'Face to Face' (PCW October 1980). To make life easier for the programmer, the disk includes a collection of Basic functions and subroutines which may be merged into application programs as required. Thus there is no need to access the machine code directly.

The construction of the blank form is achieved through a separate program called FRAMES. Once the designer is happy with the form, the program analyses the contents of the screen to extract the prompts and measure the size of the data fields.

Memory map

<table>
<thead>
<tr>
<th>Video RAM</th>
<th>64k</th>
</tr>
</thead>
<tbody>
<tr>
<td>CP/M</td>
<td>62k</td>
</tr>
<tr>
<td>User area</td>
<td>55k</td>
</tr>
<tr>
<td>CP/M</td>
<td>14k</td>
</tr>
</tbody>
</table>

Technical Data

- **CPU**: Z80, 2 MHz.
- **Memory**: 64K dynamic RAM, 2K EPROM (2716).
- **Keyboard**: 89 key; Separate number pad, cursor keys and control keys.
- **Screen**: 13 in diagonal.
- **Disk drives**: Twin single-sided, single-density 8 in drives.
- **Bus**: Non-standard.
- **Ports**: 1 RS232, 1 Centronics compatible parallel.
- **System software**: CP/M 2.2.
- **Languages**: E-Basic (others available at additional cost).

Four constraints may be applied to each field: type, data type, minimum length and number of decimal places. A field's type determines whether it is to be displayed, edited, printed, or processed; it specifies if input is optional or mandatory. The data types are Date (eg 23.11.81), Real (eg 345.99), Integer (numbers only), Alpha (A-Z, 0-9, and space), String (any character), and Boolean (Y or N). When the form is used by a program, these restrictions are imposed before the input is transmitted to the program, thus greatly reducing the need for explicit checking. The user of such a program also benefits, as he or she can edit the contents of completed forms before transmitting them.

Some well-known programs are described as 'Approved Software'—that is to say, any required customisation or support will be provided by Phipps. The current list is Basic-80 (compiler and interpreter), Macro-80, MAGSAM, SUPERSORT and WordStar/Mailmerge plus the MONITOR program described above. The copy of WordStar provided made good use of the Pasca's memory, allowing the whole program to be loaded rapidly. The ability to produce reverse scrolling is particularly useful. However, the 'printer busy' test had not been added and without such a test the performance of the 'print while editing' feature suffers to the extent of becoming virtually unusable.

Many of the other programs written for use on CP/M systems should operate without modification, and the 'Approved' list is expected to grow as more programs are evaluated.

Potential

The machine's specification and the list of approved software suggests that the Pasca is intended for the business market. My feeling is that the styling of the machine will result in its use for clerical purposes, rather than as an aid for the sophisticated manager. Whatever cachet Sir Freddie Laker gains from the Apple sitting on his desk is unlikely to accrue to the user of a Pasca.
Documentation

Leaving aside the manuals supplied with the proprietary software, the Pasca's documentation is of varying quality. The 'OEM Manual' which deals with the hardware contains (for example) a number of diagrams which are poorly printed and captioned in Japanese—but that’s better than nothing at all. If the manual is meant for the user (despite its name), the whole layout is wrong but on the other hand its level of detail is sufficient for only the most experienced service personnel or systems programmers.

A 20-page booklet written by Phipps Associates explains the essential matter of switching on and goes on to describe the use of the machine-specific utility programs. Finally, there is a summary (taken from the OEM Manual) of the hardware features which impinge on the programmer or operator. The author of this manual has managed to write concisely without sacrificing clarity. I suspect he or she also wrote the MONITOR manual, since this explains the philosophy and use of the programs in a very similar style. By following the fully-worked example, programmers should soon find themselves able to utilise the power of this aid.

Prices

Retail prices had not been fixed at the time of writing, but are expected to be around £3500 for single units without a printer. OEM/distributor prices range from £2890 each (1–4), to £2635 in quantities of 50 or more, which suggests there may be room for discounting by adventurous dealers.

Conclusions

The Pasca 640 joins the mass of Z80 – CP/M systems already on the market, at a price which is considerably higher than some computers offering comparable facilities but in line with at least one other similar machine. It is almost as if some manufacturers are attempting to use higher prices to avoid the 'toy' label applied by the so-called professionals who have yet to realise the power of microcomputers.

Westrex's plans for the future are equally conventional: a 4 MHz Z80A version, a second RS232 port and a 10Mb hard disk. Since the MONITOR routines could be modified for other computers with memory-mapped displays (they were originally produced for the Panasonic), the Pasca's attraction must be its integral twin 8in disks. If this is an essential feature, all well and good, but unless the Pasca is found to be exceptionally reliable, a more cost-effective solution can probably be found elsewhere.
Magic Wand is a very comprehensive word processing package produced by Small Business Applications Inc of Houston, Texas. It runs under CP/M and is one of the most versatile micro-based word processor systems currently available.

The test was carried out on a 64k Intertec SuperBrain running CP/M 2.2, with twin double-density minifloppy disk drives and an Epson MX-80 dot matrix printer. The version of Magic Wand tested had been specifically adapted to the SuperBrain and the computer itself had a set of special function keys replacing the normal numeric and cursor control keys.

Magic Wand comes as two separate programs: a text editor, with which you prepare your text, and a text formatter, which types the text in a format specified by you during the editing stage.

**Editing**

The editor is called from CP/M simply by typing EDIT and the file name, which can be either a new file or one already existing. You can type a second file name on the same command line and the results of your efforts will then be saved under this second name, which is useful if you want to leave the original file unaltered. Otherwise, Magic Wand saves text under the first file name and preserves the original file as a back-up.

Once the editor has been loaded, you're asked to insert the disk holding — or to hold — the text file and if the editor can't find the named file on the disk it asks you to confirm that you're working on a new file; this ensures that you'll notice if you intend to work on an existing file but had accidentally inserted the wrong disk.

You then find yourself looking at the command screen, which shows you what files are in use, the number of words and characters in the text buffer, the number of characters remaining and the current line length and tab positions.

A range of commands can be executed from the command screen, most of which are activated by only one or two letters. Typing an illegal command or a '?' causes a menu of all commands to be displayed; typing a command followed by '?' provokes a terse, single line explanation of the command.

Having set up the screen line length and any tabs you need, you move from the command page by pressing return. If you're working on an existing file, you find yourself at the top of the text; with a new file, the screen blanks disconcertingly — the electronic equivalent of a fresh sheet of paper.

The Magic Wand editor provides all the facilities one expects from a good screen-oriented word processor. There's no need to hit return when you near the end of a line as the system has automatic word wrap-around — if the whole word won't fit onto the line, it's completely transferred to the start of the next line, which aids readability tremendously. Not pressing return takes a little getting used to but it speeds up editing significantly; you can, of course, use return to force an end of line — at the end of a paragraph, for instance.

Special function keys are provided for all the inserting and deleting. You can insert/delete a character at a time simply by positioning the cursor at the appropriate place and pressing the required key; the line is opened or closed automatically on the screen as you type. A 'full insert' key opens up several lines on the screen to allow you to type in large chunks of text — the mode is cancelled by hitting the same key again. Other keys allow you to scroll back and forth both a line and a page at a time, while another pair provides an instant jump to either the top or the bottom of the text.

Search and replace commands are provided via a special key; pressing it drops the cursor to the bottom line of the screen and you type in the strings to be searched for/replaced on this line. Search/replace operates on the text between the cursor position and the text end. A repeat search key is provided and is self-explanatory. Replace will take place on all occurrences of the specified string or on a specified number of occurrences; a query option is available, which allows you to miss out some occurrences if you wish.

Two commands deserve special mention. The Include command allows you to specify a file and incorporate all parts of it into your text. Thus you can have a file of standard paragraphs on disk and select from them as you compose your text. The system displays the text to be included and gives you the option of either slotting it in or moving on to other parts of the Include file.

Spool enables you to print and edit simultaneously. Having edited one file and saved it on disk, you can then get on with editing another, using Spool to print out the first one. The theory's fine but I found it nearly unusable since the system gives priority to servicing the printer with the result that response to the keyboard slows down dramatically, to well over a second between pressing a key and the character appearing on the screen, in some cases. It's pretty debatable whether using Spool would actually save you any time.

The block commands are straightforward but only allow you to have one block active at a time. Yes, there's a special key to insert block markers but these have to be deleted by returning to the command screen and using a special command after you've carried out your block operation.

The editor allows you to print a draft copy of your text; the printout is exactly what you see on the screen, which means that any embedded formatting commands (see below) are printed instead of being executed.

The text buffer holds 37,633 characters, just over 6000 words or 13 single-spaced A4 pages. Once the buffer is full (you're warned in advance) you must save the text to disk and continue on a new file. Magic Wand won't handle a file which is larger than the text buffer. If you're working on very long texts you may find this a trifle annoying as you'll have to split text into chapters or sections; it does mean, of course, that while you're working on chapter nine you can't zip back to chapter three to check what you said there. On leaving the editor, you are given the choice of saving the text on disk, either as a new file or as an update to an existing file, or of simply quitting without saving the text.

**Formatting**

Having prepared your text with the editor, you must first save it on disk before running the formatter program, which is called simply by typing PRINT followed by the file name.

At this point an annoying inconsistency manifests itself. Once again,
Magic Wand invites you to mount the disk containing your text file and press return. However, the formatter has no equivalent of the editor's command structure; once the text file is mounted, printing starts immediately after you hit return. Printing can, however, be aborted and you can start all over again, this time prepared for the fact that instead of hitting return, you can also enter commands; one allows you to preview the formatting instructions embedded at the start of the text and alter them if necessary, although if other commands occur later in the text, they will be executed when the formatter gets to them.

As well as entering the formatting commands after calling the formatter, you can also insert (embed) them into text during editing; they are separated from the actual text by the `\' character. If you happen to want to print that character, you can define a different character (or no character at all) as the command recognition character. Various other characters with special meanings, such as `&' for ghost hyphenation, but you can also change at will at any time in the text file. The formatting commands themselves can be entered either as abbreviations or in full to make them readable to less experienced users.

Magic Wand has some very sophisticated formatting capabilities as well as the usual ones provided by most word processing systems. Thus you can not only specify either justification (both margins even) or range right (ragged right margin, as produced on a normal typewriter) but you can print out range left (ragged left margin, as in the left margin ragged, a sort of 'mirror image' to normal typing!

The system gives you total control over the page layout, although there's a minor, initially annoying inconsistency with the margin commands: lm10 sets the left margin at the tenth column of the page but rm70, instead of getting the right margin at the 70th column, as in most systems, actually sets the line length to 70 characters, so the right margin is the 80th column. To get a ragged right margin, you can define it (or pretend it's not there) and you're given the ability not only to page number anywhere you want to, even half-way through the text if you so desire. Magic Wand caters for text and paragraph indentation and allows you to centre lines or whole blocks of text between the margins. You can produce both page header and footers of however many lines you require. Line spacing can be set to any number from one to six.

An extensive range of commands is available; for instance, there are commands to create lists from a simple OUT command, which enables you to send out any ASCII control codes you like, to some very sophisticated commands for equalizing and footings of however many lines, with proportional spacing, bolding, underlining, super- and subscripting capabilities, etc — Magic Wand caters for all these features. This allows you to produce photographers' typesetting where the justification is achieved by varying the spacing between letters rather than by adding spaces between words, as is done with line printers. Using Magic Wand with an expensive daisywheel printer, you could easily produce camera-ready artwork for printing which would feature some extremely sophisticated formatting and be virtually indistinguishable from properly typeset work.

Other commands available include: a draft facility, which allows you to print a file containing specially printer commands onto a faster dot matrix unit so you can check the formatting; the choice of printing onto continuous stationery or of pausing after each page to allow the insertion of single sheets into the printer; and the ability to print multiple copies of the same document, with or without a pause between copies.

As the Epson doesn't permit variable spacing between letters, justification was performed by adding spaces between words and Magic Wand seemed to do this particularly intelligently, frequently inserting the extra spaces after full stops or in the middle of lines, instead of just at one end of the line, the result is a very neat printout.

Various facilities are included to make life easier for the operator. You can insert comments into the text file which will not be printed during formatting; NOTE prints a message to the screen only; WAIT stops the printing and waits for a command to be typed in (you can add a prompt which will appear on the screen); and SHOW prints on the screen the current values of any variables (see below) you specify, together with whatever explanatory text you require.

Summarising, the Magic Wand formatter is extremely powerful, as powerful as any user is likely to require without having resort to full typesetting facilities; it enables the user to produce simply-formatted documents with great ease and complex formatting with little extra effort.

Files and Variables

If the features I have described so far were all that Magic Wand offers, it would still be a powerful tool for many in the form of the provision for variables with accompanying commands which are on the verge of being a programming language, plus the ability to set up files which can be referenced by Magic Wand as it is printing text.

Files are set up using the editor as though they were pieces of normal text. The files can be either 'data', such as names and addresses, together with other details such as the salutation used for each person ('Dear Mr Harris,' or 'Dear "Bumper",') and any other formatting you require, or they can be paragraphs of text which you might wish to incorporate into standard letters to customise them.

There are four types of variable: string, numeric, formatted and system and you can have up to 128 variables in any one file. String variables can be up to 56 characters long (you can set them to shorter lengths to save on memory space) and you can reference the first n characters of a string. Numeric variables are positive integer only in the range 0 to 32767. Formatted numeric variables, used mostly for amounts of money, are printed out to two decimal places with commas: 10 000.5 would be printed as 10,000.50, for example and you can set this to print out in continental format: 10.000,50.

These variables can have their values set by different programs in the text file, using the SET command; from the keyboard when you run the formatter, using the GET command; or from a data file — it's this last capability which makes Magic Wand a very powerful tool indeed.

The system variables are for page number (the only one alterable by the
user), the pass number for when you're printing multiple copies of a document, then both number for when you're accessing an end of file marker, current line and column numbers and the number of lines left on the page. You can use this last to force a new page before printing a heading if there aren't enough lines of text after it — that way you avoid ending up with a heading on the last line of a page.

If the variables are conditional commands which allow you to test for a condition and act according to its value: IF NAME = "Fred", SKIP 4. This way, the program skips four lines if the value of the string variable "NAME" was "Fred", for example. So, you can get variables from a file of, say, names and addresses and print one of a variety of different paragraphs according to the variable's value.

You could use Magic Wand for many applications without ever using the variables feature; with variables, you have a word processor of great sophistication and power which would provide a very useful tool in a business environment.

Learning and documentation

As you will have gathered from the above, if you want to exploit the full potential of Magic Wand, you have a lot of learning to do. Fortunately, this is made very easy by what must be one of the best examples of documentation in the micro world.

The first two-thirds of the manual are a series of lessons which take you step by step through all of Magic Wand's abilities. The lessons use a series of text files which come on the disk with Magic Wand — you play the part of Abraham Lincoln's secretary, working on a draft of the Gettysburg address, which you have to polish and alter until the actual address results. You then go on to set up standard replies to various types of letters (from friendly to threatening), a file of names and addresses so that each person gets the reply he deserves.

At each step you're given a photograph of what the screen should look like and reproductions of the printout produced by it. These are very useful for checking that you're actually doing what you're supposed to be doing. The lessons are structured so that you can drop out at whatever level meets your requirements — there's no need to wade through files and variables if you want to use Magic Wand for straightforward editing and formatting. Great care has been taken to explain any technical terms in full as they arise so that the complete novice can sit down with the manual and feel quite at home with the system from the start.

The final section of the manual contains summaries of the editing, formatting, files and variables commands. Two of the commands which appeared on the editor's command screen were nowhere explained in the manual but this apart, the summaries were well-written, logically laid out and easy to use.

The book also includes a brief introduction to CP/M, explaining all the features which are likely to be of concern to Magic Wand users.

Users

Because of its wide-ranging facilities, Magic Wand should prove useful to all four of our 'standard' users (outlines in the introduction to this series last month), although some of them would have to accept certain limitations.

The text buffer capacity of just over 6000 words could be regarded as a handicap unless you accepted the minor inconvenience of working by chapters and storing them as a series of separate files. The author/journalist would be most affected by this feature and in fact this user would be unlikely to make much use of many of Magic Wand's capabilities, especially the files and variables facilities. On the other hand, many authors would find the hardware/software combination attractive.

Magic Wand is easy to learn to the level required for this use and the SuperBrain, with its integral construction, sits tidily on a desk. The Epson is a very civilised little printer for this application.

For the report writer there's again the 6000 word limitation but this is probably less of a problem than for the author. Again the report writer would probably not use the package's more sophisticated facilities but the very extensive formatting features would be of immense value in this application.

Coupled with a high-quality daisywheel printer (the Epson would be useful only for rough drafts to check formatting), Magic Wand should fulfill most report writers' needs.

The manager would also find Magic Wand useful, although he would certainly use only a few of its capabilities. His requirement for quick and easy learning is more than met by the excellent manual and, of course, the extra facilities are still there for him to get to grips with for urgent work on the secretary's machine. The Epson would be at home in the manager's office for draft work since it's neat and unobtrusive.

In the introduction to this series, I said that the secretary is probably the most demanding of all four users. Magic Wand has been devised quite clearly for use in a busy commercial environment and would meet most requirements in this environment. The manager is certainly well-served, and a busy office is hardly the place to sit and learn the advanced features Magic Wand offers.

Hardware

The SuperBrain was Bench tested in PCW, August 1980 so I shall not go into its technical features and will concentrate on its suitability for word processing.

Firstly, the keyboard felt a little flimsy to me — the keys have a very light touch and a rather tinny feel to them.

The display was quite civilised having a matt-finish screen to cut down reflections and a brightness control at the back of the machine. The character set is a little odd; characters such as 'g' and 'y' have proper descenders but these don't actually descend — instead, the characters are raised so that the bottom of the descender aligns with the bottom of other characters. It was most graphically described by Sue Eisenbach in her Benchtest as 'vaguely ransom note' but the novelty quickly vanishes and after a couple of hours I didn't even notice it.

The Epson has a capacity of 179 kbytes, about 25 500 words or 56 A4 pages (single spaced), which is probably adequate for many people. The disk drives on the model I tested were permanently running and this creates noise (not too much) but, more importantly, increases wear both to the disks and the drives themselves. You can reduce disk wear by removing the disks once you've loaded the programs and text but drive wear might prove a problem. Some models of the SuperBrain have been modified to turn off the drives when they're not required so this problem won't apply to those.

Any cheap printer with an RS232 interface will plug straight into the SuperBrain's auxiliary port. Any printer RS232 port is provided which makes linking to other computers, directly or via modems, quite easy. High quality daisywheel printers can also be hooked up and, because the SuperBrain comes with a built-in keyboard, you can cut down on trailing wires to trip over in the office.

The special function keys which replace the SuperBrain's control keys make the whole system very easy to use but at £50 they're very over-priced.

The Epson MX-80 is a very nice printer. It's very well made, as one would expect from Japan these days, is compact, light and very quiet. As the Benchmark results show, it's not particularly fast despite its bidirectional printing but the print quality is very good, as shown in Figure 1. Quite a variety of typefaces are available by simply changing a few parameters. With these, the emphasis - condensed gives a very dense, black character which would, at a pinch, pass for correspondence quality for those not-too-vital.
letters. By changing switch positions inside, you can get standard ASCII, English, French, German and Japanese character sets, the European character sets differing in that the English set gives a '£' sign instead of '£' and the others provide accents and umlauts. TRS-80 graphics are also in there, unless you set up for Japanese characters, which replace most of the graphics. Depending on which character set you choose, the Epson prints over 40, 66, 80 or 132 columns and takes paper from 4in to 10in wide. I tested the F/T version, which has both pin and friction feed; these mean that, by disabling the paper-out sensor (with a special control code or a screwdriver), you can print on single sheets. The printer will accept one original plus two carbon copies. It uses a cartridge ribbon which is very easy to fit and the print head can also be replaced by the user — the manual tells you how to do it and replacement heads cost about £15. The bell, incidentally, is very loud.

Summary

Magic Wand is designed specifically for commercial use and as an office tool it’s a winner, providing a wide range of extremely powerful facilities. The secretary will be its heaviest user but the report writer will also find it very useful for its powerful formatting capabilities. Thanks to the excellent manual, most users should have no trouble in learning the system to whatever level they require.

Coupled with Magic Wand, the SuperBrain is very good for word processing, especially when fitted with the special function keys, which make a major contribution to the system’s ease of use. The Epson is a very nice printer, certainly one of the better low-cost dot matrix printers on the market today. For draft or manuscript production it’s ideal, but serious users will require a daisy-wheel unit to produce correspondence and report quality material.

Look at it this way: No-one in their right mind would go out and spend £5000 on a motor car without first satisfying himself of its reliability, and overall value for money. Likewise with hi-fi. Whether you’re planning to invest several thousand pounds, or you simply need a cheap set of headphones, some products are bound to be superior to others, and mistakes can be expensive. The Hi-Fi Choice range is specifically designed to eliminate this element of chance. We can’t make your mind up for you. But we can provide the type of information that will help you decide for yourself. Alternatively, you could always buy a pig in a poke...

The Choice is yours.
John Nuttall tests an add-on which brings colour graphics to the PET.

The full PET and Chromadaptor configuration

Hands up all PET owners who have ever cast envious eyes at Apple's colour facilities. And how many even contemplated changing machines? Now, with the advent of a box of magic from Sadektronics Ltd, PET owners can cease fretting and bring some colour to their screens! The Chromadaptor is an add-on box which will enable PETs to talk in colour to any TV without modification. As a bonus, you won't even need one of those expensive sound boxes — CB2 sound comes down the aerial, too, and exits from the TV's internal speaker.

The basic principle is this: each one of the thousand screen locations in a PET has a corresponding memory location within the Chromadaptor interface. These locations can be programmed with any of the 16 colours available. One of the colours is background and the other is foreground. (On a standard PET screen the background is black and the foreground white — or green on later models.)

The interface is assembled, with its own mains power supply, in an attractive metal case. It comes with all the plugs and leads you'll require, though edge extenders are not provided. It plugs and leads you'll require, though edge extenders are not provided. It comes with all the suitables for installing and running the product. First, the personality card has to be fitted inside the PET. This is designed to fit where the video RAM chip sits. If that chip is socketed, remove it, plug in the card and finally re-instate the chip in the socket on the card. If there isn't a socket, you have problems. The instructions recommend desoldering the chip, but this is an awesome task even for the skilled: don't forget the main PET PCB is double-sided! Better to gently sweat-solder an IC socket onto and over the resident chip. The card will now fit and the ribbon cable can be attached. Plug in the user port connector and the one to the back of the Chromadaptor and finally the screened lead from the interface to the TV aerial socket.

Now that the hardware is fixed, we can turn to the software. Before actually programming or running anything, I recommend spending a little time fine-tuning the TV. Programs are supplied for this, as well as border adjustment pots on the Chromadaptor to ensure that the picture is optimised. Study of these 'demo' programs will demonstrate how simple it is to program in colour.

Perhaps I should state that all existing black & white programs can be made to run in colour by switching the software control mode (remote) to local. Thumbwheel switches are provided to manually determine foreground and background. (I understand that these switches have been dropped from current production models of the Chromadaptor, which is a pity, but in either case a simple POKE command will do the trick.)

Programming in colour sounds frightening, but it isn't! It may be done from Basic (direct or programmed) or

<table>
<thead>
<tr>
<th>COLOUR</th>
<th>b/ground</th>
<th>f/ground</th>
</tr>
</thead>
<tbody>
<tr>
<td>dark black</td>
<td>0</td>
<td>0</td>
</tr>
<tr>
<td>dark red</td>
<td>16</td>
<td>1</td>
</tr>
<tr>
<td>dark green</td>
<td>32</td>
<td>2</td>
</tr>
<tr>
<td>dark yellow</td>
<td>48</td>
<td>3</td>
</tr>
<tr>
<td>dark blue</td>
<td>64</td>
<td>4</td>
</tr>
<tr>
<td>dark magenta</td>
<td>80</td>
<td>5</td>
</tr>
<tr>
<td>dark cyan</td>
<td>96</td>
<td>6</td>
</tr>
<tr>
<td>dark white</td>
<td>112</td>
<td>7</td>
</tr>
<tr>
<td>black</td>
<td>128</td>
<td>8</td>
</tr>
<tr>
<td>red</td>
<td>144</td>
<td>9</td>
</tr>
<tr>
<td>green</td>
<td>160</td>
<td>10</td>
</tr>
<tr>
<td>yellow</td>
<td>176</td>
<td>11</td>
</tr>
<tr>
<td>blue</td>
<td>192</td>
<td>12</td>
</tr>
<tr>
<td>magenta</td>
<td>208</td>
<td>13</td>
</tr>
<tr>
<td>cyan</td>
<td>224</td>
<td>14</td>
</tr>
<tr>
<td>white</td>
<td>240</td>
<td>15</td>
</tr>
</tbody>
</table>

Table 1.

Fig 1
by machine code. I'm just starting a modest CEEFAX-like information package in colour for an exhibition. This was done in Basic, with machine code subroutines to change or flash colours.

You must first set up the colour output code, and this is normally done at the start of your program (see listing):

POKE 59459,X

if X = 255 then change both f/ground and b/ground as required;
if X = 240 then change b/ground only as required leaving f/ground white;
if X = 15 then change f/ground only as required leaving b/ground white;
if X = 0 then disable change of colour facility leaving white on white.

On power-up, the output code will be 0 and the colour code 255, which is white on white. If you are only using a colour TV this state of affairs means you won't be able to read anything, which is why I regret the removal of the mode select switches on new models! I've actually disconnected my VDU and replaced it with a Sony 16in television. However, you can run both the VDU and TV in tandem.

If the output code is 240, then only the background colour is effective. If the colour code (see below) is 27, code 11 is ignored and only code 16 is used. Similarly, if the output code is 15, then only code 11 is accepted. Both codes remain valid until changed. Once the output code is generated, you will need to select the colour code into the address 59471. This is done prior to POKEing or PRINTing characters or graphics (see Table 1).

So, POKE 59471,155 will produce a red background with a yellow foreground. The colour code is the sum of the numbers representing the desired background or foreground.

Figure 1 is a simple program to demonstrate some of the colours on a black background.

**Final verdict**

The quality of construction and display are splendid. This is one of the best TV interfaces I have seen, with none of the shake and judder of lesser models. No doubt contributing factors are the design, especially of the power supply, and a good 8 MHz modulator. While the picture is rock steady, there is a slight halo effect with colour. Selection of background and foreground needs care, otherwise you'll end up with hatching. Perhaps a professional monitor, or taking the signal to the TV's gun would obviate the problem. An RGB outlet is provided for such a connection. That said, listings are legible and editing easy.

The manual mentions a colour chip and, although this isn't available yet, it could make colour programming more direct. No doubt there will be a time penalty for program execution. The Chromadaptor isn't cheap, but it does the job very well and answers a real need. It is also Commodore-approved. For those with tight budgets, you might consider the Monadaptor at £45.00 + VAT, which plugs onto the user and cassette ports and is of good design.

This product could be a useful item in schools, where the output might drive a 26in TV. That should solve the problem of 20 bodies huddled round a

---

PET! Businessmen might have a look at the Banner program which comes with it, and is a sort of 'telecaster' for messages in large print. It's somewhat different from the usual display program in that it scrolls from right to left and, of course, in colour. Some clever stuff here!

Available from: Sadektronics Ltd, 1 Northwest House, 45 West St, Brighton, Sussex Tel 29949.

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Contract Bridge is one of the most interesting and skilful of card games, ranking alongside poker in its complexity. Many computer programmers are also bridge enthusiasts, so I expect that many of my readers will, at some time or another, have considered the possibility of writing their own bridge program. Let me warn you from the outset — this is a most daunting task. I would expect a competent programmer to take three times as long to write a bridge program as to write a fairly respectable chess program, and the size of the bridge program would be much larger — with less than 32 kbytes you might as well forget it. But since most of you who own or have access to computers will have at least 32k at your disposal, writing a bridge program is a task that can be undertaken by anyone who is prepared to devote a lot of time and effort.

In writing about computer bridge I shall attempt only to outline some simple principles which will enable the reader to write a working program. The game is sufficiently rich in ideas that stronger bridge players will be able to extrapolate from my article and include a number of more advanced concepts in their programs. Anyone who writes a 'simple' bridge program based on these articles will be able to enjoy an undemanding game without the need to find three other (human) players.

**How to play bridge**

I do not wish to go into a detailed description of the rules of the game, but some of my readers may not know how to play, so some explanation is essential. This will also enable those of you who play other bidding games to learn the principles of programming the bidding phase, which can be carried over to other games. The principles of playing the cards might also be useful in programming other games which are based on taking tricks. So don't give up if you are not attracted to the idea of programming bridge — what you learn here may help you in other games.

Contract bridge is played by four players, who form two partnerships. A normal deck of 52 cards is used, and at the start of a hand each player is dealt 13 cards. The players start by bidding for the right to play the hand, and whichever side makes the highest bid then tries to make the number of tricks indicated by that bid.
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The point of the bidding phase is to try to reach the optimal contract, partly by conveying information to your partner about the strength and shape of your hand. In order to be able to determine what contract you and your partner should be playing, it is important for you to know something about each other's hand. This is accomplished by the bidding, but before determining what contract to bid, every bidder must know what is higher than or equal to the previous bid. A partnership does not have a completely free license to pass information back and forth during the bidding, as this would lead them into an impossibly high contract. So the most important thing to do during the bidding is to try to reach the ideal contract by conveying the maximum information, in the most economical manner. Let us examine the bidding of a hand of bridge to see how information is conveyed.

For the sake of convenience we usually refer to the four hands of the compass: North, East, South and West. We shall assume that West was the dealer, and that the bidding goes like this: (players' thought processes in brackets).

West: Pass (I have a weak hand);

North: One diamond (I have a stronger-than-average hand with two good suits. I shall bid the lower ranking suit first to indicate only that I have more than an average hand with two good suits);

South: Four spades (My partner has at least four spades in his hand so we at least have four spades, which was playing to make the contract, or to be more precise, the suit of his partner is weak we will not have enough strong cards in the unbid suits to make a no-trump contract); No Trumps - the number part of the bid indicates the number of tricks that must be made if this bid is the final contract (number of tricks - number bid); Spades: 10, 3

East: Pass (I also have a hand that is no better than average, and since my partner is weak we will not have enough combined strength to make any contract);

South: One spade (I have two biddable suits, but I have more spades than hearts so I shall bid spades first);

North: Two spades (My partner has at least four spades in his hand so we at least have nine spades out of 13 between us. Obviously spades will be a good suit for us to play a contract in);

East: Pass;

South: Three hearts (I must show my partner that I have another biddable suit);

West: Pass;

North: Three spades (My first spade bid indicated only that I had reasonable spade support for my partner. Now I should tell him that I have more than minimal spade support and that I do not have enough strong cards in the unbid suits to make a no-trump contract possible);

East: Pass;

South: Four spades (My partner has at least four spades and probably holds the king of spades and aces. He also has four or five diamonds so he does not have many clubs and hearts. I have the Ace of hearts so we are unlikely to lose more than one heart trick, and I only have two clubs so we cannot lose more than two club tricks before I can trump any further clubs that are led. So we ought to be able to avoid losing any more than three tricks, and four spades seems quite possible);

West: Pass;

No Trumps (Enough is enough);

East: Pass.

The above bidding and thought processes represent an over-simplification of what was going on in the minds of the players. But it does serve to explain the type of thought processes that one goes through when bidding in a simple fashion, I ought perhaps to mention at this stage that by reaching certain contracts a partnership may qualify for a 'game bonus' if the contract is made. These game contracts are: 3 No-Trumps; 4 Hearts or 4 Spades; 5 Clubs or 5 Diamonds. Making a lesser contract allows you to score the game bonus later on if you can make another contract that counts, together with the earlier contract, for enough points to make a game. I will not go into the scoring system in this article, but you should study an elementary book on bridge before writing your program, so that the scoring will be correct.

In order to make the bidding phase easier and to ensure that information is conveyed economically, various bidding systems have been invented. In a bidding system, each bid has a fairly precise defined meaning, and by correctly interpreting a bid, a player will understand more about his partner's hand. One useful tool employed in many bidding systems is what are known as 'high card points'. This points method usually counts 4 points for holding an Ace, 3 for a King, 2 for a Queen, 1 for a Jack or singleton (a suit with only one card, other than an Ace), 4 for a void (a suit with no cards), 1 for each card after the first five in a suit. Using this point count method, various rules of thumb have been developed, including:

a) Do not open the bidding with fewer than 12 points;

b) If you hold 12-15 points you should open one of your best suits;

c) Do not open the bidding with fewer than 12 points;

d) In order to make a three No-Trump contract the combined hands should have not less than 24 points, preferably 25 or more.

The above rules can all be broken, under the correct circumstances and, in fact, the same bid can mean many different things in the same situation, depending on which system of bidding

| Spades: 10 | N 9 7 5 2 | Spades: 9 5 3 |
| Hearts: J 10 7 6 | Q 5 3 | Hearts: K 4 3 2 |
| Diamonds: Q 8 2 | W E | Diamonds: K 10 7 6 |
| Clubs: Q J 4 3 | S | Clubs: A 9 8 6 5 |
| Spades: 6 | A 5 3 | Spades: 4 2 |
| Hearts: R 3 2 4 | | Hearts: 6 4 |
| Diamonds: 6 4 | | Diamonds: 7 2 |

PCW 69
the partnership is employing. The most important thing to remember about bidding is that bridge is a partnership game. It should not be your position that will decide how you bid, but rather your partner's hand. Another important consideration is that the partnership is employing. The most important thing to remember about bidding is that bridge is a partnership game. It should not be your position that will decide how you bid, but rather your partner's hand. Another important consideration is that the partnership is employing.

### How to program a bidding system

Before writing your program, decide what bidding system will be used in the program and make a long list of what the various bids can mean in different circumstances. Whenever the program must make a bid it determines the circumstances under which the appropriate bid should be made, and then looks at the list of bids to see what the particular bid should mean in those circumstances. These two processes, the making of the correct bid and the interpreting of the partner's bid, can each be aided by keeping a number of important variables and updating them in the light of new information transmitted or received. The following variables might usefully be employed when deciding what bid to make or when interpreting a bid made by one's partner:

- **Max Clubs** (the maximum number of clubs that have been shown so far by the player who is bidding this hand);
- **Min Clubs** (the minimum number of clubs dealt in the bidding);
- **Max Diamonds**;
- **Min Diamonds**;
- **Max Hearts**;
- **Min Hearts**;
- **Max Spades**;
- **Min Spades**.

By storing values for all the above variables, the program can build up an idea of the way in which the suits are distributed in his partner's hand. For example, if a partnership is employing a bidding system in which 13 points is the minimum number for making an opening bid, a player who makes an opening bid is known to have at least 13 points so his Min Points is initially adjusted from 0 (the default value when the hand is dealt) to 13.

Adjusting the distribution variables is a particularly difficult matter. At the start of a hand the four Max variables are set at numbers which may be deduced from the holding of the hand under scrutiny. For example, if the computer is making the first bid for West in the above hand, it sets Max Spades = 5, Max Hearts = 6, Max Diamonds = 10, and Max Clubs = 4. The next thing the program needs to know is how long a suit might be, and therefore whether he has described the distribution of the suits in his partner's hand, or he has described the distribution of the suits in his own hand. In addition to knowing how long a suit might be, it is also very useful to have some indication as to how strong a particular hand might be.

This can be accomplished using two variables called Max Points and Min Points, which indicate the known limits of strength of a hand as indicated by the number of high card points in the hand. For example, if a partnership is using a bidding system in which 13 points is the minimum number for making an opening bid, a player who makes an opening bid is known to have at least 13 points so his Min Points is initially adjusted from 0 (the default value when the hand is dealt) to 13.

Deciding what to bid—a simple algorithm

When faced with the decision of what bid to make, a number of complex factors enter the thought processes of a good bridge player. Here we are discussing the problems of writing a relatively simple bridge program, and so we must try to employ a relatively simple bidding algorithm. I have devised such an algorithm, which lacks the subtlety of an advanced bridge player, but which ought to provide the computer with the ability to make bids that are reasonably intelligible to a reasonably sensible player. The algorithm applies to any bidding system, so you may choose any system that you like, preferably from a book on bidding. One word

Special conventions in bidding

There are a number of special bidding conventions, each of which may be used in a particular situation. Often these conventions take the form of a question and an answer. For example, the Blackwood convention is employed by the NS pair and the E-W partnership to ask the partner how many aces he holds, and how many kings he holds. This information is particularly useful if your partnership is employing a small slam (12 tricks) or a grand slam (13 tricks). The asking bid in Blackwood is 4 No-trumps, and the replies are:

- 5 clubs, when holding no aces (sometimes this reply is given when holding all four aces);
- 5 diamonds, when holding one ace;
- 5 hearts, means two aces;
- 5 spades, means three aces.

In order to avoid the possibility of asking too many questions your partner has simply bid five no-trumps, and he bids the number of kings at the six level (6 clubs is 0 or none, 6 hearts is 1, 6 diamonds is 2, 6 spades is 3, 6 no-trumps is 4). When the Blackwood convention is employed, the program can update the variables such as:

- **Number of Aces**,
- **Number of Kings**,
- **Number of Queens**,
- **Number of Jacks**,
- **Number of Queens**,
- **Number of Diamonds**,
- **Number of Clubs**,
- **Number of Hearts**,
- **Number of Spades**.

Another popular convention is known as Stayman, and consists of a two club asking bid after your partner has bid one no-trump. The asking bid enquires whether partner has at least four cards in either hearts or spades (or both) and when he holds four or six, he responds by bidding five hearts or five clubs. The use of this convention is helpful when making a slam decision.

Another popular convention is known as Blackwood, and consists of a four clubs bid after your partner has bid one no-trump. The asking bid enquires whether partner has at least four aces, kings, or both, and when he holds four or six aces, four kings, or eight subtractions, he responds by bidding five clubs or five hearts. This case he should respond by bidding the appropriate suit (or the better suit if he holds at least four clubs in each of the two suits). If the program asks this question on its own, it will use the reply to update the variables Min Spades, Max Spades, Min Hearts and Max Hearts, according to the reply bid.

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- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer (not available yet – but coming soon!)
- Advanced 4-chip design: microprocessor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

coming soon - the ZX Printer.

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alpha-numerics across 32 columns, and highly sophisticated graphics. Special features include COPY, which prints out exactly what is on the whole TV screen without the need for further instructions. The ZX Printer will be available in Summer 1981, at around £50 – watch this space!

16K-Byte RAM pack for massive add-on memory.

The new 8K BASIC ROM used in the Sinclair ZX81 is available to ZX80 owners as a drop-in replacement chip. (Complete with new keyboard template and operating manual.)

With the exception of animated graphics, all the advanced features of the ZX81 are now available on your ZX80 – including the ability to drive the Sinclair ZX Printer.

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To Sinclair Research Ltd, FREEPOST 7, Cambridge, CB2 1YY.

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<td>Sinclair ZX81 Personal Computer kit(s). Price includes ZX81 BASIC manual, excludes mains adaptor.</td>
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ROMs and RAMs
I would be grateful if you could answer some questions on chip compatibility:
1. Can static RAM be used as a replacement for dynamic RAM?
2. Can memory space be increased just by replacing one chip with another of a higher capacity?
3. Can unprogrammed ROM be used instead of RAM or does the first usage 'fix' it?
4. Can I replace the 2114s in my Micron with another chip to double the on-board memory space?
D Johnson, Merthyr Tydfil

Listings wanted
Where may I obtain a listing of a Basic, Fortran or Cobol interpreter?
J Mason, Hemel Hempstead

Try Lifeboat Associates or Interam Ltd. However, they are unlikely to supply you without you entering an agreed licensing agreement on which machine you consider installing the software and the estimated sales you envisage.
I assume that is not what you mean, though; remember that the result of a great deal of work worth many thousands of pounds, so a fully documented source assembler listing is not going to come free.
It is possible to dump the hex codes of an existing interpreter to a printer but you will have to decipher them. Alternatively, you could get a disassembled copy which would be easier to read but still a long way from a documented listing.
J Mason and Cobol do not lend themselves to being interpreted and are usually compiled. I don't know of any such versions but I'm sure that someone will write if there are any.

POKE and PEEK
I am experiencing a great deal of trouble understanding POKE, PEEK and USR functions on my system. I am getting on fairly well with Basic. Can I damage my computer by experimenting with them as I gather that they put things in, and take them out, of RAM?
D Gugent, Dublin; R Southern, Northallerton and others

PEEK, POKE and USR functions give you a way of looking (PEEK) at any memory location, altering it (POKE), and running a machine code subroutine (USR). None of these can physically damage your system, but random unskilled use of POKE will almost certainly corrupt your Basic interpreter, Basic program, or some other critical routine, making your system crash sooner or later. You letter says 'putting things in ROM'; just a small point but important nonetheless: you cannot put things (POKE) into Read Only Memory, you can only look at (PEEK) its contents. POKEing it will have no effect.

You can write machine code programs and POKE them into RAM from a suitable Basic program. As a machine code program runs more quickly than its Basic equivalent, this is particularly handy for things like animated graphics display. You must, however, consult your computer's manual for details of where in RAM the machine code can be POKEd. Then you can activate the machine code program Basic using USR. The format for USR varies from machine to machine but it's often something like USR(N), where N is the starting address of the machine code. Using PEEK, POKE and USR will need a deeper understanding of your computer than Basic programming. It is not easy to go much further in a reply like this. Join a local user group/club as it is far easier to be shown than to have to struggle on your own.

PET turn-off
How do you turn off/on the RUN/STOP key on a PET?
D Barnett, Barnsley

PET turn-off
You can write machine code programs and POKE them into RAM from a suitable Basic program. As a machine code program runs more quickly than its Basic equivalent, this is particularly handy for things like animated graphics display. You must, however, consult your computer's manual for details of where in RAM the machine code can be POKEd. Then you can activate the machine code program Basic using USR. The format for USR varies from machine to machine but it's often something like USR(N), where N is the starting address of the machine code. Using PEEK, POKE and USR will need a deeper understanding of your computer than Basic programming. It is not easy to go much further in a reply like this. Join a local user group/club as it is far easier to be shown than to have to struggle on your own.

More garbage
Thank you very much for your helpful answer (in the January 'Computer Answers') to my question on sorting strings in relation to 'garbage collection'. My experience of this problem is with the Superboard II. Is it true that all versions of Basic have this problem, including Z80-based machines? I Wood, Bourne End

Garbage collection is not a function of the processor but of the operating system and/or high level language. It is a problem which occurs with all versions of Basic but many
Dodge the alien Ramships and fire missiles to destroy them before they get you. The alien Flagship uses his deadly laser bolt to transform a Ramship into another Flagship or into your ship’s double. Look out! Destroy your double and you could destroy yourself.

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Other programs included are HORSE RACE, LUNAR LANDER (with moving spaceship), NOUGHTS AND CROSSES, NIM, SIMPLE SIMON, HANGMAN, LIFE, MASTERMIND, PINCH and seventeen others.

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of them deal with the problem so well that the user may feel that there is no problem at all. In many cases unused strings are allowed by the system to accumulate in memory until it starts to fill up. At the danger point the system initiates a garbage collection routine and the problem is solved. This entails much movement of data through memory and in slow machines can take a long time (many minutes!) to complete. On fast machines the problem is not noticeable to the user but on some micros it can be most annoying.

There are solutions to the problem, mainly in the form of faster processors like the Z80A running at 4 MHz. One is to force more frequent collections on the principle that "little and often" is not noticeable. Another, fundamentally better, way is to make sure that the machine code garbage collection routine is as efficient as possible. That careful attention to these points can pay off is illustrated by the fact that having had no real problems with garbage collection delays with word processors on the earlier 8-bit microcomputers designed for commercial use.

P L Melimoye

48 OK for WP

I am thinking of buying a microcomputer for use as a simple word processor, as well as for general home/business use. I suspect that a VDU line length of at least 64 columns is virtually necessary, which is a pity as I am otherwise considering an OSI Superboard C1E, which offers only 48 characters on a line. As journal editors usually ask for manuscripts to be double-spaced, would it be possible to replace each space by two spaces on the screen by two spaces in the line. As journal editors refer to the space between lines not words, this makes it easier to edit copy, correcting spelling, alignment, house style, etc — and most word processors provide a facility for varying the number of spaces between lines. Alternatively, some printers can be made to print with double line spacing, usually by an internal switch.

As for the Cegmon monitor for the Ohio Superboard, I have no actual experience so far (perhaps readers could send in their findings?). Certainly the Superboard set-up would be cheaper than a Level II TRS-80 Model I. But for your extra money you would be getting 16k of RAM rather than eight and a Z80 processor rather than a 6502. It is certainly possible to replace each space by two spaces on the screen by two spaces in the line. As journal editors refer to the space between lines not words, this makes it easier to edit copy, correcting spelling, alignment, house style, etc — and most word processors provide a facility for varying the number of spaces between lines. Alternatively, some printers can be made to print with double line spacing, usually by an internal switch.

P L Melimoye

HP speed-up

Having tidied up our programs and acquired a Hewlett Packard 9830B as recommended in the February 'Computer Answers', we still need to find a speed-up execution times. Are there no other possible solutions?

P. F. Hussey, Ministry of Agriculture, Surrey

Firstly, to re-emphasise the points made in the February issue, not only is a compiler not the best tool to have if you are looking for a full Basic compiler is not available for this machine and Fortran is not available on it at all! However, there are some solutions, thanks to an American company called Infotec. They make replacement boards and ROM packs for the HP 9830 which can lead to programs executing some ten times faster, without any alterations to the programs. If you are using cassette data and/or program storage then some further time can be saved by using the Infotec floppy disk drive for the 9830.

Fitting with these solutions to the speed problem is that, being based on hardware, they are relatively expensive, although still a lot cheaper than buying a faster computer.

These Infotec products for the HP 9830 are marketed in the UK by JSQ Data Systems of Windsor, Berks. You should also think of joining the HP Basic Users club. The contact is Nigel Stephens, Confederation Life, 50 Chancery Lane, London WC2.

P L Melimoye

Apple expansion

I own an Apple II (integer) with 48k RAM and tape input. I want to expand to be able to use floating point and word processing using an electric typewriter interface like the one supplied by Rochester Data. What is your advice on the best way to do this?

Thomas E Williams, SHAPE, Belgium

The most obvious way to expand to floating point is to use Apple's own Floating Point Basic or Applesoft. This can be obtained in several forms such as on disk or as ROM. Since you don't have a disk drive then the simplest approach is to buy the Applesoft firmware card and use this. One attractive advantage of using this card is that you can have both Integer and Applesoft languages resident in the computer and you can simply switch between them. This may be of particular interest to you as I expect that you may have many programs written in Integer so using this board enables you to run them easily.

As far as word processing is concerned, you should look through the various advertisements that appear in the magazines for suitable programs — and read PW's word processor benchmarks! There are several programs, such as Apple's Word Processing package. However, most of these will be on disk and if you are going to actively use your Apple for word processing then you should seriously consider buying a disk drive. This has the advantage that you can load in Applesoft into RAM and so avoid the expense of purchasing the firmware board, although you lose the previously mentioned ease of switching between the two boards.

M Dennis

Photo micro

I am an amateur photographer and would like to do my own processing. Is it possible to put the following applications on any micro and is the NewBrain suitable?

a) build an exposure meter for darkroom use and instead of wiring in a meter, take the voltage to the analogue input.

b) use the micro to turn various devices on and off at programmed intervals (I read in an August PCW and it was double-Greek to me).

Barbara Morgan, Leeds

The answer to both your questions is qualified yes: it does require quite an appreciation of digital electronics. If you are serious then I suggest you start reading magazines such as Electronics Today International and Personal Electronics, both of which frequently have articles aimed at the micro user. They are also both becoming more 'micro' aware and patience will eventually produce results like exposure meters and timers are very much their stock-in-trade. However, you are likely to find it cheaper and easier to buy one of many kits for these particular uses, which, although not micro based, unfortunately for you, don't use micros but a dedicated collection of bits and pieces.

If you are still game then try and join a local computer club where you are bound to find someone only too pleased to assist you in return for membership fees and your help in program writing. As far as your choice of micro goes, you might be better off off the beaten track and try and join a club where they have the Infotek floppy disk drive but still several forms such as on disk or as ROM. Since you don't have a disk drive then the simplest approach is to buy the Applesoft firmware card and use this. One attractive advantage of using this card is that you can have both Integer and Applesoft languages resident in the computer and you can simply switch between them. This may be of particular interest to you as I expect that you may have many programs written in Integer so using this board enables you to run them easily.

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**MICROCHESS**

by Kevin O'Connell

**THE DEVIL STRIKES**

The devil referred to in the heading is 'Mephisto' or Mephistopheles. Mephisto is a stand-alone chess machine which happens to be the only one manufactured in Europe. It is fitting that it is made by a Munich firm, Hegener & Glaser; since computer chess generates more popular interest in West Germany than in any other country except perhaps Hong Kong or the USA. Running on the 1802, Mephisto has phenomenally long battery life but very little computer power compared with machines using the 6502 and Z80.

Mephisto was programmed principally by Thomas Nitsche of Munich. He and his team of programmers were also responsible for Farwell which performed so disappointingly in the World Computer Championship in Linz (see PCW, December 1980) despite running on an apparently powerful system comprising a Siemens SMS2 (128k RAM) and 128f (8080A) each with 6k RAM — a grand total of 2 megaraytes of RAM!

By comparison the commercial Mephisto machine seems puny, with just 1k RAM and 6k ROM, but its purchase price of £125, combined with its playing strength, ensured that it was a complete sell-out when it came on the German market last year.

Although Mephisto didn't win the Hamburg - Munich Computer Open last year, it did fare quite well, as you can see from Table 1. The new experimental Mephisto (with 8k ROM) being prepared for the 1981 market was tremendously successful at the annual micro tournament in Stockholm last December, as can be seen from the scores in Table 2.

A three-round tournament is a very short event, but Mephisto was a very clear winner. Here is an interesting win by Mephisto against one of the programs which shared second place. The game is particularly interesting because both sides give up material for positional considerations.

**White: Mephisto X (level 6)**

**Black: Mychess (Level 4)**

7. Bd5xd7+
8. N4d-e2
9. 0-0 (Ke1-g1) 0-0 (Ke8-c8)
10. Be1-e3
11. f2-f3
12. Ne2-f4
13. Nf4-d5
14. Qd1xd5

Both sides have completed their development and White has an edge, thanks to Black's weak and backward d-pawn.

14. ... Nc6-d4
15. Rf1-c1 Ke6-b6
16. a2-a4 h7-h5
17. Qd5-c4

White needs to find a way to dislodge the knight from d4 so that decisive play can be built up along the d-file.

17. ... a6-b5
18. Be3-g5

But now White should have continued the logical plan with Nd1 and c3, followed by putting his major pieces on the d-file as a prelude to winning the a-pawn.

18. ... Rc8-c6
19. g5-f4 Re8-c6
20. Nc3-d5 Ne4-e6
21. c2-c3 Ne6xf4
22. Nd5xf4Bg7-h6
23. g2-g3 h5-h4

Here, or on the next move, Black should really capture on d4 but Mychess seems to prefer bishops to knights.

24. Re1-f1 h4xf3
25. h2xf3 Re8-e6
26. Kg1-f2 Bh6-g7
27. Qc4-b5 c5-c4
28. Nf4-d5

and White won easily. The game ended:

44. Qf2-f8+ Kb7-e7 45. Qf8-f3 Ne6-d4+ 46. Kg1-h2 Re4-e4 47. c3xd4 Rd7-h7+ 48. Kh2-g1 Rh7-d7 49. Qf3-c3 Ke7-b7 50. Qc3xe4 Rd7-d4 51. d4-d5 Rd8-d8 52. Qc4-e4 Rd7-d7 53. Qe4-e5 Kb8-c8 54. Qe5x5 Kg8-c7 55. Ng2-f4 Rd8-e8 56. Qg5-g7+ Ke7-b7 57. d5-d6 Rd8-e8+ 58. Kg1-h2 Re1-c1 59. Qg7-d4 Re1-c1+ 60. Kh2-h3 Re2-c2 61. d6-d7 Rc1-h1+ 62. Kh3-g2 Rh1-h6 63. d7-d8Q mate.

**New developments**

Many new chess computers were unveiled at the Consumer Electronics Show in Las Vegas in January and at the Nuremberg Toy Fair early in February. Both hardware and software showed obvious signs of having made great strides over the past year and it is probably correct to say that the top machines in the range are of a completely new generation.

**GOTO page 127**
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Colin Stanley, Joint Managing Director, H B Computers.

This was a very professionally handled and managed event and I was extremely pleased with the turn-out.

J. D. Hartmann, Manager, Customer Services Dept., Tandy Corporation.

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Tim Moore, General Manager, Newbury Laboratories.

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Michael Hendry and Maurice Shepherd suggest a low-cost but fast file storage and management system.

The two most commonly-used storage media for microcomputers are audio cassettes and floppy disks. Although audio cassette-based systems are inexpensive, they are neither convenient to use nor particularly reliable, especially with regard to the interchangeability of tapes recorded on different machines. Disk systems, on the other hand, offer high data transfer rates, greater reliability and a software or firmware disk operating system but they are expensive— a dual-drive mini-floppy is likely to cost at least £600. It was this large price difference that led us to consider the possibility of a tape-based system which, while retaining the reliability and file-handling advantages of disk storage, could be produced at a considerably lower cost.

The initial decision was to base this alternative system on digital recording, where the tape is always magnetically saturated in either polarity, rather than audio encoded recording, and to use a very reliable and proven digital recorder. The Philips mini digital cassette recorder (DCR), with a quoted irrecoverable error rate of 1 bit in 10^7 bits, met these requirements and is available at less than half the cost of most mini-floppy disk drives. Modification of a standard audio cassette drive was rejected as a useful approach. The development of a working system involved providing a hardware interface between the DCR and the micro bus and also writing software which would give the user facilities similar to those of a typical disk operating system.

The specific objective was to operate two of the Philips mini digital cassette recorders from a Nascom microcomputer. In this article we shall discuss the various design considerations in fairly general terms and give a more detailed description of the tape operating system devised for Nascom.

**The Philips DCR**

The Philips mini digital cassette recorder is a relatively small unit, fitting approximately into a 4in cube. Mechanically it is very much simpler than a floppy disk drive which suggests that it should have better overall reliability. It is a twin track machine which reads and writes phase-encoded data at 6000 Baud. The Philips digital mini-cassette recorder (Figure 1) has approximately 115ft of 0.15in wide tape which is certified free from drop-outs; the tapes have a runtime of about 90 seconds and can store 64k 8-bit words on each track. Unlike some of the existing audio recorders, the tape is hub driven — there is no capstan — resulting in tape speeds of 10-15in per second depending on the distribution of tape between the two spools. This is equivalent to tape densities of 560-330 bits per inch. A single motor drives the tape in either forward or reverse directions and the tape direction can be reversed in less than 0.15 second. The entire unit, including the motor and the integral signal interface board, requires a +12 V power supply and has a nominal current consumption (motor running) of 120 ma.

The signal interface board, which is largely CMOS, is mounted at the back of the DCR and uses the nine status, data and control signals described in Table 1. The status signals CIF and WEN are derived from sensing microswitches in the DCR and the BET signal is activated by circuitry on the interface board which detects when the motor is stalled on reaching either end of the tape. Removal of either of the plastic write-enable plugs from the cassette automatically prevents data from being written to the relevant track of the tape as well as activating the status signal WEN. All these signals use +12 V positive logic.

The WDA line requires phase-encoded data at a rate of 6000 Baud + 1 percent. This can be obtained by XORing normal data with a 6kHz data clock as shown in Figure 2. Phase encoding ensures that the tape magnetisation polarity is reversed at least once for each data bit. The output signal RDA can be read using the positive going edge of the internally-generated RDC signal as a strobe. It is essential with phase-encoded data that the read clock is properly synchronised in that it only stobes after valid transitions, ie the arrowed transitions in Figure 2. This is achieved by prefacing the 'real' data with a repetitive 1010 binary sequence known as the preamble, such as the hexadecimal character A, and which is subsequently responsible for synchronising the read electronics. Blocks of data are written onto the tape with the general format shown in Figure 3; the cyclic redundancy check characters are generated externally. Data can be written synchronously, ie, without the start and stop bits obligatory in asynchronous serial transmission, with a consequent improvement in storage density and byte transmission rate. A transmission rate of 6000 Baud of synchronous data is equivalent to 7500 Baud of asynchronous data.

Tape transport is controlled by the FWD and REV lines. WCD gates data onto the WDA line and if data is not sent the tape is erased. There are a number of timing requirements regarding the control signals which must be met and which are given in detail in the DCR manual. These allow, for example, for the finite start, stop and reverse times of the tape transport.

---

**Table 1**

<table>
<thead>
<tr>
<th>Status</th>
<th>Description</th>
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<tbody>
<tr>
<td>CIF</td>
<td>Indicate end of recording or of a track.</td>
</tr>
<tr>
<td>WEN</td>
<td>Indicate write enabling.</td>
</tr>
<tr>
<td>BET</td>
<td>Indicate the end of the tape.</td>
</tr>
</tbody>
</table>

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**Fig 1 Philips mini digital recorder with cassette.**
The micro DCR interface

One may now look at some of the practical aspects of designing an interface to operate between the DCR signal interface and a microcomputer bus. The necessary functions include (a) address decoding, (b) latching DCR control signals from the data bus, (c) tri-state buffering of DCR status signals onto the data bus, (d) phase-encoding serial data, (e) generation of a 6 kHz clock signal and (f) voltage translation between the micro TTL logic levels and the 12 V logic of the signal interface board. These can all be done using relatively simple TTL and/or CMOS. A rather more complicated chip is required for the necessary parallel to synchronous serial conversions. Since our particular application involved a Z80 bus the obvious choice was the Z80 SIO (Serial input/output) chip but there are several other chips available which could be used such as, for example, the Motorola MC6852 series. The Z80 SIO chips and their Mostek equivalents have, until recently, been rather difficult to find in the UK. They have also been quite expensive but the manufacturers’ prices have now dropped considerably. The SIO, which is available in several versions with different bonding options, is a programmable dual channel device which can handle most synchronous serial protocols as well as asynchronous serial-parallel conversion. In the synchronous modes it can generate and check cyclic redundancy codes (CRC) and provide the necessary character synchronisation. It also has the Z80 vectored interrupt facilities. Being a programmable device, like the more familiar Z80 PIO, its versatility depends on appropriate software. The SIO allows the programmer access to three read and seven write registers and the device manual extends to almost 30 pages. A brief summary of the programming methods will not be attempted.

One further requirement of the interface is that interblock gaps can be detected. This is necessary in order to be able to rewind the tape to the beginning of a specified block. One means of doing this is to monitor the output of a retriggerable monostable with the input signal being the RDA line.

A schematic diagram of a micro-DCR interface, showing the main interconnections, is given in Figure 4. For the sake of simplicity, this diagram only shows one set of DCR control signals although a single SIO, being a dual channel device, can support two DCRs. With a Z80 system, the buffer, the latch and the SIO can be conveniently addressed through the I/O ports – on other micros direct memory addressing may be necessary. An alternative approach is to use a special purpose cassette controller chip. In our experience this did not have a sufficiently marked effect on the overall chip count to compensate for the loss of the very versatile 280 SIO.

The prototype wire-wrapped Nascom interface board and the two associated digital recorders are shown in Figure 5. This particular board also includes the 2k tape operating system (TOS) in two 2708 EPROMs and the TOS workspace in two 4118 static memory chips. These

### Table 1
The DCR interface signals.

<table>
<thead>
<tr>
<th>Status Signals</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>CIP</td>
<td>Cassette in position.</td>
</tr>
<tr>
<td>BET</td>
<td>Beginning or end of tape detected.</td>
</tr>
<tr>
<td>WEN</td>
<td>Write-enable plug in position.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Data Signals</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>WDA</td>
<td>Input channel or write amplifier.</td>
</tr>
<tr>
<td>RDC</td>
<td>Internally generated read data strobe.</td>
</tr>
<tr>
<td>RDA</td>
<td>Output channel of read amplifier.</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Control Signals</th>
<th>Description</th>
</tr>
</thead>
<tbody>
<tr>
<td>RWD</td>
<td>Tape driven in forward direction.</td>
</tr>
<tr>
<td>REV</td>
<td>Tape driven in reverse direction.</td>
</tr>
<tr>
<td>WCD</td>
<td>Information gated to WDA line.</td>
</tr>
</tbody>
</table>

* Descriptions of status and control signals refer to the active low condition.

---

**Table 2**

**Write block subroutine**

**Rewind subroutine**

**Fig 2**

Data Clock

| 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |

Data

Phase Encoded Data

| 1 | 0 | 1 | 1 | 0 | 0 | 1 | 0 |
Software

The software for the interface described above must include a set of routines which will, for example, read and write blocks of data, backspace and tape through a block of data, rewind the tape and provide error checking. These routines involve (a) programming the SIO (or equivalent device) and/or (b) handling the DCR interface signals, within the constraints imposed by the various timing requirements of the DCR.

The simplified flow charts in Table 2 illustrate a write block subroutine and a tape rewind subroutine. The write block example also requires SIO programming to deal with the preamble, the data and the CRC generation. Software loops can give the necessary delays.

These various routines may then be amalgamated into an overall tape operating system (TOS) which permits specific files to be written, read or deleted.

TOS

The actual set of commands devised for the Nascom TOS are given in Table 3. These are all single character commands, similar to the Nascom monitor commands, with up to three obligatory arguments. TOS supports two DCRs but runs with only one DCR present although the transfer command (T) is obviously inoperable under these circumstances. The TOS software occupies 2 kbytes and was located at D000 in the prototype.

TOS makes extensive use of NAS-SYS monitor routines and automatically detects whether the NAS-SYS 1 or the NAS-SYS 3 monitor is being used; it will also operate with either a 2 MHz (making it compatible with Nascom 1 using NAS-SYS) or a 4 MHz system clock.

The operation of TOS can best be explained after examining the format of a TOS written tape track (Figure 6). The directory and the data blocks are all 2 kbytes long. The directory contains all the necessary information on the status of that particular track, i.e., a tape track identification number and the filenames and filetypes of all files stored on the track and the specific data blocks that these files occupy. A file of less than 2k occupies an entire padded-out 2k block; similarly an 8.5k file, for example, requires five data blocks. A single tape track has a storage capacity of 56 kbytes, excluding the directory.

On entering TOS (for example by E D000) the tapes in both DCRs are rewound and both directories are read into RAM directory workspace. After all write or delete commands the relevant RAM directory is updated and then rewritten into the appropriate tape directory block.

The simplified flow charts in Table 2 illustrate a write block subroutine and a tape rewind subroutine. The write block example also requires SIO programming to deal with the preamble, the data and the CRC generation. Software loops can give the necessary delays.

These various routines may then be amalgamated into an overall tape operating system (TOS) which permits specific files to be written, read or deleted.

Table 3 Nascom TOS command table

<table>
<thead>
<tr>
<th>COMMANDS:</th>
<th>(obligatory argument)</th>
</tr>
</thead>
<tbody>
<tr>
<td>DCR</td>
<td></td>
</tr>
<tr>
<td>filenumber</td>
<td>:= two digit decimal number</td>
</tr>
<tr>
<td>start</td>
<td>:= four digit hexadecimal number</td>
</tr>
<tr>
<td>end</td>
<td>:= four digit hexadecimal number</td>
</tr>
<tr>
<td>B DCR</td>
<td>Saves the current BASIC program on the specified drive.</td>
</tr>
<tr>
<td>C DCR</td>
<td>Displays the catalog of the specified drive.</td>
</tr>
<tr>
<td>D DCR (file number)</td>
<td>Deletes the specified file from the specified drive.</td>
</tr>
<tr>
<td>I DCR (filenumber)</td>
<td>Initialises a 'blank' tape in drive A.</td>
</tr>
<tr>
<td>J DCR</td>
<td>Cold start to Basic.</td>
</tr>
<tr>
<td>N DCR</td>
<td>Jump to NAS-SYS monitor.</td>
</tr>
<tr>
<td>P DCR</td>
<td>Save the current NASPEN file on the specified drive.</td>
</tr>
<tr>
<td>Q DCR</td>
<td>Warm start to NASPEN text editor.</td>
</tr>
<tr>
<td>R DCR (filenumber)</td>
<td>Rewinds both tapes and reads the catalogs of both tapes</td>
</tr>
<tr>
<td>T DCR (filenumber)</td>
<td>Transfers the specified file to the other drive.</td>
</tr>
<tr>
<td>W DCR (start) (end+1)</td>
<td>Writes binary code from location start to location end as a new file to the specified drive.</td>
</tr>
<tr>
<td>X DCR</td>
<td>Rewinds the tapes in both drives. (cf. R)</td>
</tr>
<tr>
<td>Z DCR</td>
<td>Warm start to Basic.</td>
</tr>
<tr>
<td></td>
<td></td>
</tr>
</tbody>
</table>

If an error is detected, the block write/read cycle is repeated and if an error persists after the second attempt then an error message is displayed and the

GOTO page 147
Coming as it does shortly after the recent successful Voyager probe to Saturn, this program is particularly well timed. It programs the TRS-80 or Video Genie to produce a complete and highly accurate simulation of the solar system. All of the orbits of the various planets are correctly calculated, as are their orbital speeds and gravitational pulls. Each time the game is played, the members of the solar system are differently placed, but still in correct relationship to each other and to the Sun. Hence every game is different and presents different problems to the player. There are only one or two small deviations from actual fact. One is that each planet has a mythical shuttle orbiting it from which, if you can get into orbit with the planet, you can draw fuel and so continue your journey. The purpose of the game is to blast off from the planet of your choice and travel throughout the solar system. There is no other purpose. There are no prizes, no free goes, nothing else. If you succeed in making a landing on another planet, then your reward is the thrill of having been able to do so. And for some inexplicable reason, it really is a thrill. Probably this is because the game is unbelievably difficult as all of the physical laws and relationships are obeyed. Although the player of this game has the help of a computer, it will only tell him the statistics of the journey. It is for the player to decide how much fuel to take on, what thrust to use, whether to try and blast off slowly so that fuel can be taken on at the orbital station (this, incidentally, is mandatory where the gravity is very high, such as Jupiter, as it is not possible to take off with enough fuel to attain escape speed) or whether to try and get away from the home planet as quickly as possible. The astronaut has three maps to which he may refer. The first is of the outer planets, the second of the inner planets and the third a close up view, if he is in the proximity of any planet. Superimposed on these maps is the present position of the spaceship together with the last few positions which have been occupied. It takes a large degree of experience to play the game in order to make any headway with it at all. One has to get used to a whole new mode of travel where the attitude of the craft may bear no relation whatever to the direction in which it is travelling. At all times gravitational pull, the laws of momentum and many other considerations are acting on the craft's course. Furthermore, journeys are judged in lengths of months and years. For instance, if you take off from Earth and have a look at the map to see where Jupiter is, then point your craft in that direction, and blast, there is not much chance that you will get anywhere near Jupiter because by the time you get there it will be long gone! Just as the Voyager used Saturn to pull itself, like a slingshot, onto a different path, so the player of Astro Navigator can use the gravitational pull of planets to change course without having to use valuable fuel. Most of the time, of course, the craft is not under the control of its motors at all, but is coasting through space, affected, as we have said, by many different laws of the universe as it goes. Frankly, we are not sure why the game is so appealing, graphics are used but are really only subsidiary to the play. Probably it is simply the fact that one is entirely on one's own out there and will fail or succeed entirely by reason of one's own skills. For what it is worth, it is one of the very few programs in which we got so engrossed when testing it, that the session has gone on ever since! Astro Navigator is written in Level II Basic but is also compatible with Disk Basic. Tape for 16K TRS-80 or Video Genie...£15.70 including VAT and P & P.
We are pleased to announce the commencement of a new series of Adventure games. The series named "Mysterious Adventures" is written in machine language by B. Howarth, an English author. The first episode is entitled "The Golden Baton". The scenario is that you have been sent by the ruler of your own land to a strange province with the mission of discovering the whereabouts of the legendary Golden Baton of Ferrenuil, King of the Ancient Elf Kingdom. The baton mysteriously disappeared several years ago and whilst others have ventured to the land in an attempt to discover it, none have returned to tell their tale!

The program follows what has become the normal structure for Adventure programs. Like the original main frame Adventure, directions can be designated by just the first letter of the compass point and commands may be optionally entered with just the first three letters of the appropriate word. As usual provision is made for saving the game at any stage and such standard commands as Help, Inventory, Score and Quit are all available. Experienced adventurers will inevitably draw comparisons between this series and that of Scott Adams, so we will leave it to them to make their judgements! The only comment that we will make at this time is that we find it quite invigorating to play an Adventure game by a different author as obviously they construct their stories slightly differently. Mysterious Adventure 1, "The Golden Baton" is available on cassette for TRS-80 or Video Genie machines of 16K or more and on disk for 32K up machines. It occupies a full 16K. The tape versions save their game to tape and the disk to disk.

Tape version £8.75
Disk version £11.00
Both prices plus VAT and 75p P. & P.

TRS-80 & VIDEO GENIE SOFTWARE CATALOGUE £1.00 (refundable) plus 50p postage.

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TELEX 88736 SOTEX G
Several months ago, a reader and professional TI59 user, Mr Weaver, sent me an article from the German magazine Chip. In this article, the author reported the discovery of a method of doubling the execution speed of TI59 programs, which, as any patient user will know, is a badly needed and worthwhile improvement.

Unfortunately, the original article contained errors and was written in a rather obscure fashion, as a result of which Mr Weaver could not make it work. My own attempts to decipher the piece were no more successful, but before giving up hope I sent the piece to Norman Horwood, who has previously written on TI affairs for this column (see PCW 3-1, 3-5).

Mr Horwood's expertise in TI59 programming finally triumphed but only after a hard fight of most of the April issue and the lucky discovery of a vital clue which is omitted from the original piece!

Here is Mr Horwood's account of the method by which programs written under certain special rules, will run at double speed on the TI58/59 calculators.

The trick depends on fouling the operating system. The thinking is that the computer is running a module program, when, in fact, it is running your own program. As a result, the processor no longer interrogates the keyboard for user interrupts (eg: R/S, Pause, Trace) between every step executed, as is the case during normal execution.

This results in a 100 percent saving in processing time. The rules for writing programs in this Fast Mode are, however, very strict and rather limited possible program structures.

I shall demonstrate the technique by reference to two short programs. One I have published before in PCW (May 1980) called 'Auto-Folio', which demonstrates the main modifications required to allow the new system to work, and another, extracted from the Chip article and edited and modified to make it work at all, to demonstrate the speed advantage.

The system depends on entering the library module at an address where there is a merged code '91'. This is the Op Code for LRN. (Learn mode, used from the keyboard to enter program instructions.) It must have taken our EEC/WEEDs of being able to find this serendipitous coding, even if he/she knew what he/she was doing. Incidentally, it only seems to work with the Master Library Module (ML 1), at least 1 have been unable to obtain the fast mode with the Maths Utility Module, even having found a 31 coding in programs 6 and 170 at 458 and 454 respectively. The initialising procedure seems to be working but the speed is unchanged.

Apparently, with the ML 1 in place, the pseudo call via an indirect SBR op to program number 250, to the ML 1, and program number 2 makes the processor think it is in the module when actually processing an external user program. The processor no longer displays in this mode, so that after every operation the pointer no longer tests the R/S, Pause, Trace as in normal processing. This is where the time is saved. It does mean that special steps have to be taken to allow data to be entered during a run, since when a stop instruction is encountered in one of these special parts, it's leaving displays zero. The machine is now in fast mode, and almost anything will either crash or destroy the new mode, reverting to standard. A total reset has taken place and any contents of memory, data or program instructions has been cleared. It is possible to enter the learn mode, but the display has no obvious relevance (1803 S 2) except that the 92 is the code for 'EE'. Single stepping in this condition produces an incremental increase to the four figure number with the Op Code following the 92 (eg: 1810, 710, 1840). This shows that further stepping leaving the learn mode for ever; nothing can be done to feed another program by any method. The Repeat key is the only active key at this point, and this reverts the system to standard.

Any operational program now must be read into memory through the card reader. If there has to be a change of program to partition 'Auto-Folio', say, this must be part of the initialising process contained in the magnetic card list. After reading the program card/s, each bank number will be displayed in normal, and it is possible to employ protected cards. From the listings reproduced it can be seen that both the Fast Mode and the Operational Mode programs start at 000. This is for convenience, but it should be remembered that the Fast Mode (FM) program must end with a legal R/S (ie, preceded by either CLR or EE, INV, EE) or the processor will start immediately a card has been read and continue unstoppable until a legal R/S is encountered in the program. Once the required program is safely in memory it is possible to start producing output at any location by calling a subroutine and a three digit address. Indirect addressing is allowed, but the register must be pre-loaded with the address location when the operation is loaded into memory. It is not possible to manipulate memory data in Fast Mode from the keyboard.

In our examples both programs are started by SBR 000. It is now possible to edit the program by entering Learn without affecting the Fast processing, but if you list the coding and allow the printing to go beyond the program length, this will be catastrophic. If the listing is stopped by pressing R/S before reaching the end of your program, processing starts at that point and the pointer ends up where the remainder of the program takes it. The program remains in FM as long as the pointer remains in play.

As TI 58/59 owners will be aware, in order to produce hard copy of data input, especially where large volumes of results have to be accumulated and analysed from random records, one is forced to use the Trace Auto-Folio prints on the printer. This is fine for simple arithmetic entries where each data entry is accompanied on the same line by the operation following (+, -, *). However, when data has to be accumulated into analysed registers the Trace system prints each data value twice and the data register separately, taking three lines for each entry. The Trace Auto-Folio prints one data value and the register number together on the same line, and simultaneously sums the amount into the register, so that at the end of a session (eg: INV 2nd List) produces a full analysis of the data. The partitioning used in the example makes 99 registers available.

The procedure is simple. With the original, standard speed version the value is entered with + or - (+/- key) and 'A' pressed — the display clears then the desired analysis register number is keyed in (1 to 99) and R/S pressed. After about four seconds the value entered and the data register number are printed on one line. In Fast Mode, the keys A,B,C,D,E are no longer available so the program has been looped at step 061 to return the pointer to the start position. This allows the R/S key to be used for both entries. The new procedure is therefore enter the value — press R/S — and the display clears — enter the register number as before and press R/S. This time it only takes two seconds for the print-out to complete. The TI 58 will not dwell on the HIR Op codes here as this aspect has been fully covered before, except to note that while the FM initiation program clears everything out of memory, it leaves the pending operation stack (HIR) and the T register alone.

Compiled by Dick Fountain

THE TEXAS TICKLED

CALCULATOR CORNER

Compiled by Dick Fountain

THE TEXAS TICKLED
The conversion from normal sub-routine calls which are no longer legal has been combined in this case at steps 027 to 034 combined with 072 to 075, and 039 to 046 combined with 076 to 079. Here, the GTO instruction has been combined with flag setting, testing and unsetting. This gives reasonable flexibility with safety, and I think, is better than GTO with variable indirect addressing, as long as there is enough program space and you don’t run out of flags. I am wary of introducing non-data numerical instructions in the middle of computation, as this usually means that the computed data must be saved somewhere and brought back safely — very risky.

The second example is lifted straight from the Chip article, duly edited to make it work. This is a simple iterative loop which calculates factorials, and is a neat method for comparing processing times. The procedure is to load the FM program, run it by R/S, R/S, and load the Factorial program card, initialising it if necessary; all program cards require a new value, so be careful to leave the result in the display as well as print it. If you change this, don’t forget to change the loop address to DSZ, 00, 00, 08. to allow for the two extra routine calls which are no longer legal. Finally, would someone please tell me why PCW will find space to print them when someone finds them. I hope this works? N Horwood

<table>
<thead>
<tr>
<th>Initialise fast mode</th>
<th>045 86 STF</th>
</tr>
</thead>
<tbody>
<tr>
<td>046 02 02</td>
<td></td>
</tr>
<tr>
<td>047 54</td>
<td></td>
</tr>
<tr>
<td>048 65 X</td>
<td></td>
</tr>
<tr>
<td>049 01</td>
<td></td>
</tr>
<tr>
<td>050 00 00</td>
<td></td>
</tr>
<tr>
<td>051 00 00</td>
<td></td>
</tr>
<tr>
<td>052 95 =</td>
<td></td>
</tr>
<tr>
<td>053 69 DP</td>
<td></td>
</tr>
<tr>
<td>054 04 04</td>
<td></td>
</tr>
<tr>
<td>055 62 HIR</td>
<td></td>
</tr>
<tr>
<td>056 13 13</td>
<td></td>
</tr>
<tr>
<td>057 74 SM +</td>
<td></td>
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<td>058 00 00</td>
<td></td>
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<td>059 69 DP</td>
<td></td>
</tr>
<tr>
<td>060 06 06</td>
<td></td>
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<tr>
<td>061 61 GTD</td>
<td></td>
</tr>
<tr>
<td>062 00 00</td>
<td></td>
</tr>
<tr>
<td>063 04 04</td>
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<tr>
<td>064 22 INV</td>
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<td>067 70 70</td>
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<td>068 85 +</td>
<td></td>
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<td>069 02 02</td>
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<td>070 85 +</td>
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<td>071 01 1</td>
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<table>
<thead>
<tr>
<th>Auto - folio</th>
<th>000 25 CLR</th>
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<tr>
<td>001 00 00</td>
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<td>002 69 DP</td>
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<td>003 17 17</td>
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<td>004 25 CLR</td>
<td></td>
</tr>
<tr>
<td>005 91 R/S</td>
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<tr>
<td>006 82 HIR</td>
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<tr>
<td>007 03 03</td>
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<td>008 07 7</td>
<td></td>
</tr>
<tr>
<td>009 32 X: M: T</td>
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<td>010 25 CLR</td>
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The series has now reached the point where you have analysed your requirements, designed a system to meet them, chosen a machine and specified the programs that are going to run on it.

In previous articles I've blithely referred to 'your programmer' and maybe you do, in fact, have one. Some users have friends who are programmers, others will be working in firms which have their own data processing department writing programs for user departments. However, for many users and potential users of micros, programmers are alien. They don't know how to find one, how to recognise a good one, what to pay them, how quickly they should be able to work, how to tell whether they're doing a good job, or how to make them do the back and fix the bugs you found after they went.

Of course, there's a man-management side to this which is quite outside the scope of this series and you'll have to use your own judgement in such matters. But programmers aren't as easy to come by as plumbers, nor do they necessarily have recognisable qualifications and a regulating body like accountants or lawyers. So it's more difficult to recruit someone to come and do some programming for you.

Types of contract

There are several ways of hiring a programmer. You could employ one, or you could get one of your staff to go on a programming course. Alternatively you could buy in the services of a software house or a freelance programmer, either by the day or on a fixed price for the job. Each of these has its merits and drawbacks. The solution you choose will depend on a variety of factors: how quickly you want the job done, how long it is likely to last, how much you're willing to spend and what staff are available. I'll discuss each of these possibilities in turn.

Hiring a programmer

This makes the man-management side of things so much easier. The guy's on your payroll, in your office from 9-5, so you can see what he's doing and he can see what you're doing. I don't know which of these is more important but together they mean that he is part of a team. You can discuss problems as and when they arise and he can get a feel for the way your work is done.

There shouldn't be too much difficulty recruiting a programmer. You probably don't need anyone with a vast amount of experience and could probably do with a recent school or college leaver provided you can allow them time to become familiar with the machine. Quite a few schools and colleges now have micros so you could well find someone who knows how to program even if they were clueless about the applications side of it. Suitable qualifications are A-level Computer Science and the roughly equivalent, if more practical, City and Guilds 747. O-level and CSE GCE courses don't mean a lot on their own. City and Guild 746 is a part-time course covering only computer programming. An HND in Computer Studies should provide an ideal grounding for going into the world of commercial programming. Computer Science qualifications at HND or BSc level could indicate someone who was more interested in theoretical possibilities than in applications programs. You'll need to quiz them on what they've studied or, better, on what they've understood and appreciated about the importance of creating crash-proof, easy-to-use programs which conform exactly to the user's requirements. If at all possible, you want to find someone who's already familiar with the make of machine and the language you want him to use — if not, it could take him several weeks to get used to it and even more to become really fluent.

There are two ways of hiring — either as a permanent employee or on a fixed term contract. It's only worth doing the former if you're likely to have a regular supply of work, eg, if you want to computerise your whole operation a piece at a time it could well take a year or more, by which time you'll need to change and update bits of it. There is such a high turnover in junior programming staff that no-one is likely to want to stay more than a couple of years anyway. For a one-off job you may want to put someone on a six-month contract but be careful to put the length of the contract in writing before he starts or you may be in trouble with the employment department. You can't just kick someone out if he's been with you for more than six months unless you can prove he knew it was only a temporary job. Of course, this applies to any employee.

The sort of salary you could expect to pay for anyone with a qualification or training would be about £5,600; although many young would-be programmers would be willing to work for less on a project that really interested them or that gave them an entry into the profession. Look at the job ads in the computer press to get an idea of what rates are current in your area. It's much more expensive in the short term to hire a contract programmer: 1980 prices in London were in the order of £85 a week for anyone, that was for three years' plus experience, a good track record and long hours meeting short deadlines, so you could expect to get your program written much faster than by a junior.

The one thing you cannot get from a contract programmer or from an employee is a guarantee that he won't get sick or have an accident. You don't have to pay an absent contract programmer but you will have to wait until he gets back or start again with someone else. Except where two programmers have been accustomed to working together and doing things in the same sort of way, it is next to impossible for one programmer to pick up where another guy left off.

Calling in a software house

This problem of a contract programmer going sick and leaving you stranded is one reason why you might choose to pay more even for the services of a software house. They will offer you some sort of guarantee of continuity. Quite how much continuity depends on the size and competence of the company, the small print in your contract and a bit of luck. Going to a software house doesn't guarantee you better service but it probably helps. However, if you're a small guy yourself you may feel outgunned by a large concern and feel that they are going to regard your needs as rather insignificant. There are plenty of small software companies — just a few friends working together — who have a far greater vested interest in providing you with a good service (and getting paid promptly).

A freelance programmer comes in to this sort of category, differing from a contract programmer in that he will quote you a price for a job and will not necessarily work on it in your office. They advertise in all sorts of places — your supplier will probably have a list of them. Provided you check up on their references and look at work they have done for other people, you should be able to pick someone who is reasonably competent.
How good a programmer?

To assess how competent someone is to do a particular job, you need to start by thinking about the job you're asking him to do.

The first thing is that he's got to understand what you want done; if you don't think you're getting through to him, maybe he's not the man for the job. A college leaver has probably been encouraged to believe that the important thing in programming is to crack the intellectual problem that the job poses. This is not because teachers don't realise that you have to get the details right but, because there is only a limited time for a classroom exercise, they know if you get the principles right then you can build on them later. Unfortunately, it sometimes takes the students quite a while to realise just how much building has to be done to get all the details right. A guy like that may well believe he understands all that you are trying to say just because he understands the gist of it: a teacher might not knock off many points in a programming exercise if the student sets a credit limit of £5000 instead of £500 because it doesn't affect the logical program but it wouldn't do your business much good! If you're not sure whether someone has understood and grasped all the implications of what you're saying, then get him to tell it all back to you and ask him questions about it that would make him think about it in a different way. If you can find someone who has done a similar job before and can discuss it sensibly with you, then this is obviously a strong point in his favour.

The second thing a programmer has to do is analyse the logic of the program. This is the aspect on which many programming teachers concentrate. The details of the application, the language and the machine will vary from one job to another but the underlying logic will remain much the same. So, how do you assess, when you're interviewing someone, whether or not they can manage the logic? Many big companies use computer aptitude tests, which look similar to IQ tests. Obviously they can pick out the extremes of intelligence or obtuseness but apart from that I don't have much faith in them unless they are taken very seriously by both tester and tested and with great faith in them unless they are taken very seriously by both tester and tested and with very good prospects of it working first time. Anybody who hadn't already done this groundwork would take much longer to write the program and there is a greater likelihood of serious errors being found when the program was tested.

For this reason it is very difficult to prove just how long it will take to get a computer program working. It's tempting to make what looks like a reasonable estimate and then turn it into an absolute deadline and gear your expectations and your other arrangements to the system up and ready on that day. It is also tempting to set a deadline related to your holiday dates. Many projects are notoriously difficult to supervise because your programmer will spend at least as much time dealing with that 'one last bug' as he did creating the rest of the work. This is because he is creating program code which is not usually comprehensible to his supervisor; it can be quite difficult for one programmer to read someone else's program.

If the programmer is able to give you a reasonable estimate of the time and even if you add a bit to compensate for his optimism, this is almost as good as getting an absolute deadline. Timekeeping will be the task of the manager and a good one. The obvious ones are technical - getting an accounts system into an absolute deadline and gear your arrangements to the system up by the beginning of the tax year, for example. It is psychologically difficult to deal with a single deadline several weeks or months away; you always feel that there is a little delay that might actually be worth while. Potential problems might be partly due to a user himself. Sometimes, the deadline will be arrived at by the beginning of the tax year, for example. It is psychologically difficult to deal with a single deadline several weeks or months away; you always feel that there is a little delay that might actually be worth while; potential problems might be partly due to a user himself. Sometimes, the deadline will be arrived at by the beginning of the tax year, for example. It is psychologically difficult to deal with a single deadline several weeks or months away; you always feel that there is a little delay that might actually be worth while. Potential problems might be partly due to a user himself. Sometimes, the deadline will be arrived at by the beginning of the tax year, for example. It is psychologically difficult to deal with a single deadline several weeks or months away; you always feel that there is a little delay that might actually be worth while. Potential problems might be partly due to a user himself. Sometimes, the deadline will be arrived at by the beginning of the tax year, for example. It is psychologically difficult to deal with a single
Programming is a classic example of the rule of increasing complexity. Small increases in complexity lead to large increases in the time taken.

**Structured walkthrough**

This is currently a very popular technique for managing the work of programmers. It provides a convenient way of breaking down the work into manageable parts. Each part is allocated a week or two for completion (less for a simple job) and is then tested before the next stage is begun. This means that you always know roughly how well you are keeping up with the schedule. Nothing can guarantee that you will meet your deadline but at least you will get some warning if you are going to be delayed. A simple version of the method suitable for a micro application would be this:

**Session 1** - Give the programmer the specification of what he is to do. Write down as much of this as possible and give additional verbal explanations. Give him permission to look around at the work being done as this helps him to understand what is required. Let him go away and digest this information.

**Session 2** - Get him to explain how he sees the problem and how he proposes to go about solving it. Answer any questions. Repeat this session until you are sure the project is going in the right direction.

**Session 3** - The programmer should tell you how the work has been broken down into parts so that you can set up a rough schedule for program design, coding, testing and implementing. For anything other than a small program, this breakdown will have to be carried on at a lower level — program design will be split between the design of the various modules.

**Session 4** - Look at the first part of the work in detail and decide on tight deadlines but leave the final deadline rather hazy. Repeat this process for each of the parts of the work in turn, adjusting your idea of the final deadline in the light of the rate of progress you are achieving in practice.

**Session 5** - Look at the overall program design and get the programmer to explain it to you until you understand it. Don't let him blind you with science. Good logic can be explained perfectly well in English or with the aid of simple diagrams. Repeat this process for individual program modules.

Sessions 4 and 5 are then repeated for the program coding, except that the programmer should not be able to demonstrate the programs working on the machine. It is worth his while demonstrating individual program modules even if this means he has to arrange to be able to type in data items that the full program would have collected from files, or if he simply has results flashed on the screen that would eventually be typed into a full-blown report. Although this seems to involve extra work in the coding, it saves much more time in the testing stages and enables all concerned to have a better idea of how the work is progressing.

Program testing and implementation must then be similarly broken down into their stages and each stage checked off in turn. Although this seems to take up a lot of time, it saves the time that might have been wasted when serious errors showed up too late and it also keeps the project under better control.

**Getting ready for testing**

It is very important to be clear in your mind when you are designing programs and getting them written that you have to be able to test the programs and also that you have to be able to get your data into them in the first place. Next month I shall be following up the idea of the structured walkthrough to show how testing can be integrated into the programming effort.
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PET is the trademark of Commodore
What is a mug trap? That's easy — it's a trap for mugs! The sort I have in mind is the computer who doesn't know one end of a keyboard from the other. You know who I mean — the computer prints out something like: 'PLEASE INPUT A NUMBER 1 TO 207' and then pokes slow lips anxiously, 'What do I do?' and pokes at every key in sight very often a character key. As a result the computer curtly says: 'RE-ENTER?'

It often happens that programmes written by experts contain very few or no mistakes at all of which I wrote still doesn't work, despite expert help over dozens and dozens of hours. On the other hand, five similar kits worked right off! Must be one of those Monday machines I hear about...

Several new computing magazines have blown my way recently, published by colleges, universities, etc. The educational computing scene is really livening up! A fuller write-up must wait, but one of the more promising is called MicroScope, published by Newman College, Birmingham. The name is an acronym for MICROcomputer Software Cooperation for Primary Education (that's clever!) and contains the usual mixture of articles, programs and cartoons. However, the presentation is better than most and their stated future plans look very good indeed. Interested readers should write to Roger Keeling, Newman College, Genners Lane, Bartley Green, Birmingham B32 3NT. More on this next month.

Programs received

Cricket by Hugo Clark (15) of Nottingham;
Space Mines by Stephen Oliver (16) of Chester-le-Street;
Air Attack by P. Lloyd (14) of Tuebrook;
Space Intrusion by M. Morris (16) of Kingswinford;
Tennis Trainer by Anders Quarnstrom (16) of Helsingborg, Sweden;
Peter's Space by Peter Watts (12) of Pinner, Middlesex;
Morse Code Trainer by Jonathan Roberts (16) of Ilford;
Quiz Program by Luke Fitzgerald (10) of Reading.

That's a lot of goodies! If this keeps up, I'm just going to hafta buy myself a Tandy, a PET, an Apple, a ZX80, an Atom, etc, just so that I can play all these smashing games. I reckon Space Invaders has got a lot to answer for, though.

I was very impressed with young Luke's quiz presentation. Not only did he provide a listing and a flowchart but his quiz didn't contain a single question! That's right! He has written a drive presentation routine that reads a named quiz from tape. So you load the standard routine, run it, and it prompts you for the name of the tape file.
Malcolm Peltu investigates some introductory tomes while Don Finlay brings news of a great book for serious computer music freaks.

**Computing's not the simple life.**

The best way to look at computers is the second way you'd think of a motor car or a washing machine or a Kleenex. That is a prime specimen of the latest Computing Myth.

In the Preface on the first page of his Good Book, Jarrett comments: 'A computer is primarily a functional object — it does something. You don't necessarily need to know anything about how or why it works, or how it is made: all you really need is a list of instructions about how to use it...

...once you realise how easy programming really is and how easy it is to hand the computer a new program to handle away with, there's really no limit to the kind of things a computer can do.'

With an admirable brevity that characterises much of the Good Book, Jarrett manages to introduce and confuse three different activities. Firstly, the computer as 'device' is a perception that is valid when computing power has been wrapped up in a neat package, such as an automatic cash dispenser or digital watch. Secondly, to say that programming is easy is valid only for some programming tasks. Programming is not synonymous with computing. Thirdly, to claim that there is no limit to what computers can do inevitably implies that computing is more complex than just being concerned with solving simple programs written in Basic.

In order to bolster his Born Again belief in computing simplicity, Jarrett resorts to some of the old self-confessed days of transgression among dinosaur large computers in prehistoric days, all of ten years ago: 'Too many people hold too many rigid and unsubstantiated beliefs about what computers are, what they can and can't do, how and why they work,' he proclaims. 'This book is going to change all that.'

The myths he proclaims that the unenlightened still believe include: computers can think, are large, bureaucratic, expensive, have flashing lights, are run all the time, and run all the time. But computers needn't be all that different. And for the most part people would like to think so. Nothing like a bit of evidence to support the conspiracies to support the prejudices of a few prejudices. Or course there are some people who hold these giant computer myths to be true. But, as Rodney Dale and Ian Williamson pointed out in their Myth of the Micro, there is a much newer myth that, thanks to the micro, 'computers are shrinking out of sight.'

You play your prejudice, you takes your mythical choice. Jarrett makes a common mistake of science 'popularisers'. In the search for easy — to understand descriptions of complex ideas he clearly feels a guilty, relaxed 'feelm for many computing manifestations, particularly for personal computing enthusiasts, he gives a little real sense of the deeper structures beneath the surface.

The Good Book would have been much better if it had started with fewer pretentions and had focused its target audience more clearly. Much of Jarrett's good work in terms of its laid-back, easy reading description is spoiled by a failure to distinguish between fact and opinion and, at times, a tendency to mislead or inaccurate.

On the cover, the publisher trumpets: 'All you need to know about computers (and nothing you don't)'. Well, it doesn't contain everything 'you' want, given that it is aimed at the broadest spectrum of people. It also tells you things you don't really need to know about, like the meanings of test boost, rohedon, kludge and typesphere. Jarrett leads with his chin by claiming that other introductory books and dictionaries are usually dull, boring or out-of-date. The press puff issued with the book claimed: 'At last — a comprehensive, authoritative, fresh and enjoyable (and natural) introduction to the microcomputer at a price everyone can afford!'

Yes, it is British and it is cheap. But so are at least half a dozen other books on the market, like The Myth of the Micro and the Two Micro Revolutions, books by Peters Large and Laurie. Robin Bradbeer's Personal Computer Book is weightier (I weighed it, more practical, less puffed-up, and Martin Banks' Living with the Micro is more witty (to my taste) but without being as simplistic.

To accuse dictionaries of being dull and boring is the point, revealing a major flaw in the Good Book. Dictionaries are generally dull and boring because they are a reference aid. Accuracy, consistency and comprehensiveness are the critical factors. The Good Book's glossary, however, seems to have been written to be read like a book. As such, its (grosan) jokes (eg 'a semiconductor is Malcolm Sargent when he was still quite church organist'), its (grosan) treatment for entries on the same ilk (some companies get straightforward listing, others are dismissed with uninformative throwaway comments), its strange omissions and frequent inaccuracies are acceptable.

But as a handy reference, these traits become at best irritating, at worst misleading. For example, why include Apple but not Texas Instruments, Rodny Zaks but not Adam Osborne, viewdata but not teletext? Why state that ICL 'tends to make big computers and sells them in the public sector' when the significant thing about ICL is that it is selling to smaller systems and public contracts are a small percentage of it's sales? Why dismiss MicroFocus as a 'company that happens to have a competitive version of Cobol called CIS-Cobol' without pointing out the significance of CIS-Cobol in bringing Cobol to micros? Why, after criticising other books for being out-of-date, include entries (eg for Sinclair) which are likely to become out-of-date quickly? And why, oh why, is there no entry for structured programming? (After all, the book is supposed to be aimed at trainee DP people as one of its audiences.)

I am sure that many people will enjoy reading the Good Book and will get a lot of good advice out of it. Old computer hands will, in particular, find much of it amusing. Beginners will find its introduction before the glossary is very readable but it isn't as full as other books because so much is organised and presented as the glossary.

The Good Book will perform a valuable service if it convinces beginners that computing can be fun and is worth pursuing. But I am afraid that it will start off many people on the wrong simplistic footing.

Incidentally, the entry in the glossary for PCW is both inaccurate and irrelevant. And the entry for Practical Computing — 'the top British magazine for the personal computer 'buff' — is, I'm sure, a purely objective and unbiased view and not at all connected to the facts that PCW's first editor and the Good Book's publisher happens to be PCW's first publisher!

**Telling it how it is.**

The blurb on the cover of Carol Brown's The Minicomputer Simplified — an Executive's Guide to the Basics sounds as pretentiously overblown as that for the Good Book.

'How to understand computers' puffs and (here we go again), 'How to demystify the programming mystique.' But it also claims much more than its local aims. How to choose the right minicomputer, to tell the 'vendor' (it's an American book) what you want, to
negotiate a contract, to document a system.

But whereas Jarrett spayed his gunfire in the hope of catching a multitude of game, Brown fixes her sights firmly on a single target: management executives responsible for implementing a small business system (it applies equally well to micros as well as minis).

If I were a theatre critic, I would describe Brown's book as 'A Hit! A Palpable Hit!' She simplifies the description of the technology but never pretends that implementing business computer systems is easy; in fact, she offers a great deal of practical and fairly detailed advice on how to manage the difficulties and complexities. Although the book is comprehensive, it is never heavy. Because the jokes and lightheartedness (such as a chapter headed 'The Care and Feeding of Minicomputers') are rooted firmly in grassroots practically, they never intrude.

When Brown says she is giving 'Enough computer jargon to get by on,' that is just what she does, in eight easy-to-read pages. And she does not get drawn into the more esoteric byways of Jarrett's glossary. Unlike many other American writers, Brown also avoids consultantese and verbosity.

Her descriptions are frequently both funny and illuminating, a difficult task with a technical subject. She even finds a relevant new angle on the old bug metaphor: 'Program bugs, like cockroaches in the kitchen, hide; they choose their own time and place to venture out. Only the patient and vigiliant have a chance to eradicate them. Even then, the process of battling one bug may allow another bug to go unnoticed.' That is a good example of how to explain a technical problem in a way that is understandable and accurate.

Throughout the book there are neat nuggets of advice. On programming, for example, she suggests; 'assume that the program does not work at all and then, by thorough testing, prove it does.' In a section on interactive computing, she expands this into some derivation of Murphy's Law (that if something can go wrong, it will go wrong). Assume the operator is a gorilla, she advises, who will key the wrong thing at every opportunity. Give the operator lots of assistance by providing a meaningful dialogue of prompts and error messages. Assume that the line printer will malfunction during every job...

By pinpointing these practicalities, she graphically brings to the fore the need to build safeguards into the design. She also avoids trying to suggest that computers are a magic wand that will always succeed in improving business and profitability. (This myth is currently being promoted by the British government in its propaganda campaign to stampede British management into joining the 'micro' revolution.)

Companies who want a computer mainly because 'business is sick and a computer will fix it!' will find that the result is a computerised sick business, she warns. Don't get a computer just because a competitor has got one — how do you know that the competitor isn't making a cock-up of computerisation, she asks?

After a lot of sound advice on how to go about feasibility studies, choosing consultants and systems, etc, she ends up with a Horror Story case study of what can go wrong. She also likens a computer to a motor car. But whereas Jarrett said a computer was like a motor car or Kleenex, Brown uses the analogy to say that, just as there are many different colours and types of cars, so are there many types of minis.

(The analogy is poor, I think, but not as misleading as Jarrett's.)

The Minicomputer Simplified is not the Ultimate Source for computing information. It has a limited vision, fixed within the traditional ethos of business minis. It has little to offer the non-business personal computer enthusiast, although, D.I.Y. is relevant to the businessman interested in micros.

It is glib in its comments on the employment consequences of information technology and barely touches on the wider impact of information technology and the micro, such as the electronic office and integrating telecommunications and other services.

This limited vision, however, is the book's strength. Its market is clearly defined, frills that fall outside this aim are avoided and, most of the time, it hits Bull's Eye on its narrow target.

Man and computerman

Cybernetics is a branch of information theory and computing technology which takes us to the opposite extreme of the image of computer as Kleenex. It raises the question of just how far intelligent machines can evolve towards those qualities which are regarded as human.

In The Cybernetic Imagination in Science Fiction, Patricia Warrick turns a review of certain sci-fi literature into an informative and interesting book that analyses the nature of cybernetics and of the way cybernetic images reverberate throughout time, starting with early myths. (Greek mythology, not Micro Myths.)

Cybernetics is far from simple. As Warrick explains, 'Cybernetics comprises all systems, mechanical and biological, in which information plays a role. Information theory and general systems theory aim at describing the function of cybernetic systems.' She also says that information processing, computer science and artificial intelligence bring into focus arguments about the nature of consciousness. She then uses examples from (mainly American) science fiction to see how the artistic imagination has used cybernetics and robots as a springboard to explore many vital human anxieties, hopes and aspirations.

She offers sufficiently explicit summaries of key works to enable her thesis to be understood even by people who have not read the books. As she points out, many sci-fi stories are so
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devoid of characterisation and are so essentially characterless that an exposition of ideas and puzzle-solving, that a
summary of the stories is probably just as good as reading the whole thing.

She ranges widely through philosophy and literature, science and mythology in tying together her many themes, and
boxes herself into a Pseud's Corner and her division of works into categories like 'Isolated-System' and 'Closed-System'
models is unnecessarily confusing. I recommend it however, because it explores a wide variety of issues relating to
the impact of computers in a thorough, factual way, as well as venturing into imaginary realms.

If you are a sci-fi freak, Roderick by John Sladek is a new book in the cybernetic genre. It is about a robot called
Roderick and his (its?) journey throughout the universe electronic brain and something approaching human form. As
literature, it is more in the tradition of Catch 22 and other 'zany' satire than science fiction. I found it tough going at times.
But when Rodenick's adopted father bashes Roderick's head into a Pseud's Corner and her division of works into
categories like 'Isolated-System' and 'Closed-System'

Section I: 'Background' has five chapters, of which the first three are introductory, on principles and analogue methods.

Section II is entitled 'Computer-Controlled Analogue Synthesis'. Firstly, there is a chapter on analogue modules
such as the VCO, VCA, and VCF, with several circuit designs. Then conversion from digital to analogue or vice
versa, multiplexing and the first suggestions for multiplexed oscillators, one of which generates 16 independent
waveforms but has no provision for dynamic control, while the other is a Fourier-series oscillator more suitable
for an expressive solo instrument. An intelligent oscillator, which can accept high-level commands, is suggested, and a
modular digital synthesiser. Where cost prevents the all-digital approach, a hybrid system may be preferred, and a
design for a hybrid 'voice module' is presented — although I for one would not like to try to build a number of
these in a synthesiser, as the digital section alone needs about two dozen chips, and the analogue circuit has
many more components. There is also a brief description of two commercially available digital 'voice-per-board'
modules, by Solid State Music and Afl and respectively, which as far as I am aware have not been advertised in
the UK and could be of considerable interest.

Finally comes a chapter on music synthesis software. The hierarchy is discussed, deducing that at least five
different levels can be identified. The listing for a 6502 fixed-point arithmetic package is given by way of
illustration, and progress through the development is mentioned. Two more listings, with discussion, cover a
generalised digital filter and Fourier synthesis. The author's own NOTRAN (note translation) system, for organ
music, is described in some detail.

If this review reads like a catalogue, it is because there is so much information on many topics that it is difficult
to choose between them. The book should be on the shelf of every electronic music studio where development
work goes on, and its style, clarity and content make it an invaluable aid on computer interfacing to audio and
signal processing systems.
In this article I will explain how time and money are related and how we may calculate the effect of one on the other. A computer program is included which does the necessary calculations and which may help the businessman to evaluate projects and make financing decisions.

Time and money
Money in your hand now is worth more than money to be paid to you at some time in the future. However, you may sometimes wonder if you should spend some money now in order to get — or save — more money later on. If the savings are very large in relation to the cost, the decision is easy. For example, you may have to decide whether to spend £10 on a bus or train pass. If the savings will be £1 per week for the next year (a total of £52) then you don't need a computer to help you decide to invest.

Conversely, if the savings are very small in relation to the cost of the proposed investment, you will decide quickly not to invest.

Another fairly straightforward case is where a single payment will produce a fixed income, or saving, every year for the rest of time. In this case, the saving may be expressed as a percentage of the initial investment, and the result regarded as an interest rate. If money can be borrowed at a lower rate, or if you can use money which would otherwise be invested at a lower rate, then it would seem you should go ahead. For example, some houses are held on leasehold terms, which involve paying a ground rent each year. If you own such a house, you may be wondering whether you should try to buy out the freehold, and so not have to pay ground rent. Suppose that your ground rent is £80 per year and that, after negotiating, you find that you can buy the freehold for £400. In this case the saving (£80) is 20 percent of the initial investment. If you can draw the money out of a building society, or borrow from a bank at a lower rate of interest, then the figures suggest you should go ahead.

Complicating factors
In the real world, most decisions are more complicated than the examples above. For instance, a project may involve committing you to more than one payment, or the savings may only last for a few years, or they may not be the same amount each year. Most likely of all, you may find that you have not got enough money to go ahead with all the projects you have, even though you believe they are all worth while. And what about inflation?

All these problems can be catered for. The basic technique used by accountants is called ‘discounting’. All sums of money which are to be paid out, or received, at some time in the future are ‘discounted’ to find their ‘present value’. The present value of an amount X at some time in the future is the amount that would have to be invested at the present, at compound interest, to give that amount X at the specified time in the future. For example, if we are considering a project which will produce a single saving of £144 in two years time, and we reckon interest at 20 percent, we realise that £100 invested now at 20 percent would be worth £120 after one year, or £144 after two years. Thus £144 in two year's time has a present value of £100. (You needn't worry about the mathematics — that's what your computer is for.)

Once all the payments and savings involved in a project have been converted to their present values, they may be added together or directly compared. This technique is called 'Discounted Cash Flow'. There are two main ways of using it, called 'Net Present Value' and 'Internal Rate of Return'.

Net present value
This approach is suitable when money is available at a known interest rate, which may be because we have enough money for the project being considered, which will otherwise remain invested in a bank, building society, etc. The interest rate to be used is normally whatever is being paid by the bank, etc. Money is also available at a known interest rate if we know we can borrow it without difficulty. In either of these circumstances the computer will calculate the Present Value of all the payments and savings and subtract the one from the other to get the Net Present Value. If this is positive, then the figures suggest we should go ahead with the project.

There is an example of this type of problem later on, in the section on using the computer program.

Internal rate of return
The second approach is suitable in the more complicated, but more usual circumstances where there are lots of projects we would like to do, but no hope of getting enough money for all of them. Here we regard each project as a separate investment, and see what interest it pays. This rate of interest is the rate which would have to be paid by a bank to give you the same returns from the same investments as this project requires. In fact, it is the rate of interest which makes the Net Present Value equal to zero. This rate is called the Internal Rate of Return of the project. You then spend whatever money you have on the project, or projects, which give the best return. Again, there is an example of this type of problem near the end of the article.

How the program works
Lines 10 to 42 are headings, giving information to anyone who wants to work on the program in the future. Lines 50 to 90 initialise some of the variables used. Lines 90 to 320 get the user to enter the necessary data. (See following example for details of data to be entered.) Lines 350 to 495 present the user with a menu to enable him to select what he wants to do and jump to the appropriate section of the program.

If the user wants to do a Net Present Value calculation, the program jumps to line 1000, where it asks for the interest rate to be used, then calls the subroutine at lines 500 to 590 to calculate a discounted cash flow (DCF) table and finally jumps to the section starting at line 700 which displays the table on the VDU screen.

If the user wants an Internal Rate of Return, the program jumps to the section 1100 to 1220. This section sear-
TO BUY OR NOT TO BUY?

That is the cliche
most recent value of P1 is stored as P2, and the subroutine at line 500 is called again. This procedure is repeated with R being stepped back in smaller steps until P1 again becomes positive. We continue to step R back and forth in smaller and smaller steps until the step is less than 0.005, which means we are as close as we are likely to want. This is not the fastest or most elegant way of finding the value of R, but it works and does not need many lines of program.

This program was written for a computer with both a VDU and a printer. It was designed so that most of the output appears only on the VDU screen, but the DCF table can be printed on the printer if required. Both the section 700 to 760 (for displaying the table on the screen) and section 1300 to 1390 (for outputting the table on the printer) use the subroutine at lines 800 to 970 to do the actual layout of the table. The statement at line 710 causes print statements with the £ symbol to output to the VDU terminal; the statement at line 1320 causes the same print statements to send their output to the line printer instead.

Modifying the program for your computer

If your computer has no printer, you may omit lines 400, 480, 740 and 1300 to 1390. You may also omit the £ from the print statements where it appears. If your computer has a printer, but requires different commands to route output to fit, then you must modify these lines as required.

Most Basic dialects accept multiple lines of program, and some versions of Basic, this should be omitted.

The symbol in front of the J on line 870 and 88 after the pair of multiplication signs, or * in some versions of Basic, should be replaced by a pair of multiplication signs, i.e.

PRINT USING is used in this program to print out columns of numbers with the decimal points in line, and with commas as required to separate digits into blocks of three. If your Basic does not allow PRINT USING, you can simply omit the word USING and the string between quotes in these print statements. You will then want to do something to tidy up the printout and get the numbers to line up.

The simplest would be to replace lines 870 and 880 with:

870 PRINT "YEAR","CAPITAL","SAVINGS","DISCOUNT","PRESENT
880 PRINT "FACTOR","VALUE

chess for an interest rate R which will give a Net Present Value P1 nearly equal to zero. As a first guess it sets R equal to 0. It then calls the same subroutine at lines 500 to 590 to find the Present Value. With R=0 the present value will usually be positive. R is then increased by S1, i.e. by 1, the

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When you run the program with this statement, you will find that it prints out a number of times, so yes, the subroutine is working. You can see the program going up at first, and then up and down as you would expect. Then you will see that, even when the value of \( x \) gets very small, the program stays in the loop. This should suggest a closer look at line 1170. If you are so boggle-eyed at this stage that you can't see anything wrong, the best tactic may be to re-type the whole line. Finally, when all seems to be well, enter the number in one or more of the examples below and check that you get the same answers I did.

**Example one**

When the program is running, the first thing it will do is to ask you for a name for the present project. This will play no part in the calculations, but will be printed at the top of discounted cash flow tables, to help you to avoid mixing up the output from different runs of the program.

For the first example, consider the possibility of buying a colour TV to save the same amount of money. When asked: NAME OF PROJECT? answer NEW COLOUR TV.

If you get an error message while entering the program, or while running it, or if you get some obviously wrong output, then the most likely problem is a difference between two dialects of Basic I use. The one used for this program accepts a comma after the string in quotes in an INPUT statement (eg line 90). The other needs a semi-colon.

If these steps fail, you can wait for the next few issues of this magazine to see if anyone else writes in with a solution to your particular problem. Much better to get stuck in, find the problem and write in to the magazine yourself. One useful trick for chasing bugs is to print out statements to help you follow what's going on. For instance, if you type 51 instead of S1 in the example of the previous page, you will get lost whenever you ask to calculate an Internal Rate of Return. This will happen because 51 will never be less than 0.005, so the program will get stuck in the loop 1150 to 1190 for ever and ever. It's nearly 5. However, unexpected results are not always what's going on. All you will know will be that you saw the menu, gave the command 'I', and got the message 'WAIT'. When you get tired of waiting and interrupt the program, a cancelled line or whatever your computer requires, you will know it has got to 1120. Your first question could be: 'Did it get back from the subroutine?' or 'Was it ever there?' You could try adding a statement: 1155 PRINT "BACK FROM SUB." R=";R;"S1","P1=";P1.

### TO BUY OR NOT TO BUY?

**That is the cliche**

will save, say £165 per year: CONSTANT AMOUNT? answer 165. If we assume that the rental will be fixed for the life of the contract, we may answer: ANNUAL INFLATION PERCENT-AGE with 0. There will be no special savings with this project, so when asked: IN YEAR IN WHICH SAVING IS DIFFER-ENT? answer 99 Then the answer will now show the main menu. Let us imag-ine that the purchase is to be paid for with a loan bearing an effective interest rate of 25 percent, so give the command 'N' and when asked: INTEREST RATE? answer 23.

The result should be the table shown in Figure 2. The first three columns are fairly self-explanatory, repeating the inputs we have made. The fourth column gives the discount factor, calculated from the interest rate and year, by which all the cash flow in that year are multiplied to convert them to present values. In the last column the savings in each year, minus the capital expenditure in that year, have been multiplied by the discount factor. The right hand column is totalled to give the last figure in the table, the Net Present Value. As this figure is positive, it indicates we should go ahead. In fact, it tells us how much richer we will be by going ahead, if our estimates of the repair costs, life, etc, are correct.

### Example two

I will continue to use domestic examples, as these can be widely understood, and businessmen can see the similarities with the problems in their particular circumstances. This example concerns double glazing, and introduces two new complications.

The first concerns the possibility of extra savings, on income, in a particular year. In this case, I assume that you do not have to live in the same house for the rest of your life, but you would hope to get more when selling it if it has been double glazed. For the sake of the example, I assume that you expect to sell in about ten years time, and that you would expect to get £1000 more for the house at the time due to the double glazing. Note that this refers to actual cash in ten years time, remember not with inflation between them and then, this will only be a fraction of the cost of double glazing at that time.
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The second complicating factor is the effect of inflation on the savings you expect to make through having your house double-glazed. With the cost of fuel going up every year, you may expect the savings to increase every year. Without getting involved in the political arguments about single figure or double figure inflation, it may seem reasonable to assume that fuel prices will increase by ten percent per year on average over the next ten years. This means that the actual amount of cash saved each year will be greater than the amount the previous year (unlike the previous examples, where the cash amount of the annual saving was fixed.) Once the first year’s savings and the inflation rate are entered into the computer, it will calculate the actual amount of cash you expect to save each year before it applies the discount factor.

Assuming the initial cost of the double glazing is £1128 and that it will be financed by a bank loan at 16 percent, the inputs are as follows:
- NAME OF PROJECT? answer DOUBLE GLAZE
- NUMBER OF YEARS? answer 10
- CAPITAL EXPENDITURE? answer 1128
- YEAR? answer 99

Then on the savings:
- CONSTANT AMOUNT? answer 150
- ANNUAL INFLATION PERCENTAGE? answer 10
- YEAR IN WHICH DIFFERENT? answer 10
- EXTRA SAVING? answer 1000

The rest is similar to the first example, and the result is the table in Figure 3. Again, the positive result for the Net Present Value suggests that, other factors allowing, we should go ahead.

In our imaginary house we now have three projects to save money, ie, buying out the freehold (cost £400), buying a colour TV (cost £350) and double glazing (cost £1128). If we have not got enough money to go ahead with all three and we decide not to borrow, then we need to place them in some order of priority, so we can decide which to do first. Buying out the freehold produces a saving equivalent to 20 percent. We can discover a comparable figure for each of the other projects by asking the computer to calculate an Internal Rate of Return. The results are:
- New Colour TV 28.219 percent
- Double Glaze 18.156 percent

Thus these figures suggest that we will get richer quickest if we, first, buy the colour TV, then buy out the freehold and, finally, double-glaze the house.

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(BLOCK CAPITALS PLEASE)
Peter Faff follows up his recent 'Printerfacing' series with details of interfacing a calculator to a micro to use both its printer and number-crunching capability.

The 'Printerfacing' series was aimed at people with a certain amount of knowledge of digital electronics. The idea was to give would-be constructors enough information on the various low-cost printer mechanisms available so that they could build control circuits to link a printer to their micro.

Several readers have asked if it is possible to interface their printing calculators to a micro. Yes, it certainly is possible and it can work out very cheaply if you require only a very simple printer.

Anyone building a printer from my series would have had to design some fairly complex control circuits. If, on the other hand, you decide to use a printing calculator, you will find that most of the hard work has already been done for you. These days you can buy several cheap printing calculators that use a dot matrix printer mechanism and most of these units will be suitable for modification. This approach may seem too good to be true and, as you may have expected, there is a snag. The problem is that, in most cases, you will find that you can only print numeric data along with the calculator's somewhat limited character set but for an outlay of £40 to £70, what more can you expect?

To use a calculator printer you will have to get the line of data to be printed into the calculator. The easiest way to do this is to enter the data via the calculator keyboard. Figure 1 shows a diagram of a calculator keyboard. As you can see, it comprises a matrix of single pole switches. Now for your micro to enter data into the calculator it will have to operate the keys in the correct sequence but since your micro probably has no fingers this may seem difficult. The answer is to connect an electronic switch across every key that your micro may wish to operate. You will also have to arrange some simple address decoding so that the micro can load data into the latch at will. Most printing calculators have a non-add (#) key or a print (P) key. When these keys are pressed they cause the calculator to print out the contents of the display register.

Entering data into the calculator is very easy. The 4-bit word for the first character should be loaded into the latch and must remain for 50 to 150ms; the latch should then be cleared for a similar period before the next key is operated. You have to enter data in...
Financial modelling
made easy

IF MICROMODELLER were a wine you might be forgiven for describing it as presumptuous and definitely non-vintage. As it is a software package, these may be seen as positive advantages.

Micromodeller comes to the market with the claim that it is the software program that will enable non-computer trained managers to do sophisticated financial modelling on a mere Apple microcomputer. It will cost a fraction of using an expensive program on a minicomputer let alone time sharing on a mainframe.

The Micromodeller software program costs just £425. A complete Apple II computer system, complete with video display, floppy disc drives for memory and a printer costs £4,000. By comparison the program for a minicomputer which rivals Micromodeller would cost around £10,000 according to Applied Computer Techniques the publicly quoted company, which is marketing the new program.

ACT believes that Micromodeller will rival VisiCalc, the highly successful American software program which can be used on most micro-computers. VisiCalc, which enables micro-computers to be used as sophisticated calculators, has itself been a significant driving force behind the success of micro-computers.

Micromodeller, which is considerably more sophisticated, is expected to encourage sales of micro-computers among business users. In the first 12 months, and it was only launched last week, ACT anticipates sales of over 2,500 programs. Many large companies with high financial modelling costs are expected to adopt Micromodeller on Apple computers.

Intelligence (UK) Limited, which wrote Micromodeller, says it has 95 per cent of the facilities offered by other financial modelling packages—including those costing around £10,000. It says the few features it does not offer are those like declining balance depreciation under French law, and third order polynomial regressions which are very seldom used.

The program has colour graphics and it can present information as line graphs, bar charts or pie charts. Instructions are given in English—the program is designed to be used by businessmen rather than by computer programmers.

ACT is claiming that it only takes a couple of hours to learn how to use—with the help of a tutorial guide. At its launch even some of the most jaundiced observers of the computer industry were making some highly favourable predictions for Micromodeller’s future.

JASON CRISP

PET is the trademark of Commodore Systems. Apple is the trademark of Apple Computers.
this way because the calculator chip contains a built-in switch de-bouncing circuit that limits the rate at which you can enter data. By experimenting, you may be able to reduce this time.

When the line of data has been entered, the micro should then operate the print key to print out the line. While this line is printing, you should be able to enter the next line; in fact, most calculators have a five or six line buffer built in which does speed up data entry. This is certainly the cheapest approach if you only wish to use a printer to log numeric data.

If you own a scientific calculator, with or without a printer, you may wish to make use of its accurate calculating abilities, i.e., full floating point, 10 or 12-digit accuracy over a range of $10^{-99}$ to $10^{99}$. Again there is a slight snag: in this case, your micro does not have any eyes with which to read the display. This problem can again be overcome by a fairly simple interface circuit. One word of warning, though: if you have a calculator with a liquid crystal display then forget it as trying to encode the drive signals to a multiplexed liquid crystal display is, to put mildly, very difficult. If your calculator has a LED display, a green fluorescent display or an orange 'panaplex' display then breathe a sigh of relief and read on.

All calculator displays are multiplexed to save connections so unless your machine is very old, you will not be able to get at the BCD data. On modern machines, this generally lives within the chip along with everything else. To get at the data you will have to encode the digit and the segment drive lines. This is not too difficult because 7-segment to BCD converters and 16-line de-multiplexers are readily available. The only problem lies in level shifting between the display and logic. Figure 3 shows how a multiplexed display is driven and this will be found to be common on most calculators although the logic levels may be reversed. The easiest way to encode the display data is for the 7-seg to BCD conversion to be carried out continuously. The micro will load the code for the digit that it wishes to read into a latch. The data held in this latch is then compared with the output of a de-multiplexer that reduces the digit drive signals down to a 4-bit code. When these two words agree, the output of the 7-seg to BCD converter should be read by the micro after a short delay. In this way, the micro can select and read each displayed digit. While the machine is calculating, the display is generally blanked so there should not be any problems with the micro picking up garbage. Figure 4 gives a block diagram of the system; as you can see, it is really quite simple. As a scientific calculator can be bought these days for next to nothing, it seems sensible to use a calculator to carry out mathematical functions while leaving your micro free to work on higher things. Anyway, I hope that this short article has been of some interest to you; if you have any problems, write to me at PCW.
THE GREAT COVER-UP!

Not since the days of Watergate has there been a public scandal of such far-reaching implications. It has recently come to the attention of the PCW Secret Police that certain regular readers have been storing their valuable back issues 'au naturelle'. We consider this practise to be singularly lacking in dignity, and would therefore appeal to you in the name of common decency to please ensure that your magazines are properly dressed at all times. This may be achieved by the simple expedient of purchasing one or more of our sturdy yet colourful PCW binders. So why not join in the great cover-up and preserve your precious PCW's in their original pristine perfection. Just check the coupon at the foot of the page.
The problem with micro software theft is that, like tax evasion, many people don't consider it to be theft. In both cases those who gain do so at the expense of the rest of the community. You may gather from the above that this month I'm talking about what we in the trade call 'rip-offs'.

Let's take the simplest example: I know that a large number of you are personal computer users, ie, you don't have to use your computer to earn your living. Most of you will have one of the more popular makes, like PET or TRS-80, supplied with its own cassette unit. The advantage of sticking to the more popular machines is that software is usually plentiful and very cheap. It also means that you are quite likely to find plenty of other local users of the same equipment - and that's where the problem arises. It is just too easy for you to 'share' software. One of you buys a game, someone else buys another and then you go round with your blank cassettes and copy each other's. That way, the two of you end up at the cost of half. Of course, if there are more of you the advantage could be even greater.

'But the game only cost a few pounds,' I hear you say. Well, okay, let's look at how much it cost to produce that game. Most of you will have written at least one program of your own on your computer. How long did it take you to write it? How many lines of code did you write? If you'd like to add your comments, write to: Sharp End, PCW, 14 Rathbone Place, London WIP 1DE.

The result of all this is that software producers are building up a large amount of software designed to make theft either very hard or theoretically impossible. Protection is achieved in a number of ways and I'll describe a few of the methods I've used together with others I've seen used.

The first and simplest is what I call the unreadable method. Many software writers, myself included, prefer to use a high-level language because of the productivity advantages it gives. Now while the program is being developed in, say, BASIC, you will use lots of remarks and the program will be spaced to ease comprehension. As soon as the development has finished all the remarks and unnecessary spacing are removed. I even know one friend who has written a 'decomprehension' program. This means that when a listing of the program is taken, it will take quite a while to unravel it if something goes wrong.

Some programmers include coding in their programs which is just rubbish to confuse any 'poachers' and identify it subsequently should this become necessary. Now, staying with high level languages, obviously the methods described above will only hinder 'theif'. There are two more methods which help to make his task even harder. The first of these is the non-listable program file. In this, the user is supplied with software utilities which allow him to do all security dumps and file prints but will not allow programs to be listed. Now this may not stop the programs being used, but the thief can only use the

system as designed for the original user. In addition, the user name is displayed regularly throughout the system, it is always obvious that a theft has occurred. I use this method.

One of my supplier friends has another method with Basic programs. He has a Basic assembler in which the Basic program is used as the source for an assembler program which produces a machine-code version of the program. So the advantages in development are kept but the program is made incomprehensible to all but those with assembler knowledge and even then the program is, to all intents, completely protected.

The final methods are, firstly, of course, to write in a low-level language. Some software houses go to great lengths to write assembler code subroutine which can stop programs being used, unless you have a means of copying the operating system as well as the programs. This ability is, of course, only given to those who can be trusted.

Now the net result of all this protection is that a large amount of time and effort is spent doing it. In fact in some cases more care is taken ensuring that programs are 'rip-off proof' than goes into the software in the first place. It is, after all, one deterrent if the program still has a few bugs in it. It's also true that the better the software, the more likely writers are to want to protect it. That means the costs are going to increase - I estimate by at least 100 percent. If you think that's an exaggeration think how much effort goes into the protection of a program against simple operator errors - it's at least half, and probably more.

All that means that you, the purchaser of software, have to pay more for your programs which, in turn, are likely to be of lesser quality because of the inordinate amount of time we, the producers, are spending protecting our livelihoods against thieves.

Think about it.

PCW would like to hear whether or not you support Mike's point of view. Our main concern is that piracy prevents many good program products ever reaching the market-place. This means that the many potential buyers of microcomputers are being denied you and will continue to be so until this tricky problem is resolved.
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Arranging tiles into patterns is an ancient pastime. One simple set of tiles, rich in arrangement possibilities, has been used to form the pattern in Figure 1. This can be cut out, pasted onto cardboard and then cut up into the 16 tiles that make up the complete set.

These tiles are oriented – that is, they may not be rotated and they are one-sided, so they cannot be turned over. The edges of each tile are either blank or have a line leading to them from the centre of each tile. With four edges and two possibilities for each, that gives $2^4 = 16$ tiles altogether.

**Fig 1 A set of all 16 tiles in an acceptable arrangement.** To make a set of tiles, cut out the diagram along the outer frame and paste it to a piece of card. Then cut the card and diagram into 16 tiles using the guide lines on the outer frame. So that the patterns do not match if a tile is rotated the main lines are slightly off-centre on each tile, and the horizontal lines are thicker than the vertical ones.

In an arrangement, every edge with a line must be matched by another edge with a line and no such line may be left unmatched. Any blank edge must either be on the outside of the arrangement or must be alongside another blank edge. Figure 1 shows how these conditions can be satisfied. Tile 0 with no lines can be placed anywhere round the outside of the arrangement, adding nothing of interest, so it will be ignored for the moment and only the remaining 15 tiles considered as the set. These are shown both diagrammatically and in order in Figure 2.

Considering an arrangement in terms of the pattern of the continuous line formed across the tiles, this clearly always has four ends, formed by the terminator tiles 1 to 4. The arrangement of Figure 1 also has two enclosed areas and it can be shown that this is always the case, provided that the line formed is all in one piece. To do this, only the topology of the lines need be considered; their detailed geometry can be ignored.

Group tiles according to the number of unmatched ends. Tiles 1 to 4 have one end each; tiles 5 to 10, the straight-through tiles, have two ends each. Tiles 11 to 14, the T-pieces, have three ends each and, finally, the X-tile 15 has four ends to be matched. To show that any arrangement must have just two enclosed areas, imagine it being built up, starting with the X-piece. There are thus four ends to begin with. As each of the tiles 5 to 10 is added, as they must be in some order, the number of ends is unchanged. As each of the T-tiles 11 to 14 is added, the number of ends is increased by one, since one end is used up but two more appear. That gives eight ends in all. Lastly, as the terminator tiles 1 to 4 are added, each one uses up a free end, leaving four ends unsatisfied. The only way for the arrangement to be completed is for these four ends to be joined in pairs, either directly or through some of the other pieces. This arrangement is unaffected by the order in which the tiles are added. Each pair of ends joined in this way makes an enclosed area, so there must always be two such areas. This is illustrated by Figure 3.

Remember that only the form of the pieces matters here, not the detail, and this proof does not show that an actual arrangement is possible, only that if any is, it has the stated property. The proof would not be changed by the removal of some of the straight-through pieces or by the addition of some extra ones but the number of possible arrangements obviously would be altered. If all the pieces 5 to 10 are removed then no arrangement is possible, but the proof still shows what form they would take if there were any.

If the line across the tiles in a solution is allowed to fall into two or more separate parts, a different number of enclosed areas is necessary, one area for each piece. The proof follows the same lines as the one just given. Figures 4 and 5 show that solutions are possible with the line in two and three parts. A solution in four sections would have five closed rectangles but there are not enough corner pieces in the set to make this number. Even six areas in five separate sections is topologically possible, as shown in Figure 6, but this would require 18 corner pieces to close the loops.

**Fig 2 The tiles in order**

**Fig 3 Topology of solutions**

**Fig 4 A solution in 2 sections**

**Fig 5 A solution in 3 sections**

**Fig 6 Topology of a solution in 5 sections**

PCW 111
in Figure 7. The four pieces, 10, 12, 14 and 15, group (a), which have ends to be matched at both sides, can only be placed in the centre column, C. Similarly, pieces 2, 5, 6 and 11, group (b), which have a right-hand end to be matched, can only be placed in columns L or C. Pieces 4, 7, 8 and 13, group (c), can only be in columns C or R, while the remaining pieces, 1, 3 and 9, group (d), may be put in any column. This is summarised in Figure 8.

Each horizontal end in the centre column must be matched by a corresponding end in the L or R columns. There are already eight horizontal ends in the four pieces which must be in the centre column, and there are only eight more horizontal ends in the remaining 11 pieces. So the fifth piece to be selected from the 11 to complete the centre column must have no horizontal ends, otherwise there would be more horizontal ends in C than could be matched in L and R. Hence, the fifth piece must be one of group (d).

Now consider the matching of vertical ends. Each column must have an even number of these, since they must match in pairs where they meet. The four pieces of group (a) which must all be in column C, have just four vertical ends. It follows that the fifth piece must have an even number of vertical ends and so must be number 9.

For column L, this leaves the four pieces of group (b) plus 1 or 3. For column R it leaves the four pieces of group (c) plus 3 or 1.

These alternatives are equivalent by reflection. In either case, we are left with five vertical ends each in columns

<table>
<thead>
<tr>
<th>GROUP</th>
<th>PIECE</th>
<th>COLUMN</th>
</tr>
</thead>
<tbody>
<tr>
<td>(a)</td>
<td><img src="https://via.placeholder.com/150" alt="image" /></td>
<td>C only</td>
</tr>
<tr>
<td>(b)</td>
<td><img src="https://via.placeholder.com/150" alt="image" /></td>
<td>L or C</td>
</tr>
<tr>
<td>(c)</td>
<td><img src="https://via.placeholder.com/150" alt="image" /></td>
<td>C or R</td>
</tr>
<tr>
<td>(d)</td>
<td><img src="https://via.placeholder.com/150" alt="image" /></td>
<td>any</td>
</tr>
</tbody>
</table>

Fig 8 Table of pieces and columns

L and R, and no arrangement is possible with an odd number of vertical ends in a column.

Now that we know something about arrangements, what kinds do and do not exist, is it possible to start listing all of them? First of all, it must be decided what is meant by 'all of them'. Many solutions, such as the one in Figure 1, have a mirror image. And both of these may have three further versions each by rotation. So that, rather than one solution, there is a set of eight solutions. In addition to these variants not being interesting, it is also a waste of time counting them all separately. Only basic solutions, without their reflections and rotations, are to be counted.

To keep the program and discussion to a manageable size, only solutions which fit all the tiles into a matrix of 4x4 cells are to be enumerated. Tile 1, the blank tile, can always be fitted into the empty cell left when the other 15 tiles have been placed. In what follows, for the sake of convenience in the program, this tile will be known as tile 16.

Rotation can be ruled out by keeping the symmetrical X-tile, number 15, fixed in one cell. Clearly it cannot be in one of the 12 cells round the edge of the matrix but only in one of the four centre cells, and these are equivalent by rotation. Figure 9 shows the numbering of the 16 cells with the X-tile in cell 6.

To rule out mirror images is only slightly more tricky. Consider the axis which runs diagonally across the matrix through the centre of the X-tile. The blank tile 16 must be on this axis, or on one side or the other of it. Only cells on or above the axis need be used for tile 16. In addition, tile 16 cannot be next to the X-tile, so it cannot be in cells 2 or 7. The only cases that need be counted are those with tile 16 in one of cells 1, 3, 4, 8, 11, 12 and 16, as also shown in Figure 9. In fact, the program given here only counts the cases with tile 16 in cell 1. It will be seen below that the other cases can easily be enumerated by resetting the initial data and slightly altering some of the tests.

There are at least two ways of counting the arrangements, depending on how the next cell on which a tile is to be placed is selected. The first way is to run through the cells in order as they appear in the matrix. This is easy to program but may entail trying a lot of cases that could simply be ruled out by building slightly more knowledge about the constraints into the program. Alternatively, a record could be kept of the free ends that are currently in the partial solution. For example, there are initially four from the X-tile. Then only pieces which satisfy these ends could be selected, and the solution would be built up as a connected line, rather than in the numerical order of the cells. This difference is similar to that between vector graphics and scan-line graphics. This second, more clever, method needs more programming but takes less machine time. For once, I am going to present the brute force method, and leave the sophistication one to you. Well, it's not very flattering the other way round.

Figure 10 shows the main steps in the algorithm. You may be surprised that there is no FOR loop. There is only one pointer, F, which records the cell currently being dealt with. Which tiles have been used and which are still free is recorded in the data. Each time a new cell is to be filled the free tiles are tried in numerical order. If one is found that fits then the process is repeated for the next cell. If no tile fits then the tile in the preceding cell is removed and the next tile for that cell is tried, and so on. When all 16 tiles have been placed, then a solution has been found. When an

![Fig 10 Main steps in the search algorithm](https://via.placeholder.com/150)
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Knight's tours

Statements to set up the initial data which cells and which sides are neighbours of a given cell, together with the order in which the sides of a cell are dealt with. Table 3 displays the data of Table 1 set out on the matrix of cells.

The code is given as Program A. The output is shown in Figure 11.

Next month I shall write more about the arrangement of these tiles and why my method of eliminating symmetrical cases doesn't quite work.

Knights tours

Last month I wrote about Knight's moves round chessboards of different sizes and shapes. In particular, about tours of a board which are complete not only in visiting every cell, but in passing just once along every possible link between two cells. I asked what is the smallest board, having no isolated island cells and no unused cells surrounded by used ones — inland seas — on which such a tour is possible.

The solution is shown in Figure 12. It is a 3x3 board with one side cell and the centre cell missing; seven cells in all. There is no solution with six or fewer cells.

<table>
<thead>
<tr>
<th>Fig 11 The first 12 solutions</th>
</tr>
</thead>
<tbody>
<tr>
<td>Fig 12 Smallest board for a complete tour of paths</td>
</tr>
<tr>
<td>Fig 13 Arrangement of cells at with an even number of paths</td>
</tr>
<tr>
<td>Fig 14 An unlimited solution with three rows of cells.</td>
</tr>
<tr>
<td>Fig 15 Possible arrangements of two rows of cells</td>
</tr>
</tbody>
</table>

Table 1 Tile and cell data — initial values

<table>
<thead>
<tr>
<th>T(4,16) Tile data</th>
<th>C(4,16) Cell data</th>
<th>D(16) Tile on cell</th>
<th>S(16) Tiles used</th>
</tr>
</thead>
<tbody>
<tr>
<td>1 -1 -1 -1 -1</td>
<td>-2 -1 -1 -2</td>
<td>16</td>
<td>0</td>
</tr>
<tr>
<td>2 -1 -1 -1 -1</td>
<td>1 0 0 -2</td>
<td></td>
<td>0</td>
</tr>
<tr>
<td>3 -1 -1 -1 -1</td>
<td>0 0 -2 -2</td>
<td></td>
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<td>0 2 0 0</td>
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Table 1 Tile and cell data — initial values

<table>
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<tr>
<th>U(4) Increment to neighbour cell</th>
<th>V(4) Side number in neighbour cell</th>
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<tr>
<td>1 -1</td>
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<td>2 4</td>
<td>4 4</td>
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<td>3 1</td>
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<td>4 -4</td>
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</table>

Table 2 Neighbour data

I also asked what is the largest board on which such a tour can be made. The answer is that there is no largest board, since boards can be constructed of arbitrarily large size. Or, if you prefer to put it another way, the largest board is of infinite size. The trick in finding
At any computer show, the Apple demonstration is a big draw, partly because of the colour graphics, but also because of the treble and bass elf music notation which can be seen on the screen if it happens to be showing the music entry system provided by Alf Products of Denver, USA. If the demonstration is of the musical item with nine independent parts, the visitor cannot fail to be impressed by the quality of sound produced and intrigued by the unconventional display of horizontally-moving, coloured blips which indicate simultaneously what each part is doing. I have spent some time studying how this system works and a little time using it, whereas my colleague Dr Kevin Jones has spent considerable time using it. This is a two-part article, therefore, giving our respective technical and musical impressions.

The authors and designers of the package (Rick Harman, John Ridges, Philip Tubb and Forrest Thiessen) must have decided against computer-generated waveforms on the grounds of slow speed, poor signal-to-noise ratio and foldover. Instead, they went for computer control of externally-generated waveforms, in this case, the electronic organ technique of squarewaves, derived from a master oscillator by frequency division. A squarewave can sound reasonable if we are trying to accurately produce the notes of the equal-tempered scale, or any other tuning, or if we want a glissando. To produce 440 Hz, for instance, the divider must be 1782000 divided by 440, which is exactly 4050. If we divided by 4049 or 4051 we would still be within one part in 4050 of the required frequency, which is more than adequate compared with the usual requirement of about 0.1 percent quoted from pitch perception tests.

At the top note of the range provided by software, however, which is G sharp at 6645 Hz, the required divisor works out to 268 plus a fraction. Since we can't use the fraction, we divide by 268 to get 6649 Hz, an error of 4 Hz. Now, musicians prefer to express pitch errors in cents. A semitone, which is a frequency ratio of the 12th root of 2, is 100 cents, so a cent is 1/1200th the equal-tempered scale, is 100 cents, so a cent is 1/1200th the frequency of the 12th root of 2, which works out to 1.000578. The ratio we have is 6649 divided by 6645, or 1.00060, which is clearly a little over 1 cent but is an error of 0.1 percent quoted from pitch perception tests.

The 3-voice board which forms the basis of the system uses a programmable timer chip, the Intel 8253, which contains three independent timers. This is a fairly large chip in a 24-pin package, but is quite conspicuous on the board. It is driven from an on-board crystal-controlled clock oscillator at 1.782 MHz. Each of the timers accepts a 16-bit number in an appropriate register and then counts down. In the particular mode for producing a squarewave from a timer, the output frequency of the waveform is given by the clock frequency divided by the number loaded in, so we can deduce the resolution from this — an important point if we are trying to accurately produce the notes of the equal-tempered scale, or any other tuning, or if we want a glissando. To produce 440 Hz, for instance, the divider must be 1782000 divided by 440, which is exactly 4050. If we divided by 4049 or 4051 we would still be within one part in 4050 of the required frequency, which is more than adequate compared with the usual requirement of about 0.1 percent quoted from pitch perception tests. At the top note of the range provided by software, however, which is G sharp at 6645 Hz, the required divisor works out to 268 plus a fraction. Since we can't use the fraction, we divide by 268 to get 6649 Hz, an error of 4 Hz. Now, musicians prefer to express pitch errors in cents. A semitone, which is a frequency ratio of the 12th root of 2, is 100 cents, so a cent is 1/1200th the equal-tempered scale, is 100 cents, so a cent is 1/1200th the frequency of the 12th root of 2, which works out to 1.000578. The ratio we have is 6649 divided by 6645, or 1.00060, which is clearly a little over 1 cent but is less than 1.5 cents, which is the figure claimed in Alf's leaflet as the maximum tuning inaccuracy, in the highest octave of the MC16. The crystal also has a tolerance, stated as 0.015 percent, which is about a quarter of a cent. Adjustment of the

The ENTRY program running on the Apple II.
pitch can be made by software, using an OFFSET command. However, this gives only a small adjustment; what it evidently does is add a constant number to each divisor, making the adjustment 'linear' and thereby slightly affecting the tuning ratios.

It is also possible to produce pulse waveforms, by gating one squarewave output from another in each board; this, of course, reduces the number of independent voices from three to two on each board. This is part of the CHROMA routine, a listing for which is given.

Also on the MC16 board are three 8-bit digital-to-analogue converters for volume control of the three voices, giving 256 settings. Normally this 256:1 ratio in a linear converter gives a 48 dB range, but here the range is 78 dB because the chip employed is a 'comparing' DAC made by Precision Monolithics Inc to meet a Bell System specification for PCM transmission. In the 8-bit word sent to the DAC, three bits are used to give the logarithmic shape in a piecewise linear approximation, four further bits give linear segments, and the remaining one gives the sign. The seven amplitude bits give a normalised output range from 2 to 8031, which is a 72 dB range; feeding the sign bit from the squarewave timer output effectively doubles this, giving 78 dB.

The MC1 and the MC16 cards plugged into the Apple II expansion slots

Photography by Kevin Crabtree

The MC1 and MC16 boards

MC1: The low-cost version

The second system gets the same functions, and more, onto one board which is priced at £91. We find no timer chip but four 76489s driven from the Apple Q system clock at 2.046 MHz. These 16-pin chips turn out to be much more complex than their size implies, being 'sound generator' chips of the type made for TV games circuits. Each contains three programmable dividers, operating on similar principles to those in the MC16, and three programmable attenuators; but each also contains a noise generator (feedback shift register type) which can be used for wind and percussive sounds, etc.

Naturally, sacrifices have to be made to achieve so much in so little. Firstly, the frequencies are obtained by dividing the clock by 32 first, giving an effective reference frequency of 63.9 kHz. The divider ratios applied to this are now ten bits, giving a maximum of 1023 instead of the 16 bits of the MC16 which can give 65536. The effect of this is again worst at the highest frequencies, where the divisor is smaller; to get the highest note allowed by software, in this case 4186 Hz, needs a divisor of only 15, with resolution some 260 times poorer than previously. The claimed worst case is 33 cents in the highest octave, which is noticeable. The resolution improves as the pitch is reduced, of course.

The other sacrifice is in the attenuator DAC, which uses only four bits, each controlling binary-weighted attenuator sections of 2, 4, 8, and 16 dB, and giving a claimed maximum of 28 dB when all are used. (Strange - my arithmetic makes the total 30 dB, not 28. Has Alf not picked up the error in the Texas data sheet?)

The chip includes eight registers which contain information for the frequency and volume of each of the three squarewave channels; the noise mode, ie, rate of clocking the feedback shift register; and the noise channel attenuation. Updating the frequency requires a 2-byte transfer, and updating noise or any attenuator requires only one byte. As with the MC16, sound production is continuous between updates.

One notices that the MC1 board actually contains 12 squarewave generators and four noise generators, although only nine and one are used respectively. Connection of the boards to the external audio system allows stereo in all cases except where only one MC16 is used, in which case the three outputs cannot be separated. This is not true stereo, of course, only the feeding of a
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<table>
<thead>
<tr>
<th>Apple II</th>
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<tr>
<td>Maximum Memory Size</td>
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<tr>
<td>Screen Display</td>
<td>40 column (10 column with peripheral card)</td>
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<tr>
<td>24 Lines</td>
<td></td>
</tr>
<tr>
<td>Upper Case</td>
<td>210 x 192</td>
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<tr>
<td>Screen Resolution (B &amp; W)</td>
<td>140 x 192 (16 colours)</td>
</tr>
<tr>
<td>Screen Resolution (Colour)</td>
<td></td>
</tr>
<tr>
<td>Keyboard</td>
<td></td>
</tr>
<tr>
<td>Numeric Key Pad</td>
<td></td>
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<tr>
<td>Input/Output</td>
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<td>Disc Drives</td>
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<tr>
<td>Languages</td>
<td>BASIC, Fortran 77, Pascal, Assembly, Pilot, Cobol</td>
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<td>48K RAM Apple with BASIC, single disc drive, B &amp; W Monitor (9''), Silentype® printer.</td>
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<tr>
<td>Suggested retail price</td>
<td>£1,066.90</td>
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sound signal to one channel or the other, or equally to both.

The system in use

The Alf music synthesiser cards can be plugged straight into an Apple computer, connected up to amplifier and speakers, and are ready to use. They certainly add a whole new dimension to the machine, and have proved to be very useful in the music department at The City University, where the system has been working for nearly a year now.

The cards consist of squarewave oscillators with variable pitch and volume. Sophisticated software comes with the system to provide a powerful range of programming possibilities.

There are two cards available. The older but more accurate MC16 provides three voices and up to three of these cards may be used together. The newer MC1 has nine voices and the possibility of three channels of white noise (for percussion-like sounds) all on the card, but it makes certain sacrifices in accuracy and precision. There are a few other differences which will be mentioned as we proceed.

The menu gives an adequate range of time values, rests, sharps, flats and naturals. Triples are also catered for. Figure 4 shows that quite complex lines can be entered.

The symbol menu is also used to carry out editing. It is possible to backtrack, move forward, replace, insert or delete notes as required.

The Apple keyboard is used to enter additional information to change the volume or envelope settings for a sound. The envelope shape of a note defines the way in which the note builds up to its peak volume and dies away again. This is very important in giving a note a characteristic sound quality, for example, to determine whether it sounds more like a harpsichord or a piano accordion.

The ENTRY program allows the user to specify an ADSR (Attack – Decay – Sustain – Release) envelope for each note. Regrettably, the section of the manual dealing with envelope shaping is not exactly the model of clarity. I can't resist a temptation to quote from it:

"The current loudness can increase by an amount less than or equal to the "current decay" setting. (Not to be confused with the "decay setting"). In this fashion, it will arrive at the loudness as quickly as the attack/current decay settings permit.

'Once the current loudness collides with the desired loudness the desired loudness spontaneously changes to a new value called the "current sustain level" (not to be confused with the "sustain setting"). Probability states that the new desired loudness may be different than the current loudness (although the current loudness is equal to the old desired loudness), so the"
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current loudness must again seek the "current" loudness. This astounding natural process continues at all times during playback. The current loudness cannot be affected directly, so it must be "guided" by selecting appropriate parameter settings.

Notetrinos generated using a high-power paramatron at the University of Northern South Dakota (just across the border from Hoople) have revealed the following characteristics of these settings. When a new note begins, the most recent decay setting is written into the "current decay" rate.

And so it continues. I wonder what a 'paramatron' is? Shades of an Oedipus complex perhaps?

But to return to the Apple synthesizers. Fortunately, a set of default envelope settings is built into the ENTRY program which allows the user to start putting in notes immediately. After a little practice, this can be done quite quickly. When the first voice (PART 0) has been completed, subsequent parts can be entered in the same way.

At any time it is possible to play back the work in progress simply by typing PLAY. When this is done, or when any stored composition is being played, the screen changes to a different display. It is not possible to represent up to nine independently moving parts in traditional notation, so an ingenious alternative has been used.

A horizontal line corresponds to each part, and the pitch range stretching from left to right, low to high, just as on a piano keyboard. As the pitches change, a little square sweeps backwards and forwards, following the notes up and down like a magic hand on an invisible keyboard. The colour of the square changes according to the note's intensity. With all nine parts going simultaneously, the result is an exciting representation, which clearly shows the shape of the sounds being heard.

During playback, the speed can be altered as desired with one of the paddles. The more parts there are, the harder it is to avoid. Either voices need to have rests in certain voices, everything becomes apparent in this respect. If the number of parts is reduced in the middle of a piece, for example, by having rests in certain voices, everything speeds up. When the resting voices come back in, it slows down again. This is difficult to avoid. Either voices need to be doubled up, or else resting voices have to be given dummy parts to play at a silent volume level.

Once a composition has been entered, it can be saved on disk (or tape) and subsequently recalled at any time for further editing or to be played.

A very useful aspect of the package is the subroutine facility. Strings of notes can be defined as subroutines and then called from other subroutines, or incorporated into a part definition. This is a great labour-saving device, as most music contains a great deal of repetition. Subroutines can also be transposed (in steps of a quarter-tone) and may be called with different envelope characteristics each time. A subroutine can even be called from itself, thus creating infinite loops.

I have had lots of fun experimenting with such loops of varying lengths which fit together differently every time they come round. This makes the package ideal for experimenting with music in the style of the American composers Steve Reich, Terry Riley or Philip Glass; and also for the type of composition associated with Mike Oldfield's music.

The synthesizers on their own are not really sufficient for any sort of commercial musical use, for the square waves soon become very tiring on the ear. But by using filtering and other studio treatments, there is no reason why the sounds should not be made more interesting.

With the MC16 board, there is the possibility of pulse-width modulation to vary the square-wave sound. This facility is not available with the ENTRY package but can be programmed in Basic, making use of a set of assembly-language routines called CHROMA. The Basic programming option opens up a wide field for more serious research, and for the generation of new, lively timbres. I have made a few experiments using stochastic techniques (where probabilities are used to make choices) to control very fast changes in a sound's specification. This has produced some interesting results.

These synthesizers, then, have a wide range of application. In The City University music department they have already begun to prove useful in teaching. I have written some aural training programs which enable a user to test himself alone, without the embarrassment of flunking in front of anyone else. This generates intervals randomly, and so should produce different sequences each time it is used. The ENTRY package is invaluable for trying out harmonic exercises and compositional ideas. At a lower level, it can help the beginner get to grips with standard musical notation. A simple INTRODUCTION program is supplied with the MC16 which explains some basic acoustic principles. There is also a MUSICAL SKILLS disk available for testing intervals, pitch and scale recognition, but I do not know how this compares with similar programs which I have written myself.

At the university, the synthesizers have also been used to prepare experiments in psycho-acoustics and musical perception. It is possible to define particular sounds very precisely and exercise fine control over such aspects as speed of playback.

In conclusion, the Apple Alf music synthesizers represent an invaluable addition to the Apple family of accessories. After many months of using the software it seems, amazingly, to be quite free from bugs. Unfortunately, the documentation is, in general, rather muddled and could be quite a problem for anyone new to the microcomputer scene. This is a pity in a package which is obviously designed to be self-contained. I also find the general patronising style of such Transatlantic manuals a little off-putting (isn't this exciting?). But perhaps that is just the view of an insipid Englishman.

I reckon it represents good value for money. Enterprise music departments might consider it worth buying a complete Apple package for the sake of the synthesizers and accompanying software alone.

Acknowledgement: our thanks to Microsense for the loan of an MC16 board.
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MVT Famos

Sue Eisenbach and Chris Sadler bring you the second operating system review in our multi-user Benchtest Series.

We were intrigued to be offered an opportunity to review an implementation of the MVT Famos operating system — billed as a system 'without peer in design and operating efficiency'; multi-tasking and multi-user with 'no significant degradation in response, even with several concurrent terminals'; and with a Basic compiler 'well suited to the computer's machine architecture'.

S100 system had 192k of RAM and 18 Mbyte of disk space. The documentation states that Famos requires disks, an 8080 or 8085 processor with a CP/M bootstrap in ROM, 32k RAM for Famos and 32k for each additional user. There are no inherent restrictions on the number of users which a Famos system can support although, in practical terms, the particular application will determine both the degradation experienced and the acceptable upper limit.

Efficient disk access is essential as all the system functions and utilities are stored on the disk and normal operation engenders a great deal of traffic — hard disks, therefore, are a distinct advantage. All terminal communication with the operating system must occur in upper case so the system demands either an upper case terminal or a terminal featuring a 'caps lock' or similar switch. (Anyone who thinks that a simple shift-lock will do has not counted the number of times that '1', '0', '9', or '8' digits are required in normal programming.) The word processor Wordflow requires 'clear screen' and an addressable cursor and is most easily used if 'clear to end of screen', 'clear to end of screen', 'delete line' and 'insert line' are implemented also.

Famos seems to offer software to support a fair range of disk-controllers including Industrial Microsystems 8000, Tarbell and XCom floppy's and MITS 88, XCom and Calcomp hard-disks. Support here includes formatting functions and a range of interleaving options.

The documentation claims that Famos uses a number of microprocessor facilities which are not exploited by other operating systems (all eight interrupt levels on the 8080, for instance), so that hardware which runs other systems quite happily may crash under Famos because some such facility has never been fully tested. The documentation, further states that it is the user's responsibility to ensure the integrity and reliability of the hardware before using Famos. We take this to imply that Famos itself does very little automatic checking during operation, although there are a number of stand-alone diagnostics for checking both memory and disks.

The operation system

MVT Famos is a multi-tasking, multi-user operating system offering the usual four features, namely; dynamic allocation/scheduling; a filing system; a security system and command processing software. Despite its name, Famos bears no relation to IBM's operating system MVT. Scheduling is handled by an algorithm which allocates varying (interleaved) intervals of CPU access to process tasks on a priority basis, there being 16 priority levels. Memory is allocated from a free-memory pool on a 'best fit' basis which works in conjunction with a fragment collection scheme. The operating system occupies 128 kbytes of memory, leaving a further 32 kbytes of addressable user memory, although bank-selection in 16 or 32 kbyte banks is supported. Incoming tasks are automatically assigned to the least busy bank.

All devices (ie, both I/O and mass-storage peripherals) are accessible through device drivers recognised by the file-system. Each mass storage device supports a single directory which records all the file names on the disk; file types (A for alphanumeric; B for Basic object files; C for machine code segments and E for Editor files); file sizes and file protection, which includes a password. Files can be protected from being opened, deleted, written, shared or having their names changed.

Security is via a password system which controls access at log-in and is also used to prefix user-files by placing certain automatic protection features on files so created. User names beginning with 'X' and file names beginning with 'C' are exempted from the security scheme — so users with a login name beginning with an 'X' (ie, system users) can access all files whereas ordinary users can access only their own files or those whose names begin with 'C'. Unfortunately, an ordinary user can gain the rights of a system user merely by prefixing a single ASCII character (specifically mentioned in the word-processing manual) to forbidden file names.

Fortunately, there is one further level of security. Utilities and file names can have individual passwords on them preventing use by anyone (including an 'X' user) who doesn't know the password. On the review system utilities such as SCRATCH (delete a file from the disk) had passwords. The implications of this are that the utilities are not available to users and all housekeeping is left to a system manager. The alternative — making the utilities public in a single directory filing system) would only be contemplated by the naive.

The operating system can be built by a 'system generation' process during which details of the hardware configuration together with device drivers and such specifics as the numerical precision within the Basic run-time system (3-3.18 decimal places). The relevant machine code segments are brought together either by the link editor or, more interactively, by means of a special Basic program. Most modifications to the configuration or general system organisation will require regeneration of the system.

The entire operating system appears to be the work of one George Pilipovich.
of MVT Microcomputer Systems whose article ('Multi-Tasking the 8080: Famos on a Micro-System', Interface Age, February 1979) is recommended to readers who want more details. As a 'one-man show' the general feel of the system is that it seems to exhibit some idiosyncrasies which, with a little care, will enable you to be able to utilise the following description of the command-line processor.

During log-in, a task is created called the 'Super Selector'. This is the (re-)entrant command-line interpreter and is the 'parent' of any other task the user initiates. Like its UNIX counterpart (the shell), apart from its ability to spawn sub-tasks in this way, the Super Selector (SS) is not capable of initiating much processing in its own right. In fact, it will recognise only commands which are in the Super Selector box. Unlike the UNIX shell, there appears to be no way to dispatch two or more simultaneous tasks from a single command-line although it is possible to initiate sequences of commands on one line.

Apart from user-defined tasks, the SS, however, can generate system tasks available to the user under the Super Selector. These are divided into 'functions' and 'utilities', the distinction being that a utility requires the 'Q' command for its initiation (eg, Q VERIFY, to check that disk sectors are good), while a function name is directly recognisable by the Super Selector (eg, COMPILE). It would have made for a nicer user interface if the Super Selector had a way of separating the two types of programs so the user did not have to remember when to put 'Q' to the name of a utility call. Various function files are required on the floppy-disk-based system in order to provide the Super Selector with its power. On the time-sharing machine, the system utilities and functions effectively tied up one of the two available disk drives.

The system functions are described in Table 1. The system utilities comprise a rather cumbersome (largely of the 'monitor administration' type) which provides facilities to inspect and test various features of the hardware (disks and memory system (files, User Accounting Blocks, etc). Most ominous among them is CFIX, a routine to clear the compiler queue should it become too full (more than 64k) when testing the Basic benchmarks.

Editors

There are two editors of the Famos system, the first a simple line-editor; the second a screen-oriented word-processing package called Wordflow.

The line-editor (invoked by the command EDIT), prompts with a >> symbol, once the requisite file-name has been specified. The DELT command number (delete line), EDIT line number (find and display line for editing), ENDE (terminate edit), LIST (list whole files) are recognised. Anything else must be an input line preceded by a four-digit (no more, no less) line number. Utilities exist, external to the editor, for removing, replacing or altering line-numbers. One rather surprising feature of the DELT command arises when the specified line number does not exist on the file. In this situation, instead of simply issuing an error or warning message, the editor will delete the next highest line — so any mis-keying could have some unpredictable and fairly disastrous results.

Once a line has been referenced for editing, control keys are used to position the cursor on the line and effect any editing as follows: CNTRL G — move cursor one character to right; CNTRL H — move cursor one character to left; CNTRL I — insert one character to the left of cursor (if more than one character needs to be inserted, then before the string is input, CNTRL I must be typed once for each character in the string); SPACE BAR — delete one character.

Once ENDE is typed, certain automatic housekeeping functions are performed on the file (basically, all the modifications are written into the file) so that it is not immediately available for further processing. We thought that this seemed a fairly ordinary sort of line editor, much along the lines of the editing facilities to be found on most interpreted Basic systems.

MVT Wordflow is the word-processor package. It consists of a suite of programs which includes a screen-editor and various printing programs. The screen-editor can be used by any number of users simultaneously (ie it is 're-entrant'), but separate copies of the printer programs are required when more than one user wants to output.

The user has control over how much of a file can be in memory at any one time during editing — obviously for one user, the greatest convenience would be to have the whole file present, but clearly this isn't always possible in a busy

| (i) User Accounting Functions |
| ACCOUNT — Displays cumulative account |
| ADDUB & DLUUB — used for creating and deleting a possible user |
| PUAB — for printing out possible users |
| (ii) Monitoring Functions |
| BCASTS — displays status of each memory bank |
| CORE — displays free memory |
| MAP — displays disk file directory |
| PASSWORDS — displays file directly with password |
| PROGRAMS — gives status of non-resident programs in memory |
| (iii) Processing Functions |
| CREATE & CREATE-C — for creating files |
| COMPILE |
| EDIT |
| MOVE — puts file in printer queue |
| SCRATCH & SCRATCH-C — for deleting files |
| RUN |
| (iv) Altering Functions |
| CHANGE — change name (or password) of a file |
| FREES — release functions from memory |
| LOADKP — loads and locks down programs in memory |
| LODn — loads a specific function |
| MERGE-M — merges files |
| MOVE — move a file |
| RELEASE — release a non-resident program |
| SUPER-ZAP — used to end or suspend any task in the system |
| TRMTYPE — for patching a specific terminal driver |
| SETIME & TIME |
| SEND — for interterminal messages |

Table 1 Super Selector functions
A full library of arithmetic, string-handling and formatting functions is available, together with the ability to implement new library functions. Calling library routines and assembly language routines (8080 or Z80) may have parameters passed to them. Batch monitors may be initiated within a Basic program and a variety of file-handling and terminal output control routines may be called on the same basis. These make Basic a powerful development system for the production of commercial programs, notwithstanding our reservations about the overall awkwardness of the operating system, and our doubts about the wisdom of using Basic for commercial program development.

The compiler generates (line by line) pseudo-code object programs which may be submitted to one of three run-time systems: Basic (for 8080 machine code), BasicZ (for Z80 machine code) and Basic DBUG for debugging. This is a clever arrangement, since it allows for a certain amount of flexibility and tuning of the relevant run-time systems without committing the compiler to any give computer or resource program. However, as our benchmark results show, neither the arithmetic nor file-handling functions show the performance benefit of the extra efficiency of Z80 code.

The debugging run-time system allows the user to see and clear breakpoints, display the contents of variables and start the execution at any place in a program. The compiler produces a source listing with hex numbers before the Basic line numbers and a symbol table where each character is given a hex value. It is these compiler-generated hex numbers, rather than the Basic line numbers and variable names, which the debugger compares to the corrected assembly. A pity that the debugger designer requires the programmer rather than the debugger to remember these references. Debuggers are much easier to use when they refer directly to Basic variable names and line numbers.

One irritation we found was in the format of the individual Basic statement, where the BCD number is represented in BCD (with a maximum of 9999), while the rest of the line is in ASCII. The line-editor can cope with this but Wordflow, the wordprocessor, required a modification. Each BCD number must have a control character preceding it (a lesson we learned the hard way).

**Benchmarks**

We ran the single-user benchmarks under both run-time systems. The multi-user benchmarks were run in single-user mode on the floppy-based review machines (using both the 8080 and the Z80 run-time systems) and with up to four users on Microtek's hard-disk system, using the 8080 Basic. Rather than getting involved in the details of how one would go about extrapolating these figures to cover all configurations, we shall present our timings without (much) comment. All times are in seconds.

We were at a loss to explain the performance of the hard-disk system on the terminal test in single-user mode (longer than with floppies) and on the Multiple Open disk access test with three and four users. We can only assume that, since four terminals were always logged into this system (though inactive) while the single-user tests were being run, there is a certain system overhead in servicing the inactive users; also, the lock-out mechanism, which comes into play when more than one user tries to access the same file, would be used ineffi- ciently when several users are queued for access.

Finally, the last table reflects the fraction of the single-user time that was taken, per terminal, when running the multi-user tests. If this figure is greater than 1, it would be more efficient to run the jobs in sequence. As expected, the processor test shows some degradation in response. The others show a remarkably buoyant system (up to four users), especially the anomalous test 3.

**Potential**

Although not every type of multi-user application could be sensibly put onto a single Z80 processor, there are many applications which are not particularly processor-bound and where Famos, running on a suitable hardware configuration, might be used. The Computer Services, who supplied the review machine, uses Famos to develop commercial software and has spent a lot of time developing its own utilities and tuning the operating system. Apparently MVT will accept and distribute its own utilities, as well as those from other software houses. So anyone thinking of setting up a com- mercial operation could get some help with tailoring a friendly development system. As it was, however, we felt that the processor test shows some degradation in response. The others show a really smooth development environment.

This type of tuning takes time and would require someone with a good working knowledge of assembly language programming. Microtek found the ISAM file structure (which is not covered in the manuals) very useful for the production of its commercial software. All the file handling in Basic employed a lock-out system to prevent more than one user from accessing the same file record at the same time. Routines exist in assembler so that the system programmer can easily set up file-protection routines. However, it is unusual to find a commercial applications program- mer capable of, or willing to, program
more than a tiny bit of his work in assembler, and the only other language at present on the system is Basic, although according to Microtek, an arrangement has been made so that Pascal may be implemented.

For the businessman, the major advantage of Famos is that it has been around for several years and in use in a number of software houses. Microtek, for example, a multi-user integrated accounting, stock control and banking packages. There is very little commercial multi-user software currently available, and when it is micro, so that what is needed and if the package handles nicely (the ones we saw seemed to, although we did not study them in depth), the Famos system could be worth going for. However, the cost of such multi-user software could reflect the time and effort needed to bring it into being under Famos.

Turning to the educational market, we thought Famos would be a poor choice for a school system. Firstly, it lacks any graphical capabilities and has a very limited choice of programming languages, and, more importantly, it does not handle the new development user gently enough — this may not matter to the intelligent extrovert in a class; but the diffident plodders who risk being put off computing for life. Thirdly, the system requires a systems programmer and/or manager to set it up and perform constant housekeeping chores, and this individual is a luxury which few schools can afford. Finally, the system does not particularly recommend itself as a laboratory tool as there are no device drivers for data-logging equipment and such-like, and the mathematical subroutine library (part of the operating system, and not of Basic) is too slow for much number-crunching.

A Famos system could be employed as a multi-station word-processing system — and, according to Microtek, it is used for this purpose by the US Navy. Wordflow, being menu-driven, is reasonably powerful and easy to use, although it is not as easy to use as some others we have seen. In the multi-user context, however, Wordflow has the advantage of being re-entrant — so with only one copy of the program in memory and with a good spooling program to the printer, the system could be loaded up with quite a few typists without suffering severe response problems. However, for this sort of application, a hard-disk subsystem is a virtual necessity, since Wordflow employs a tiny memory-buffer for the text-file so the higher transfer rate offered by the hard-disks would be another vital factor in keeping the response buoyant.

**Documentation**

The Famos documentation came in two large ring binders and comprised a user manual, a Basic programmer’s guide, a Wordflow manual and a program development manual: Our overall impression was that these had been prepared with greater care than is usual in the micro-world. All were paginated, had a reasonable degree of contents and were well laid-out. In the programming sections, each instruction is given a full page which includes a definition of the instruction, an explanation of its function and a full example. At the end of the section, all the instructions are summarised with a one-line description. The style of the text is slightly patronising in tone (eg, ‘It is absolutely essential that all of the General Consideration section be read carefully prior to the use of Famos’) and is given to rather sweeping statements (eg, ‘The system is designed to virtually preclude system crashes owing to user errors’). Nevertheless, the manuals seemed to provide a good overall introduction to the system, although there may have been room for more detail on the workings of certain features, particularly the filing system.

The one manual we didn’t like was the Wordflow manual. This consists of 165 pages of description supposedly aimed at the secretary. Every feature therefore is described in laborious detail with every option and possible outcome spelled out. The result is that it is page 62 before one finds out exactly how one goes about actually typing some text in. There is no real overview given and no short-cut. (In fact, the introduction states: ‘It is extremely important that this manual be read sequentially and carefully.’) Obviously, this sort of detail is necessary to enable the frequent ‘professional’ user to get acquainted with all the features and to become an expert, but both the beginner and the casual user need a simple set of instructions showing how to set up a standard sort of text-file and get it printed out.

### Conclusion

MVT Famos is a multi-user operating system that runs on a single (8080 family) processor. We spoke to a dealer who sells several multi-user operating systems for 8080s and asked him why people chose Famos. His reply was that Famos stood up better to a large number of terminals than did the other operating systems available.

In its favour, Famos offers a high standard of documentation, nice utilities for file handling, three Basic run-time systems and a word processing package. Most of the software can be re-entrant although this sharing is dependent on the way the memory is divided up.

The major disadvantage of Famos is that it is an unfriendly operating system that requires the programmers and system managers to spend a significant percentage of their time doing housekeeping on the system. In this day of pricey programmers and £10 processors, a software house could probably find that the overall cost of the packages introduced was lower on a more expensive configuration.

**IMS Prices in £s.**

| Desk top system, 64k dynamic RAM, three double sided 5in double density floppy disk drives, giving 900k storage | 2362.00 |
| Desk top system, 64k dynamic RAM, two single sided 8in double density floppy disk drives, giving 1Mb storage | 2720.00 |
| Desk top system, 64k dynamic RAM, three double sided 8in double density floppy disk drives, giving 2Mb storage | 2964.00 |
| System, 128k dynamic RAM, three double sided 8in double density floppy disk drives (2Mb storage) | 4769.00 |
| Desk top system, 128k dynamic RAM, four double sided 8in double density floppy disk drives (4Mb storage), two serial I/O boards | 5341.00 |

<table>
<thead>
<tr>
<th>Multi-User Tests (One User)</th>
<th>8080 (Basic)</th>
<th>Z80 (Basic)</th>
</tr>
</thead>
<tbody>
<tr>
<td>Processor test</td>
<td>30.5</td>
<td>25.8</td>
</tr>
<tr>
<td>Test disk Single Open</td>
<td>40.1</td>
<td>39.9</td>
</tr>
<tr>
<td>file access Multiple Open</td>
<td>222.1</td>
<td>221.8</td>
</tr>
<tr>
<td>Terminal Test</td>
<td>55.4</td>
<td>51.7</td>
</tr>
</tbody>
</table>

<table>
<thead>
<tr>
<th>Multi-User (8080 with hard disk)</th>
<th>1 user</th>
<th>2 users</th>
<th>3 users</th>
<th>4 users</th>
</tr>
</thead>
<tbody>
<tr>
<td>processor test</td>
<td>30.1</td>
<td>63.4</td>
<td>100.4</td>
<td>134.6</td>
</tr>
<tr>
<td>single open disk access</td>
<td>7.6</td>
<td>11.6</td>
<td>16.3</td>
<td>21.3</td>
</tr>
<tr>
<td>multiple open disk access</td>
<td>76.1</td>
<td>93.6</td>
<td>73.9</td>
<td>87.3</td>
</tr>
<tr>
<td>terminal test</td>
<td>69.1</td>
<td>95.7</td>
<td>143.1</td>
<td>185.7</td>
</tr>
</tbody>
</table>

**Percentage of single user times**

<table>
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<th>Tests</th>
<th>1</th>
<th>2</th>
<th>3</th>
</tr>
</thead>
<tbody>
<tr>
<td>1</td>
<td>1.05</td>
<td>1.11</td>
<td>1.12</td>
</tr>
<tr>
<td>2</td>
<td>0.75</td>
<td>0.71</td>
<td>0.70</td>
</tr>
<tr>
<td>3</td>
<td>0.61</td>
<td>0.32</td>
<td>0.29</td>
</tr>
<tr>
<td>4</td>
<td>0.31</td>
<td>0.87</td>
<td>0.85</td>
</tr>
</tbody>
</table>

Q = queue — initiate named subtask. This will create the new entry in the appropriate tables and begin execution. For example, to see if a file the program DISPLAY must be executed which is done by 'Q DISPLAY'. Control can be returned to the Super Selector by pressing the ESC key.

S = suspend — stop execution of named task. This command is probably not the most needed; ESC performs the same function.

R = resume — continue execution of previously suspended (by S or ESC) task. If the letter W is typed after the task-name, control of the terminal will be passed to the task: otherwise control remains with the current task.

E = end — terminate execution of named subtask and remove from memory.

O = off — log out terminal

Table 2 Super Selector commands
Fitting for PCW

PCW welcomes approaches from would-be writers, even those who may never have appeared in print before. In this game it is often those with practical experience who have important things to say so we don't mind too much if their prose is less than perfect. Providing that submissions have a sensible structure and follow a logical sequence, we can take care of the polishing. Here are some tips:

If the article is already written, simply send it in, making sure that your name, address and 'phone number appear on both the article and the covering letter. If you have submitted the same work to other magazines you should tell us - it would be embarrassing (to say the least) if the same article appeared in more than one.

If you have an idea for an article or a series, write us a letter outlining your ideas. A one or two page synopsis giving the proposed structure, sequence and the quality of performance of the playing program.

If you have nothing specific in mind but feel qualified to conduct case studies, Benchtests or whatever then drop us a line saying what you'd like to do and why you think you're qualified to do it. We're not particularly looking for strings of academic qualifications - experience carries just as much weight.

Dick Benton is always on the lookout for interesting calculator features and we wouldn't mind seeing one or two readers getting on their soapboxes but remember: even articles such as this need a structure.

Reading PCW will give you a good idea of the style we prefer. You may notice that we try to avoid pomposity and we almost forgot - if you have an idea for an article or any wheels. Oh, we almost forgot - PCW does pay for all published work.

Micros

Microtek rack system prices
MRS-32D - 128k dynamic RAM, 32Mb Phoenix hard disk drive, (16Mb fixed & 16Mb cartridge), four serial and two parallel ports, rack mounted $6054.00
MRS-96D - As MRS-32D but with 96Mb hard disk drive (80+16) $9309.00

Famos operating system
NVT Famos operating system including: Basic compiler, utilities, assembler system, run time system, 'Wordflow' word processing, and manuals $889.00

Software
1 - MCS full accounting system (sales, purchase and nominal ledgers) $1500.00
1 - MCS stock control system $1000.00
1 - MCS payroll system LEASE
1 - MCS client information and mailing system $850.00
1 - MCS plant hire system $1000.00
1 - MCS job costing system $1000.00
Utilities 10-250

Other systems POA

Peripherals
Texas T810 matrix printer (150 cps), Full ASCII, paper tray and stand $1280.00
Okidata Microline 82 matrix printer 550.00
Lyman 5080 VDU 900.00
TVI 912c VDU 595.00

Manuals only £30

Micro Chess

All the major manufacturers were displaying their wares in Las Vegas. I will deal with them alphabetically.

Applied Concepts unveiled its new modular chess program for its Modular Game System. The program consists of three modules called Grunfeld, Morphy and Capablanca (three famous chess players of the past) - they cover, respectively, the opening, middle and endgame. The Morphy module, however, also contains enough opening and endgame knowledge to stand on its own as a complete program, the other modules being used for their respective phases of the game to improve the overall playing strength. This is one of the four new programs announced which is definitely stronger than anything at present on the market.

Fidelity Electronics, last year's market leader in both unit volume and turnover, unveiled a completely new item: a pocket set with a sensory board, pieces that plug into holes on the sensory board and three levels of play. Fidelity also had the old Voice Challenger program ensonced in a large wooden chess table.

The new program for the Sensory Voice Challenger, based on the Scraklen's program which won the World Microcomputer Championship at last year's PCW show, was not on show and probably will not be unveiled before the Chicago Consumer Electronics Show in June. Though that is unlikely to be running at 4 MHz in the production unit, it, too, will be stronger than anything currently on the market.

The giant Mattel Electronics entered the field with a small pocket unit called, enterprisingly, 'Computer Chess'. The advertising blurb referred to it playing 'brilliant chess', which owes rather more to the integrated LCD chess board than to the quality of performance of the playing program.

Novag, previously a distributor of SciSys products, has now ventured into the field of manufacture. It unveiled a whole range of excitingly designed units and if looks were everything it would capture the entire computer chess market. The software is provided by Dave Kittinger, using his Mychess program.

At the bottom of the Novag range is the 4k Micro Chess with, like the Fidelity unit, a sensory board and plug-in pieces. Next in line is the 8k Super Sensor IV with Fidelity-type sensor board. It was, though, the two units at the top of their range, both using a 24k variety of Mychess, that aroused the greatest interest. Savant has an LCD chess board display combined with sensory touch technology. With this technique the user simply touches the piece on the LCD that he wants to move and then touches the square to which he wants to move the piece and that's it. Then there was the super-sleek Robot Adversary. Unlike Applied Concepts' Boris Handroid, this does not use an 'x,y plotter' approach but has a true robot arm. A most impressive entrance to the market place by Novag.

SciSys now has the largest range of machines on the market. In Las Vegas it unveiled Junior Chess and Graduate Chess, Chess Executive, Sensor Chess and the Chess Champion Mk V. Junior and Graduate Chess each have a 2k program and will retail respectively for about £20 and £30 or less. The Chess Executive is quite a strong 4k program with built-in LCD chess board and a unique cursor system for moving the pieces which requires no knowledge of chess notation on the user's part. All three of the above units are battery operated and pocket-size. Sensor Chess is a modular system with a basic 4k module, expandable to 6k or 8k, and its sensor board is of an improved type requiring less pressure on the squares to register piece movement. Top of the line was the new SciSys flagship, the Chess Champion Mk V.

The second European Microcomputer Chess Championship will take place during the 4th PCW Show, 10-12 September 1981. For details, send a large SAE to: European Microcomputer Chess Championship, PCW, 14 Rathbone Place, London W1P 1DE.
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Tel (0734) 664345/6 GDSS
Welcome to the confusing world of the microcomputer. First of all, let's get it out of the way: there's nothing complicated about this business, it's just that the jargon used by an immense amount of necessary jargon. Imagine if we had to compartmentalize our computer into a system with a radix of 16 in which the letters A to F represent the values ten to 15 when instead we can simply say 'hex.' No doubt soon many of the words and phrases we are about to explain will eventually fall into common English usage. Until that time, PCW will be publishing this guide — every month.

We'll start by considering a microcomputer's functions and then examine the physical components necessary to implement these functions.

The microcomputer is capable of receiving information, processing it, and then either putting the results or sending them somewhere else. All this information is called data and it comprises numbers, letters, and special symbols which can be represented in any 'human' form, inside it's a different story — they must be held in the form of an electronic code. This code is called binary — a system of numbering which uses only 0s and 1s. The microcomputer uses each character, number or symbol is represented by eight binary digits, which are known as bytes, and they are called, ranging from 00000000 to 11111111.

To simplify communication between computers, several standard coding systems exist, the most common being ASCII (American Standard Code for Information Interchange). As an example of this standard, the number five is represented as 01010101 — complex numbers, letters and characters for the computer! This collection of eight bits is called a byte and computer freaks who spend a lot of time mess about with bytes are called hex. The hex equivalent of a byte is obtained by giving each half a single character code (0–9, A–F): 0 = 0000, 1 = 0001, 2 = 0010, 3 = 0011, 4 = 0100, 5 = 0101, ... 15 = F111. Our example of 5 is therefore 35 in hex. This makes it easy to handle complicated collections of 0s and 1s. The machine detects these as bytes and is able to perform simple arithmetic on, or by comparing them with other data. It's the latter function that gives a computer apparent 'intelligence' — the ability to make decisions and to act accordingly and to be given a set of rules in order to do this and, once again, these rules are stored in memory as bytes. The rules are called programs and while they can be output in binary or hex (machine code programming), the usual method is to have a special program which translates English or near-English into machine code. This speeds programming considerably, the next step in the process being translated into English. The faster the programming time, the other hand, program execution speed tends to be slower.

The most common microcomputer language is Basic. Program instructions are typed in at the keyboard, to be coded and stored in the computer's memory. To run such a program the computer uses an interpreter which picks up each English-type instruction, translates it into machine code and then sends it into the processor for execution. It has to do this each time the same instruction has to be executed.

Two strange words you will hear in connection with Basic are PEERK and POKE. They give the programmer access to the memory of the machine. It's possible to read (PEEK) the contents of a byte in the computer and to modify a byte by POKE.

Moving on to hardware, this means the physical components of a computer's system. It is opposed to software — the programs needed to make the system work.

At the heart of a microcomputer system is the central processing unit (CPU), a single microprocessor chip with supporting devices such as buffers, which amplify the CPU's signals for use by other components in the system. The packaged chips are either soldered down to a printed circuit board (PCB) or are mounted in sockets. In some microcomputers, the entire system is mounted on a single, large, PCB; in others a bus system is used, comprising a long PCB holding a number of interconnected sockets. Plugged into these sockets are several smaller PCBs, each with a specific function — for instance, one card would hold both the CPU and its support chips. The most widely-used bus system is called the 8080. The CPU needs memory in which to keep programs and data. Microcomputers generally have two types of memory, RAM (Random Access Memory) and ROM (Read Only Memory). The CPU can read information stored in RAM — and also write information there. Two types of RAM exist: static and dynamic; all you need know is that dynamic RAM uses less power and is less expensive than static, but it requires additional, complex, circuitry to make it work. Both types of RAM lose their contents when power is switched off, whereas ROM retains its contents permanently. Not surprisingly, manufacturers offer store interpreters and that like in ROM. The CPU can only read the ROM's contents and cannot alter them in any way. You can buy special ROMs called Proms (Programmable ROMs) and EPROMs (Erasable ROMs) which can be programmed using an external device; EPROMs can be erased using ultra-violet light.

Because RAM loses its contents when power is switched off, cassettes and floppy disks are used to save programs and data for later use. Audio-type tape recorders are often used by connecting data to a series of audio tones and recording them; later the computer can listen to these same tones and reconvert them into data. Various methods are used for this, so a cassette recorded by one make of computer won't necessarily work on another make. It takes a long time to record and play back information and it is difficult to locate one specific item among a whole mass of information on a cassette; therefore, to overcome these problems, floppy disks are used on more sophisticated systems.

A floppy disk is made of thin plastic, coated with a magnetic recording surface rather like that used on tape. The disk, in its protective envelope, is placed in a drive which rotates it and reads/Writes recorded information, and it is difficult to locate one specific item among a whole mass of information on a cassette. Therefore, to overcome these problems, floppy disks are used on more sophisticated systems.

A typical floppy disk is 8 inches (203 mm) in diameter and is made of plastic coated with magnetic material. The tiny magnetic dots on the surface can be magnetized in any one of two ways to represent a 'one' or 'zero.' The disk is divided into concentric rings called tracks, each of which is in turn subdivided into sectors. Using a program called a disk operating system, the computer keeps track of exactly where information is on the disk, and can get to any item of data by moving the head to the appropriate track and then moving to the right sector to come round. Two methods are used to tell the computer where on a track each sector starts: soft sectoring where special signals are recorded on the surface and hard sectoring where holes are punched through the disk around the central hole, one per sector.

Half-way between cassettes and disks is the stringy flexible miniature continuous loop tape cartridge, faster than a cassette but cheaper than a disk system. Hard disk systems are also available for microcomputers, the more information than floppy disks are more reliable and information can be transferred to and from them much more quickly. You, the user, must be able to communicate with the computer and the generally accepted minimum for this is that you call your machine VDU (Visual Display Unit), which looks like a TV screen with a typewriter-style keyboard, sometimes these are built into the system itself; sometimes they're separate. If you want a written record (hard copy) of the output, you'll need a printer.

The computer can send out and receive information in parallel and serial. Parallel input/output (I/O) requires a series of wires to connect the computer to another device, such as a printer, and it sends out data a byte at a time, using a separate wire carrying each bit. Serial I/O involves sending data one bit at a time along a single wire, and with extra bits added to tell the receiving device when a byte has finished. The baud rate divided by ten equals the number of bytes sent per second.

To ensure that both receiver and transmitter link up without any electrical horrors, standards exist for serial interfaces, the most common is RS232 (or V24) while, for parallel interfaces to printers, the Centronics standard is popular.

Finally, a modem connects a computer, via a serial interface, to the telephone system allowing both computers with modems to exchange information. A modem must be wired into the telephone system and you need British Telecom's service, although some modern modems are also available for microcomputers, making it possible to exchange information in this way.

There's nothing complicated about the business, it's just that the jargon used by an immense amount of necessary jargon. Imagine if we had to compartmentalize our computer into a system with a radix of 16 in which the letters A to F represent the values ten to 15 when instead we can simply say 'hex.' No doubt soon many of the words and phrases we are about to explain will eventually fall into common English usage. Until that time, PCW will be publishing this guide — every month.

This is our unique quick-reference guide, reprinted every month to help our readers pick their way through the most important pieces of (necessary) jargon found in PCW. While it's in no way totally comprehensive, we trust you'll find it a useful introduction. Happy microcomputing!
### Packages

PCW's 'Packages' section is produced bi-monthly, alternating with our 'In Store' hardware guide. We have confined coverage to packages which are available and supported at national level and which have been in use for at least six months in a minimum of five sites. Producers of packages which fall within these constraints should send details or updates to: Packages, PCW, 14 Rathbone Place, London W1P 1DE.

The layout has been designed to allow you to discover which packages are available for the application you have in mind and to show which packages are available for your computer if you already have a machine. In either case the code enables you to look up the supplier's name and telephone number in the table below.

#### Applications

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<tr>
<td>Management Information System</td>
<td>Apple II</td>
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#### Packages

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<td>ACT/Profot</td>
<td>021-454-1558</td>
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<tr>
<td>A2</td>
<td>Ason Data Processing</td>
<td>0132-222525</td>
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<tr>
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<td>0204-26644</td>
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<td>C4</td>
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<td>Graeme (Writer) Ltd.</td>
<td>04-634-2120</td>
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#### Office admin

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#### Order entry/invoicing

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#### Payroll

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#### Payroll

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## Packages

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<td>Prof app's indiv</td>
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Mercer, Hull.

TS-80 L2 k64... code, Basic, manual, £210. Tel: 01-876 1460.

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TS-80 k2... code, manual, £210. Tel: 01-876 1460.

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Outlook No.1

Here are the details of additions and changes recently notified. If we have failed to include YOUR group (or have published incorrect information) either here or in the complete listing, then please address changes/additions to: PCW (User Groups Index), 14 Rathbone Place, London W1P 1DE.

Finally, the next complete listing will appear in our May issue.

Here is a complete index to the current volume of PCW (up to and including last month). Full indexes to previous volumes were published in March 1980. April 1980 and January 1981. A quick guide to available back issues is given below.

**Network News**

Forum 80... operated by Frederick Brown, tel: Hull (0482) 859169. No access charge, open to any micro owner. Operating Tues & Thurs 1900 - 2200. Facilities: bulletin board, program library for downloading programs (all in Microsoft Basic), program uploading for adding your own programs to library; Forum 80 Users Group (membership free) enables access to programs not in public domain.

National TRS-80 Users' Group... being set up at time of writing, will be available to all micro users, not just TRS-80 owners. Initially access charge will be a £1.50 sub, but as more join, this will be reduced and refunds made accordingly. Facilities: bulletin board & programs for downloading. Contact: Brian Pain, tel 0908 566660 (office).

**Feature Index**

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**Programs**

- ZX80 Maths Test
- ZX80 Calendar
- PET Link Index
- TRS80 Rocket
- TRS80 Dropout
- TRS80 Giant Trap
- TRS80 Four in a Row
- TRS80 Target Practice
- PET Convoy
- PET Wire
- PET Maze Chase
- PET Android
- PET Anagram

- PET Obstacle Course
- PET Greenfingers
- ZX80 Numberbunch
- (3 programmes)
- PET Brick Stop
- TRS80 Show
- Jumping
- PET Grand Prix
- PET Aircraft Landing
- PET Bouncy

**Back Numbers**

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USER GROUPS INDEX

As promised, here is a complete printout of our User Group Index. If we have failed to indicate YOUR group, then please address the relevant information to PCW (User Group Index), 14 Rathbone Place, London W1P 1DE. Notification of changes will also be appreciated. The next full listing will appear in PCW's August edition. In the meantime we shall of course continue to publish User Group Index update information—as and when it reaches us.

INTERNATIONAL

Tangerine Users Group (International). Recently formed for users of 8088, 8086 etc, the TUG will act as a central information exchange of programs etc. Annual membership subscription of £5 from TUG at 3/22 Donoughmore Road, Neasden, London NW10, UK.

USCD System User Society. Set up in San Diego in June for users of USCD Pascal, the society aims to establish a software library, promote regional and special interest groups, and liaise with USCD system distributor Software Technology for future development plans. Existing special interest groups include industrial application, word processing, real time, business application, etc in the UK contact: John Ash, Dicoll Data Systems Ltd, Bond Close, Kingsland Estate, Basingstoke, Hampshire, RG21 4RS.

European Sorcerer Club. New name for SPEC (Sorcerer Program Exchange Club). Not confined to Europe, in fact, as 200 strong and growing, people from all over the world. Publishes newsletter on hardware & systems. Annual sub: $10 for individuals, $20 for institutions, distributed by CRO in the USA.


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 on both a regional and national basis. For full details on MUSE's range of activities, contact the MUSE secretary, R. Trigger, 48 Charlestown Road, Hove, Sussex BN3.

NATIONAL

Box 1131, Mount Shasta, California 96067. Initials P.E.C., Encouragement and fellowship. Meetings are held in San Diego in June for users of the 6502 processor. The club exists for the purposes of information and program exchange exchange (on a non-commercial basis) and all revenue is plowed back into the club. The club has recently established the 6502/Z80 users. Membership costs £5. Contact: D. Blagden, PO Box 159, Kingston upon Thames, Burmec, KT2 5UQ (a.e. for further information).

Microcomputer Users Club: Contact: Natural Products Club, 11 Spratling Road, Luton, Beds LU2 0SR (enclosed s.a.e, please). Newsletter on hardware & systems. Annual subscription £5. Newsletter £3, cassette £3.

British TI Users' Club. A loose association of owners and users of TI's Programmable/Programmable calculators, the club exists for the purposes of information and program exchange (on a non-commercial basis) and all revenue is plowed back into the club. The club has recently established the 6502/Z80 users. Membership costs £5 p/a which includes a newsletter and cassette program exchange (and is in no way sponsored by TI). The main activity is production of software (roughly) monthly newsletter and membership costs £5. Details from 2 Woodside Crescent, Cirencester, Glos. Stfs 5T 4BW.

Z80 Users Club, Bi-monthly magazine, No software. Technical support, Subscription £10 (UK), £10 overseas. Contact: D. Blagden, PO Box 159, Kingston upon Thames, Burmes, KT2 5UQ (a.e. for further information).


British National Computer Users Association. Full membership now costs £8.00, but you'll get a free databank of special routines for the UK101/Super on enrolment: Dave Allen's databank includes a fast basic line renumeration compiler—only four lines long). For full details send an SAe to: The Secretary, NPCUA, 11 Stillwell Street, Mansont, Ramsage, Kent.

Powertran Users Club. Annual subscription £5.00, which includes a monthly newsletter. Contact: T. L. Proberts, 50 Cowper Street, Wimbeldon, London SW19 8LZ.

ACOM Atom User Group. Set up for interchanging of software ideas, tips, programs etc. Contact: Brian M. Walsh, 65 Rosewood, Northolt, Middlesex.


Cosmac Users Group (proposed). For people using the KCA 2A02, Cosmac ELF, ELFII, Super ELF etc. Contact: James Cunningham at 7 Harrowdon Court, Harrowdon Road, Luton LU12 0SR (enclosed s.a.e. please).

Central Regional Users Group. Activities include a computerised bulletin board service (see 'Network News'). Contact: P. J. Pain, National TRS-80 UC, 408 High St., Stone Stratford, Milton Keynes, (tel. 0908) 549234/549279. (Home phone). ZX80 Users Club. The group's aim is to create and share software which will fit within the limits of micro 360/370-equivalent systems. Annual subscription £10 for individuals, £25 for organisations, £100 for co-operatives. Contact: Chris Eves, P.O. Box 151, 1322 Heevoi, Norway.

Apple Users Group: Contact: Malcolm Newton, 5 The Poultry, Nottingham, Tel: 0602 583348/9.

Cosmac Users Group. Contact: The Secretary, NPCUA, 11 Stillwell Street, Mansont, Ramsage, Kent.


users Group (Northwest Group)). Meets 1st Tues eve & 2020 users. Meets 1st Tues eve & Wigan. Contact: Melvyn D. Blackburn, 28 Hilda Road, Orford, Wigan, WA3 3JL tel: 0942 81248.


CPS Users Group (UK). Annual subscription £5.50 for news & cassette. Contact: M. Hatfield, Computer Unit, Northumbria Polytechnic, Newcastle upon Tyne. Contact: M. Hatfield or R Reed, Computer Unit, Northumbria Polytechnic, Newcastle upon Tyne. Contact: M. Hatfield or R Reed, Computer Unit, Northumbria Polytechnic, Newcastle upon Tyne. Contact: M. Hatfield or R Reed, Computer Unit, Northumbria Polytechnic, Newcastle upon Tyne.

British Apple Systems User Group. For Apple II and ITT applications. Contact: R. T. Sharpe, 223 Lordship Lane, Wood Green, London N10 4HY. Contact: John Sharp, Garston (0908) 722098 or Ongar Park Street, Ongar Park (0727) 279217.

Anyone interested in forming a Texas T919/4 Users Club. A group and a magazine and a software library. Contact: Mr P. D. P. Davies, Dataprocessing Manager, Penkive Price Systems Organisation Ltd, 3-5 Data House, 141 Morden Rd, Mitcham, Surrey CR4 4XJ, tel. 01-484 7099.


British Amateur Robotics Association. Set up for anyone interested in robotics, both small and large scale. Latest small but production ready for newsletter. Contact: D. Stroop, 66 Watertoo Rd, Penyfan, Cardiff, S. Wales.

NORTH-EAST

North-East RML 3802 Users Group. Meet on 42nd floor of Data Systems Ltd, Bond Close, Kingsland Estate, Basingstoke, Hampshire, RG21 4RS. Contact: Mike Jago, 72 King Street, Newcastle upon Tyne, contact: M. Hatfield or R. Reed, Computer Unit, Northumbria Polytechnic, Newcastle upon Tyne. Contact: M. Hatfield or R. Reed, Computer Unit, Northumbria Polytechnic, Newcastle upon Tyne. Contact: M. Hatfield or R. Reed, Computer Unit, Northumbria Polytechnic, Newcastle upon Tyne. Contact: M. Hatfield or R. Reed, Computer Unit, Northumbria Polytechnic, Newcastle upon Tyne.

North-East Medical & Laboratory Users' Newsletter. Free quarterly newsletter detailing users interests, programs & applications, supported by but independent of the NHS. Contact: Dr N. Robinson, The Readeny, Northwick Park Hospital, Harrow, Middlesex.

SOUTH


NORTHWEST
USER GROUPS INDEX

Ireland

Anybody in the West of Ireland interested in setting up a West of Ireland Apple User Group can contact John O'Byrne, Apple UK, 30 The Mall, Ballinasloe, Co. Galway. 091-551 024, or Pat Fennell, 107 The Orchard, Sporton Road, Newnham, Cambridge.

Bucks

Would any one interested in setting up an Apple Users Group in the Bucks/Berkshire area contact Steve Farnsworth, 105 Greenway, Maidenhead, Berkshire, Tel: 0753 77677 (off hours).

Cambridgeshire

Recently formed, meets on 1st and 3rd Wednesdays at 7:30pm at the University of Essex, Southend, Essex CO1 3PU. Contact: Bob Shillingford, 140 Ely, Cambridge, Tel: 0223 72891 (day), 0223 45678 (evening).

Cleveland

Meetings: 1st Monday each month at 7:30pm. Contact: Mike Smith, 35 King Street, Middlesbrough, Tel: 0642 322583.

Cornwall

Meetings are held on alternate Wednesdays at the YMCA, St. Ives. Contact: Peter Gough, 25 East Street, Callington, Tel: 0318 72786.

Devonshire

Meetings are held on the 2nd and 4th Thursdays each month at 8pm at the New Hotel, Barnstaple. Contact: Mike Smith, 35 King Street, Middlesbrough, Tel: 0642 322583.

Dorset

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### USER GROUPS INDEX

#### SELMIC (South East London Microcomputer Club)
Meetings: fortnightly at Thames Polytechnic, Abbey Chase, London SE25 6LH.
Contact: Mike Bayliss, 021-743 7197.

#### EAST LONDON AMATEUR COMPUTER CLUB
Meets: 7-10pm on 2nd & 4th Tuesdays monthly at Harrow Green Library, Leighton Buzzard, London LU1 1JR. Contact: Fred Linge 051-654 3288.

#### LONDON & SOUTH EAST
Sharp MZ-80K User Group. Contact: Joe L.P. Seet, 16, London Rd, Sunbury -on-Thames TW16 5AF. Tel: Sunbury 86649.

#### MANCHESTER
Atom Users' Group. Meetings: first Thursday of the month at a pub near the Deansgate area of the city. Contact: Clem Rutter, 061-434 3092 (eves).

#### NORTHANTS
Microsoc the Oxford University Computing Society. Meetings: 1st & 3rd Thurs each month at Garie Junior School, membership £3 pa. Contact: Derek Daines tel 0380 56198.

#### NOTTINGHAMSHIRE

#### OXFORD

#### SURREY
Compukit User Club. Details, including meetings with the Oxford Microcomputer Club: Contact M. Bouris, St. John's College, Oxford.

#### SOUTH
IPUG South East Regional Group. Meetings: 3rd Thursday each month, 7.30pm at Charles Darwin Building, Oxford. Contact: Managing Editor, Oxford Microcomputer Club. Address: M. Bouris, St. John's College, Oxford.

#### SUFFOLK
Anyone interested in forming a Suffolk Computer Users' Club should contact Ian on Ipswich 831353 eves/weekends.

#### SURREY
Richmond Computer Club. Held the second Monday of each month at the Richmond Community Centre (20p per meeting), members have the use of a good range of equipment. Contact: Robert Forster, 164 Shipley Drive, Sevenoaks, Kent TN13 2EH. Tel: 0734 55380.

#### SURREY MICROPROCESSOR SOCIETY (SUMPS)
SUMPS is centered on Crawley & Horsham. Aims to meet monthly & publish a newsletter. Details: contact either Mr J. Fieldhouse, 111 Selhurst Road, London SE25 6LH; Mr J. Clarke, 31 Hyde Heath Court, Pound Hill, Crawley, West Sussex (Crawley 864 507).

#### TYNE AND WEAR
Newcastle-upon-Tyne Personal Computer Society: meets first Tuesday each month at the Fishburn Centre, Sunniside, County Durham. Contact: Roy Diamond (Chairman), 27 Shipley Road, Dudley, West Midlands (0203 454061). Contact Paul Sanderson (Secretary), 8 Vernon Road, Tolsy, Sheffield S17 3QE (0142) 351889.

#### WEST MIDLANDS
Research Machines 380Z. West Midlands User Group. Further details from: Peter Smith, Birmingham Educational Computing Centre, Camp Hill Teachers Centre, Stratford Road, Birmingham, B11 1AR. Tel: 021 6534144.

#### YORKSHIRE
A PET group is being formed on the Sussex/Surrey border, presented by the Piccadilly User Group. Aims to meet monthly & produce a monthly newsletter. Contact: Richard Dyer, 33 Partridge Rd, Ilfield, Crawley 867 067.

#### YORKSHIRE
A computer club has recently been formed in Wakefield. Contact: anyone interested in personal computers, with or without computing facilities. The intention is to hold meetings weekly, and publish a monthly or bi-monthly newsletter. Details: contact Mr J. Fieldhouse, 111 Selhurst Road, London SE25 6LH; Mr J. Clarke, 31 Hyde Heath Court, Pound Hill, Crawley, West Sussex (Crawley 864 507).

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This month we have an experiment in M6800 code and some Z80 arithmetic.

**Motorola/ Z80bridge**

For the experiment we are now giving in M6800 code three routines that have previously been published in Z80 code. This should help those more familiar with the Z80 to understand the M6800 code and vice versa. Let us know whether or not it does!

One point for Z80 practitioners to note is that the Motorola stack pointer points to the next location on the stack to be used and the TSX instruction puts the value of the stack pointer +1 (that is, the address of the last unremoved data actually stacked) into the IX index register.

The first two routines, FOWIM and GYCVM, are the Motorola equivalents of April's FOWIA and GRYCV. These get the current program address into a register and show how this can be used to access a table in a routine relative to the program location, thus making such routines position independent.

---

**Datasheet**

**FOWIM** - Get current program address.

- **CLASS:** 1
- **TIME CRITICAL?** No.
- **DESCRIPTION:** Gives in IX the address of the instruction it is then at, after returning to the code that called it.
- **ACTION:** IX-(SP) + 1
- **IX=Address IX was pointing at**

**GYCVM** - Gray code conversion

- **CLASS:** 1
- **TIME CRITICAL?** No
- **OUTPUT:** IX contains the address of the current program instruction; ie, the instruction immediately following the CALL to FOWIM
- **REGS USED:** IX
- **STACK Usage:** None
- **LENGTH:** 4
- **PROCESSOR:** M6800

---

**Datasheet**

**GYCVM** - Gray code conversion

- **CLASS:** 1
- **TIME CRITICAL?** No
Now for something slightly more complex: ASBNM, the Motorola equivalent of November's ASCNO, ASCII to 16-bit binary; ASBNM, the Motorola equivalent of ASCNO, gives the state of the stack between the seventh instruction and the label EXASC, except when in routines NUMCH and ERR1.

 bytes it took the Z80 to do ASCNO? To help Z80 users follow the M6800 code, Figure 1 (which vanished when we last did M6800 code in March) gives the state of the stack between the seventh instruction and the label EXASC, except when in routines NUMCH and ERR1.

**GBCV:**
- **BINARY-TO-Gray code**
- **INPUT:** The most significant nibble of the `A` register is zero
- **OUTPUT:** The most significant nibble of the `A` register is zero
- **APPLICATIONS:** Fast conversion
- **DEPEN:** None
- **IMPLEMENTATION:** 16-bit
- **EXAMPLE:**

```assembly
LDA A 9,X
BNE GYCV1
DEC A
INC A
JSR FOWIM
```

**FUNCTIONAL DESCRIPTION:** Converts a string of ASCII characters, in the range 30H to 39H, to Gray code. The string may be preceded by a binary number. The string may be preceded by a binary number.

**INPUT:** The most significant nibble of the `A` register is zero

**OUTPUT:** The most significant nibble of the `A` register is zero

**INTERFACES:** None

**SUBr DEPENDENCE:** FOWIM

**STACK USE:** 2

**REGs USED:** IX, A

**OUTPUT:** The most significant nibble of the `A` register is zero

**INPUT:** The most significant nibble of the `A` register is zero

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Nestra Software
Arithmetic

There are two small amendments to March's four-byte integer divide. Paul Jenner gave these changes to his DIV4 program which was published in your magazine.

The changes make the routine 53 bytes long, the 39th machine code byte 07 instead of 09, the 51st byte DB instead of D9 and cause the 40th and 41st bytes to be deleted and byte B7 to be inserted before the last byte.

The routines to divide and convert ASCII to binary and binary to ASCII will be given next month.

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by A King

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1) **FORI=1TO11:** POKE36+I,0 NEXT POKE464:14 PRINT"PETZAP IT!":IY=I
2) **PRINT**"WHEN THIS GAVE YOU JUST STOP IT";
3) **PRINT**"ALIEN INVASION BY SHOOTING THEM!
4) **PRINT**"WITH YOUR LASER, YOUR OWN WAY!"
5) **PRINT**"USE ROVER RIGHT USING < AND LEFT"
6) **PRINT**"TO FIRE YOUR LASER PRESS ";
7) **PRINT**"R "O" THE ALIEN MOVE IN THREE";
8) **PRINT**"DIRECTIONS STRAIGHT UP AND";
9) **PRINT**"TO PRINT ENTRANCE IN A GRID";
10) **PRINT**"AND THEN SHOOT THEM!"
11) **PRINT**"IF THE USER BECOMES BORED ON LEVEL 1 THEN HE MIGHT LIKE";
12) **PRINT**"SOME NEW ENTRIES FOR YOU!"
13) **PRINT**"YOU ZAPPED":S="INVADERS ON SKILL LEVEL":H=1, IF S>SHIT THEN H=1=S
14) **PRINT**"THE CROSS WILL BE AN OBSTACLE FOR YOU ";Y$=
15) **PRINT**"THE OBJECT OF THE GAME IS TO KILL A MOVING DEMON":I=1
16) **PRINT**"THE CROSS WILL BE AN OBSTACLE FOR YOU ";Y$=
17) **PRINT**"THE CROSS WILL BE AN OBSTACLE FOR YOU ";Y$=
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Fig 16 A stairway of pairs of cells.

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PATTERNS

Continued from page 78

a solution of this kind is to look for configurations in which every cell has an even number of paths to and from it. Figure 13 shows the simplest arrange-
is shown in a dotted line and the other half in a solid line, but they are joined together to form one continuous path round that end of the board. This path round the whole board is re-entrant, to use the usual jargon of the literature.

\[
\begin{array}{cccccc}
-2 & -2 & 0 & 0 & 0 & 0 \\
-2 & -1 & 1 & 1 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
0 & 0 & 0 & 0 & 0 & 0 \\
\end{array}
\]

Table 3 Initial values for cell data in arrays C and D as in Table 1

on Knight’s moves: that is, it is continuous, and the tour can start on any cell and will end on the same cell.

It is also possible to have just two cells on the board which have an odd number of paths in and out. One of these will then be the starting point and the other will be the end of the path.

Thus, there may be symmetrical solutions with one odd-valued cell at each end. In searching for the simplest solution I have looked at arrangements with two rows of cells, either both together, as in Figures 15(a), or one row apart, as in Figure 15(b). In this second case, remember that there can only be one block of cells used in the middle row to join the other two rows together — otherwise an inland sea of unused cells would be formed.

I have not found any such configuration with four enough odd-valued cells: 0 or 2. But I have not convinced myself, let alone proved, that there is no solution the main part of which is two rows of cells with a few extra cells at each end in order to eliminate the odd-valued cells.

If you find any such boards, or any other interesting results relating to these complete Knight’s tours then please write and let me know c/o PCW, 14 Rathbone Place, London W1P 1DE.

Since completing this article, I have found one configuration based on a staggered two pairs of cells, which can be thought of as two staggered rows. Some extra cells are needed at each end to allow the route to turn round. This is shown in Figure 16. Further pairs of cells can be added to the middle of the stairway without limit to make a board as large as you like.

---

**Making Tracks**

Continued from page 83

write command is aborted. From experience of the overall reliability of the system this is likely to indicate a physically damaged tape and there is therefore little advantage in using more than two write/read cycles. Each block is prefaced by the memory location from which it originated and the number of valid bytes in the block.

The file delete command alters the directory but does not actually erase the relevant data block(s). The ‘deleted’ blocks are then available and may be overwritten by the next write command. This tends to keep the valid data blocks concentrated towards the

---

**ZX80 Newsflash**

Campbell Systems announces a flicker-free dynamic INVASION game to fit STANDARD 1K ZX80. This amazing program features fired/misled hit/damage counts updated in real time, a moving missile launcher, alien targets and missiles launched instantly on the touch of the trigger key; and, incredibly, an accurate stopwatch clocking in 50th of a second. In 1K, and in perfect TV sync. Send 7p for cassette, full instructions, and we’ll also tell you how everything is done.

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A new tape must be initialised before use. TOS contains check routines which prevent a previously used tape from being reinitialised by accident.

The command table does not contain a direct command to erase tapes. This was purposely omitted to avoid accidental erasure, but the tape can be erased by direct monitor commands to the I/O ports used by the interface.

Many applications require files to be written, read or deleted during the execution of machine code. Basic programs. These can be achieved by calling the relevant subroutines within TOS and providing the necessary arguments.

### Finally

The prototypes have now been running for several months. Although the transfer rate and the access times are obviously slower than those of disk systems, this has not proved to be a serious practical disadvantage. The reliability is high, after some 48 hours of repeatedly reading and writing 32k files without any error it was decided that the probability of a 'nasty' mains spike was higher than that of a tape system failure and the test was discontinued. The system has met our initial specifications and has shown that, for many users of smaller microcomputers, reasonably sophisticated tape-based storage can provide an acceptable alternative to the more expensive disk systems.

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148 P.7W
The gremlins struck at February’s pro-gramms section with a vengeance - pages 138 and 139 were somehow transposed and the correct an-swer to the asking bid. But in the general case the program must evaluate each bid and then choose the bid with the highest score, or, if two or more bids have a similarly high score, the program selects the lower bid so that it can convey information in an economic manner.

How exactly this matching procedure is programmed will depend entirely on the type of bidding system you employ in your program, but a few hints may be useful for setting you on the right track. Firstly, we should consider a situation in which the program ought to make an asking bid. This might happen when it has discovered that it and its partner have a total of 34 points or more between the two hands. The program may wish to know how many aces and kings are in its partner’s hand (unless it has all the aces and kings itself), in which case it bids 4 No-Trumps. If the answer indicates that its partner has all the missing aces, the program can then ask how many kings are in its partner’s hand. It will then find out whether the partnership is missing any of the impor-tant top cards and make its decision as to whether it can afford to bid 7 (for a Grand Slam) or only 6 (a Small Slam). But if the program does not have adequate information (say either an ace, or a king and one other card, a queen and two other cards or a jack and three other cards), then the number of points assigned to No-Trumps can be adjusted to some high value (say 15). Each time that the partner bids another suit, which he has not yet bid, this score is increased by 2. The program then has a relatively easy measure of whether suit is worthwhile, and whether No-Trumps is a possibility. Then, as the level of the bidding gets nearer and nearer to the guideline limits, the program can easily make a decision about the final contract. It is then only important to avoid making a bid which is so high that partner can no longer make a safe bid (ie, a bid within the guideline limits) in a suit which is deemed to be acceptable.

Next month, I shall write about playing the hand once the bidding is over. In the meantime, I suggest that you find a good book on bidding and information about three of the variables, then the bid is, in some sense, more useful to the program’s partner than a bid which gives useful information about only two variables.

One final point, which is important to implement because of the necessity of playing a contract in the best suit (or in No-Trumps if that is better than a suit contract): throughout the bidding the program should keep some kind of measure for each suit and for No-Trumps. This measure should indicate the desirability of playing a contract in that suit. At the start of the hand when the cards are dealt, the measures might simply be the number of high card points in each of the suits (excluding the points for singletons and voids). For No-Trumps the measure should be zero. When the program’s partner makes a bid, the number of high card points for the suit bid should be in-creased by (say) 8 for the first time that partner bids the suit, 4 for the second time and 2 for the third time. If the program’s partner bids all of the suits in which the program does not have adequate information (say either an ace, or a king and one other card, a queen and two other cards or a jack and three other cards), then the number of points assigned to No-Trumps can be adjusted to some high value (say 15). Each time that the partner bids another suit, which he has not yet bid, this score is increased by 2. The program then has a relatively easy measure of whether suit is worthwhile, and whether No-Trumps is a possibility. Then, as the level of the bidding gets nearer and nearer to the guideline limits, the program can easily make a decision about the final contract. It is then only important to avoid making a bid which is so high that partner can no longer make a safe bid (ie, a bid within the guideline limits) in a suit which is deemed to be acceptable.

Next month, I shall write about playing the hand once the bidding is over. In the meantime, I suggest that you find a good book on bidding and select an easily programmable system.
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Still more goodies in the program, for Mike has devised it so that it prints out the name, the entry, start and end addresses in the bargain. And there’s a facility to jump to any address during the procedure.

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The Sinclair ZX80 is innovative and powerful. Now there’s a magazine to help you get the most out of it.

Get in sync

SYNC magazine is different from other personal computing magazines. Not just different because it is about a unique computer, the Sinclair ZX80 (and kit version, the MicroAce). But different because of the creative and innovative philosophy of the editors.

A Fascinating Computer

The ZX80 doesn’t have memory mapped video. Thus the screen goes blank when a key is pressed. To some reviewers this is a disadvantage. To our editors this is a challenge. One suggested that games could be written to take advantage of the screen blanking. For example, how about a game where characters and graphic symbols move around the screen while it is blanked? The object would be to crack the secret code governing the movements. Voilà! A new game like Mastermind or Black Box uniquely for the ZX80.

We made some interesting discoveries soon after setting up the machine. For instance, the CHR$ function is not limited to a value between 0 and 255, but cycles repeatedly through the code. CHR$ (9) and CHR$ (265) will produce identical values. In other words, CHR$ operates in a MOD 256 fashion. We found that the "=" sign can be used several times on a single line, allowing the logical evaluation of variables. In the Sinclair, LET X=Y=Z=W is a valid expression.

Consider the TL$ function which strips a string of its initial character. At first, we wondered what practical value it had. Then someone suggested it would be perfect for removing the dollar sign from numerical inputs.

Breakthroughs? Hardly. But indicative of the hints and kinds you’ll find in every issue of SYNC. We intend to take the Sinclair to its limits and then push beyond, finding new tricks and tips, new applications, new ways to do what couldn’t be done before. SYNC functions on many levels, with tutorials for the beginner and concepts that will keep the pros coming back for more. We’ll show you how to duplicate commands available in other Basics. And, perhaps, how to do things that can’t be done on other machines.

Many computer applications require that data be sorted. But did you realize there are over ten fundamentally different sorting algorithms? Many people settle for a simple bubble sort perhaps because it’s described in so many programming manuals or because they’ve seen it in another program. However, sort routines such as heapsort or Shell-Metzner are over 100 times as fast as a bubble sort and may actually use less memory. Sure, 1K of memory isn’t a lot to work with, but it can be stretched much further by using innovative, clever coding. You’ll find this type of help in SYNC.

Lots of Games and Applications

Applications and software are the meat of SYNC. We recognize that along with useful, pragmatic applications, like financial analysis and graphing, you’ll want games that are fun and challenging. And, indeed, you’ll find games in the charter issue of SYNC you’ll find several games. Acey Ducey is a card game in which the dealer (the computer) deals two cards face up. You then have an option to bet depending upon whether you feel the next card dealt will have a value between the first two.

In Hurkle, another game in the charter issue, you have to find a happy little Hurkle who is hiding on a 10 X 10 grid. In response to your guesses, the Hurkle sends you clues telling you in which direction to look next.

One of the most ancient forms of arithmetic puzzle is called a “boomerang.” The oldest recorded example is that set down by Nicomachus in his Arithmetica around 100 A.D. You’ll find a computer version of this puzzle in SYNC.

Hard-Hitting, Objective Evaluations

By selecting the ZX80 or MicroAce as your personal computer you’ve shown that you are an astute buyer looking for good performance, an innovative design and economical price. However, selecting software will not be easy. That’s where SYNC comes in. SYNC evaluates software packages and peripheral devices and doesn’t just publish manufacturer descriptions. We put each package through its paces and give you an in-depth, objective report of its strengths and weaknesses.

SYNC is a Creative Computing publication. Creative Computing is the number 1 magazine of software and applications with nearly 100,000 circulation. The two most popular computer games books in the world, Basic Computer Games and More Basic Computer Games (combined sales over 500,000) are published by Creative Computing. Creative Computing Software manufactures over 150 software packages for six different personal computers.

Creative Computing, founded in 1974 by David Ahl, is a well-established firm committed to the future of personal computing. We expect the Sinclair ZX80 to be a highly successful computer and correspondingly, SYNC to be a respected and successful magazine.

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Right now we need all the help we can get. First of all, we’d like you to subscribe to SYNC. Subscriptions are posted by air directly from America and cost just £10 for one year (6 issues), £18 for two years (12 issues) or, if you really want to beat inflation, £25 for three years (18 issues). SYNC is available only by subscription; it is not on newsstands. We guarantee your satisfaction or we will refund the unfulfilled portion of your subscription.

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Shelley's recent 'Get well say that, thanks to Alan delighted buyers rang him to cassettes to sell as 'lucky dip' job lot of reject Petsoft Calver, recently picked up a man from Supersoft, Peter

understand he's now got one arrival of a baby boy. We

Computers' Mike Sterland

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...Look out for Zilog's answer to Unix. It's called Zeus and will run on a soon-to-be-announced, Z8000-based system, provisionally named the MCZ3. We also hear that Zilog plans to licence its neat Z-Net interface hardware and software.

Congratulations to Personal Computers' Mike Sterland and family on the recent arrival of a baby boy. We understand he's now got one of each. Quit while you're winning, Mike... That nice man from Supersoft, Peter Calver, recently picked up a job lot of reject Petsoft cassettes to sell as 'lucky dip' items at 50p each. Many delighted buyers rang him to say that, thanks to Alan Shelley's recent 'Get well soon' article in FCW, they managed to recover the software which was on the tape before its rejection... It's nice to see that Lifeboat, the CP/M software mail order specialist, is back in business under new management. Helen Smith is in charge, and she can be contacted on 01-836 9028... Editor Tebbutt managed to get himself reported in his local rag recently. Among other things it accused him of visiting Silicone Valley last year. His wife, Sylvie, says she can't understand this accusation since she's never been near a cosmetic surgeon in her life... The organisers of the recent Microsystems '81 show won't thank us for reporting that invitations were still being posted on 11 March — the first day of the three-day show! We have the envelope to prove it... Shortly after 'Uncle' Clive Sinclair's withering comments about the BBC at his ZX80 launch, guess who his secretary had lunch with? Yes you've got it, one of the team in charge of the forthcoming Aacom-based TV series. All can be forgiven when we tell you that it was the only spare seat in a very crowded room. And the BBC man did have the grace to blush furiously named the MCZ3. We also hear that Zilog plans to licence its neat Z-Net interface hardware and software.

We present the first of an occasional series of specially selected mug-shots. For some as yet unfathomed reason, some PR companies believe that they add weight to their press release. This is Jon Baldachin (see last month's 'Newsprint').

PCW 191
192 PCW

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