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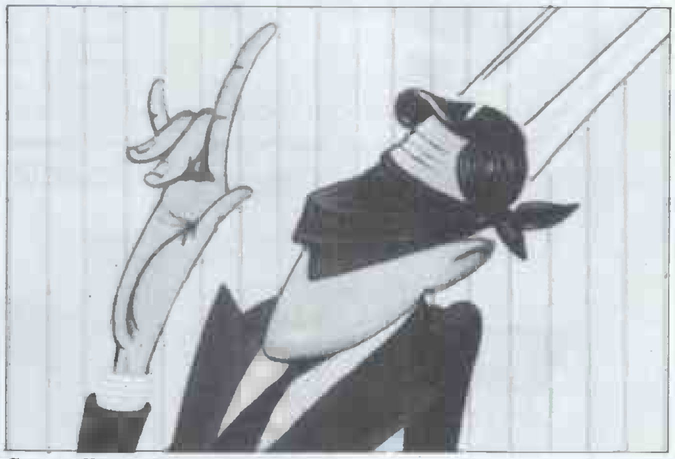

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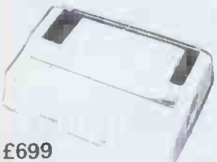

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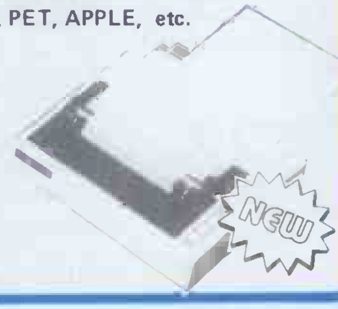

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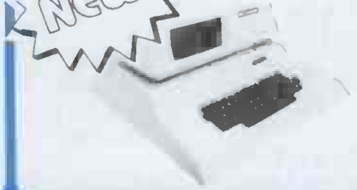

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From Motor...

The way things are developing leaves little doubt: while the motor was in every sense the driving force in the first half of the present century, the second half will clearly belong to the dator. The nearer the good old motor, as an additional source of power in our daily lives, gets to the limits of its capabilities, the more the new dator will be called upon to keep things moving. Less motorization – more datorization.

The history of the motor and the development of the dator are strikingly similar. Available in its early days only to a selected few, the motor is nowadays indispensable to almost everybody. Once the engineers and the businessmen had realized its tremendous potential, things began to move – literally – much faster and very soon almost everyone had his own car, his own private means of transport, for business and pleasure alike.

The 1980s will be for the dator what the 1920s were for the motor. But with one little difference: the "luxury" of a professional, reliable high-performance data processing machine is in fact something we can all afford now. For business or private use. Even people who, technically speaking, haven't a clue will find it almost impossible to go seriously wrong with a modern dator.

G.L. runs a small company specializing in exclusive equipment and fittings for boats: "The ABC80 is my dator for costing and checking materials, invoicing, work planning and word processing. I can now do my invoicing 8–10 times faster. Suddenly I've got enough time again and don't have to rely anymore on my old rule-of-thumb calculations. And my wife does our word processing on the dator as well."

H.W. is an executive in an international food manufacturing group: "The ABC80 is my dator for developing programmes for the central computer. At last I can do my programming in peace and quiet – and the company saves up to 30% into the bargain, because I no longer need to work on-line."

P.A. is production manager in a medium-size factory making effervescent tablets: "The ABC80 is my monitoring and control dator. You can't imagine the problems even a missing tube-cap used to cause on our packaging line in the old days. Now, with uniform production throughput, we're not only saving time and money – we've also built up a great working atmosphere among our personnel."

C.W. is a teacher in a perfectly ordinary school in a small town: "The ABC80 is our dator for teaching and learning. Every student learns in five lessons how to write his own programme, get rid of his computer complexes and is far better prepared for almost any career."

P.A. is an engineer in a laboratory investigating air conditioning systems: "The ABC80 is my dator for calculating fan performance. Waiting for days for data from our central computer department is a thing of the past for me. If I've got an idea – or a customer comes up with one suddenly on the phone – I can get cracking on my dator right away. That's what I call service."

H.E. has three children and is a dyed-in-the-wool private user: "The ABC80 is my home dator. Befor I got it I hadn't the faintest idea about computers. Now I know that there's nothing magic about them. And I've discovered that you can do no end of useful things with them – quite apart from the fun we all have with the dator almost every day."

...to Dator*

So much for these six satisfied users selected from the total of ABC 80 dator pioneers which now exceeds 15,000. Now let's see what the ABC 80 dator engineers at Luxor – Sweden's leading manufacturer of sophisticated electronic equipment, have to offer:
The screen: 12" with built-in sound generation and graphics/View data-compatible/Real-time clock.
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The cassette tape unit: Double-frequency encoding with transmission rate of 700 baud/Start and stop program controls/Fast forward and reverse/Counter.
The main options: User storage can be extended up to 32 K/Diskette storage up to 2 x 1 MBytes/Daisy-wheel printer with standardized interfaces/Separate numerical keyboard/ Plotter/Digitizer/Video and colour TV adaptor/UART/IEEE adaptor/AD and DA converters/Relay matching.

*Swedish for computer

ABC 80 – The professional microcomputer from Luxor in its basic version: display unit, keyboard and cassette tape unit.

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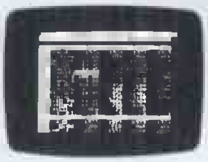

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- Fields may be COMPUTED FIELDS.
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- Select fields to be printed.
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FORTRAN is a powerful programming language, especially suitable for work in mathematics, engineering and the sciences. Apple FORTRAN, usable with the Apple Language System, is the ANSI Standard Subset of the recently-defined FORTRAN 77 standard; in several areas, Apple FORTRAN contains enhanced features and capabilities.

Apple is providing FORTRAN for use by technical professionals and educators who are both familiar with the FORTRAN language and are using packages written in FORTRAN. Because FORTRAN is a well-established language, large libraries of FORTRAN programs are already in existence, particularly for engineering and scientific applications. Apple FORTRAN provides the sophisticated FORTRAN user with the capability to develop new and modify existing FORTRAN programs on an Apple. Apple does not recommend FORTRAN for the individual new to programming.

Apple FORTRAN...

- *offers enhanced features and capabilities because it supports the newest computer industry standard, ANSI X3.9-1978. .*
- *provides a comprehensive software design environment including an editor, linker, file handler, assembler, Apple Pascal compiler, and system library, operating in the Apple Language System ..*
- *eliminates the need to recompile or reassemble existing code files when incorporating them into FORTRAN programs; compiled P-code and assembled machine code can be combined with a FORTRAN P-code file through the Apple Language System's linker facilities...*
- *allows you to take full advantage of Apple's Hires graphics capabilities by interfacing to graphics routines in the system library...*
- *gives programmers access to large libraries of material, since FORTRAN is a familiar, well-established language...*
- *provides access to special Apple features, such as sound generation and control paddles, through its system library routines...*
- *permits you to combine several source files in a single compilation through compiler directives in the source code.*

First, Some Words About FORTRAN '77

FORTRAN 77 contains significant additions and enhancements to the previous 1966 standard. For example mixed-mode arithmetic expressions are allowed. Structured programming is supported through expanded IF statement constructs. Logical IF, Block IF, ELSE IF, ELSE, and END IF statements provide a vastly improved method of clearly and accurately specifying the flow of program control. CHARACTER data type replaces Hollerith, alphanumeric data can be represented as strings rather than array elements

Some Specifics About Apple FORTRAN

Apple FORTRAN is the ANSI Standard Subset FORTRAN 77. It also supports enhancements and facilities from the full FORTRAN 77 language. In particular:

- Subscript expressions may include array elements and function calls
- DO statement limits may be defined by expressions, rather than just single variables.
- I/O units may be specified by expressions, rather than just constants or simple variables.
- The I/O list of a WRITE statement may include expressions
- All combinations of FORMATTED/UNFORMATTED and SEQUENTIAL/DIRECT files are allowed, with the following restrictions:
  —BACKSPACE is supported only for files connected to the blocked devices, it is not supported for UNFORMATTED SEQUENTIAL files.
  —DIRECT files must be connected to block devices

Apple FORTRAN contains a number of enhancements beyond the full FORTRAN 77 specifications. In particular:

- Compiler directives may be included in the source code. For instance, the $INCLUDE directive allows you to insert previously-developed code into your program without having to repeat the code. This is useful, for example, when you are writing many subroutines which use the same COMMON block. You can write the COMMON block just once, and $INCLUDE it in every subroutine
- An additional parameter to the OPEN statement allows you to specify whether the file is blocked or unblocked

There are two minor differences between the ANSI Standard Subset FORTRAN 77 and Apple FORTRAN. They are:

- Subprogram names cannot be passed as parameters
- INTEGER and REAL data types have different storage requirements—two bytes for INTEGER, four bytes for REAL

Apple FORTRAN is written in Pascal and produces P-code which runs in the Apple Pascal Operating System

Diskettes: 16 sector format

To use Apple FORTRAN, you will need:

- Apple II or Apple II Plus each with the Apple Language System.
- Apple Disk II drive with controller*
- video monitor or television

*While a single drive system is adequate for very small programs, two drives are strongly recommended for ease of operation and more serious program development

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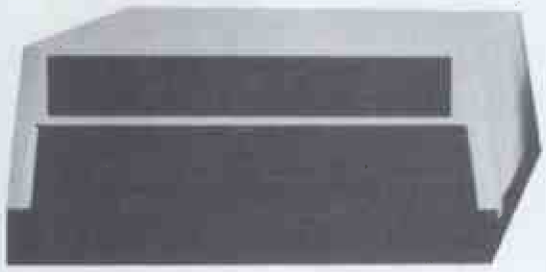

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Literally thousands of CP/M based applications can be easily transferred to run on the Apple. It is simply a matter of converting programs from standard 5" and 8" CP/M disk format into CP/M disk format. This is done by transferring CP/M files from a CP/M machine to the Apple via a serial I/O port. You'll need an Apple High Speed Serial interface or an Apple Communications interface; a connecting cable; and, of course, a CP/M machine from which to transfer. Utilities that make this process easy are supplied with the Z-80 SoftCard.

USING PERIPHERAL WITH THE Z-80 SOFTCARD

A Z-80 SoftCard system will run with all standard Apple peripheral I/O cards and most independent peripherals including any printer that is supported by Apple printer interface cards. Since CP/M provides the same I/O environment as Apple Pascal, a good rule of thumb is that the SoftCard will interface with any peripheral that currently works with Apple Pascal.

The Z-80 SoftCard will support up to six disk drives. 24 x 80 column video cards such as the Videx and Sup-R-Term are supported as are most popular 80 column terminals such as those from Hazeltine and Soroc.

In addition, user I/O drivers can be easily added to CP/M.

WHY CP/M?

Next to the SoftCard itself, CP/M is the most important key to allowing a wide variety of Z-80 software to run on the Apple including version 2.2 of the CP/M operating system in the SoftCard package.

More soft-ware choices for the user. You have your choice of many sophisticated system, word processing, accounting, business and professional software packages when you have CP/M.

Unlike standard Apple DOS, CP/M supports many languages in addition to BASIC. These include FORTRAN, COBOL, BASIC Compiler.

And CP/M has many conveniences not found in Apple DOS. Such as easy interface to machine language programs; faster disk 1/0 simple file transfer; and wild card file-narning conventions that allow you to refer to multiple files with one name.

Included as standard with CP/M 2.2 is a complete set of system utilities that give you complete control of the CP/M operating environment. These include PIP, a general purpose file transfer utility and STAT, a program that lets you keep track of important system information such as disk space and file size. SUBMIT and XSUB allow you to execute batch processing jobs. And a powerful text editor, assembler, and sophisticated assembly language debugger, are also included.

The Z-80 SoftCard is not an emulator. It is an actual Z-80 chip plus interfacing circuitry on a circuit board that plugs directly into any of the slots on your Apple (except slot 0).

The Z-80 does not replace your 6502; it adds to it. You use Z-80 mode when you want to run Z-80 software. Switching back and forth is simple.

When you are in Z-80 mode, the Z-80 assumes all the processing tasks, but the 6502 continues to handle I/O. Thus, you can still use most Apple peripherals when you are in Z-80 mode.

MEMORY REQUIREMENTS

To run the Z-80 SoftCard requires a disk-based Apple II or disk-based Apple II Plus computer with at least 48K RAM memory. If used with a Language Card, 12K additional RAM can be utilized.

Whether you have a 48K system or a 60K system with Language Card. 4K of RAM is required to handle the Apple screen and CP/M sector read and write routines.

CP/M occupies 7K of RAM, 2K of which can be used by other programs, such as BASIC. The standard versions of Microsoft BASIC, which supports all Applesoft extensions except high-resolution graphics, requires slightly more than 24K RAM. So BASIC and CP/M together occupy just over 29K RAM.

The version of BASIC that supports high-resolution graphics is somewhat large because 8K of screen memory is necessary for high-resolution graphics. It occupies just over 33K, making a total of slightly more than 38K for both CP/M and the high-resolution version of BASIC.

BEYOND MICROSOFT BASIC

Microsoft 5.0 BASIC is provided with the Z-80 SoftCard. Microsoft FORTRAN, COBOL, BASIC Compiler, and Assembly Language Development System will be available and sold separately to Z-80 SoftCard users.

Just imagine the power of your Apple Computer when it has one of the following:

Microsoft FORTRAN-80.Comparable to the FORTRAN compilers used on large mainframes and mini-computers. Microsoft's FORTRAN-80 brings the world's most popular science and engineering programming language to the Apple. Compilation is very fast (up to several hundred statements per minute) and less than 25K bytes of memory are needed to compile most programs. All of ANSI FORTRAN X3.9-1966 is included except the COMPLEX data type. Therefore, you may take advantage of the many application programs already written in FORTRAN.

Microsoft COBOL-80. The most widely used language for business applications, COBOL is excellent for inventory, personnel, payroll, order entry, accounting and forecasting applications. Powerful use of disk files, CRT screen handling, easy-to-use syntax and readable programs give programmers the tools they need to meet the rising challenge of data processing. Microsoft's COBOL-80 is an ANSI standard COBOL with many enhancements.

Z-80 SOFTCARD PRODUCT SPECIFICATIONS £25

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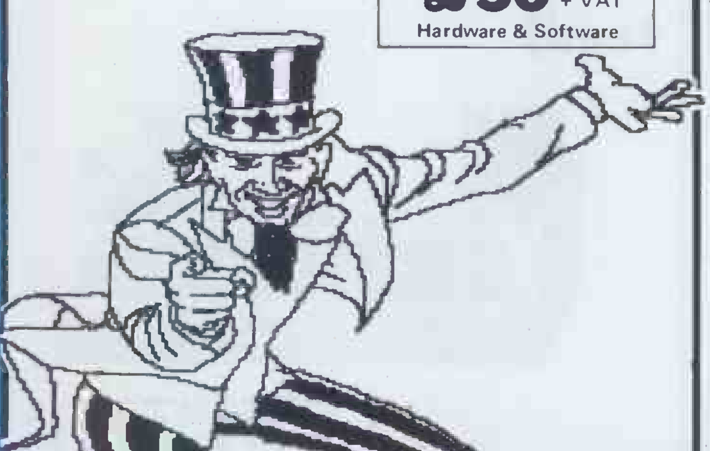
Hardware & Software



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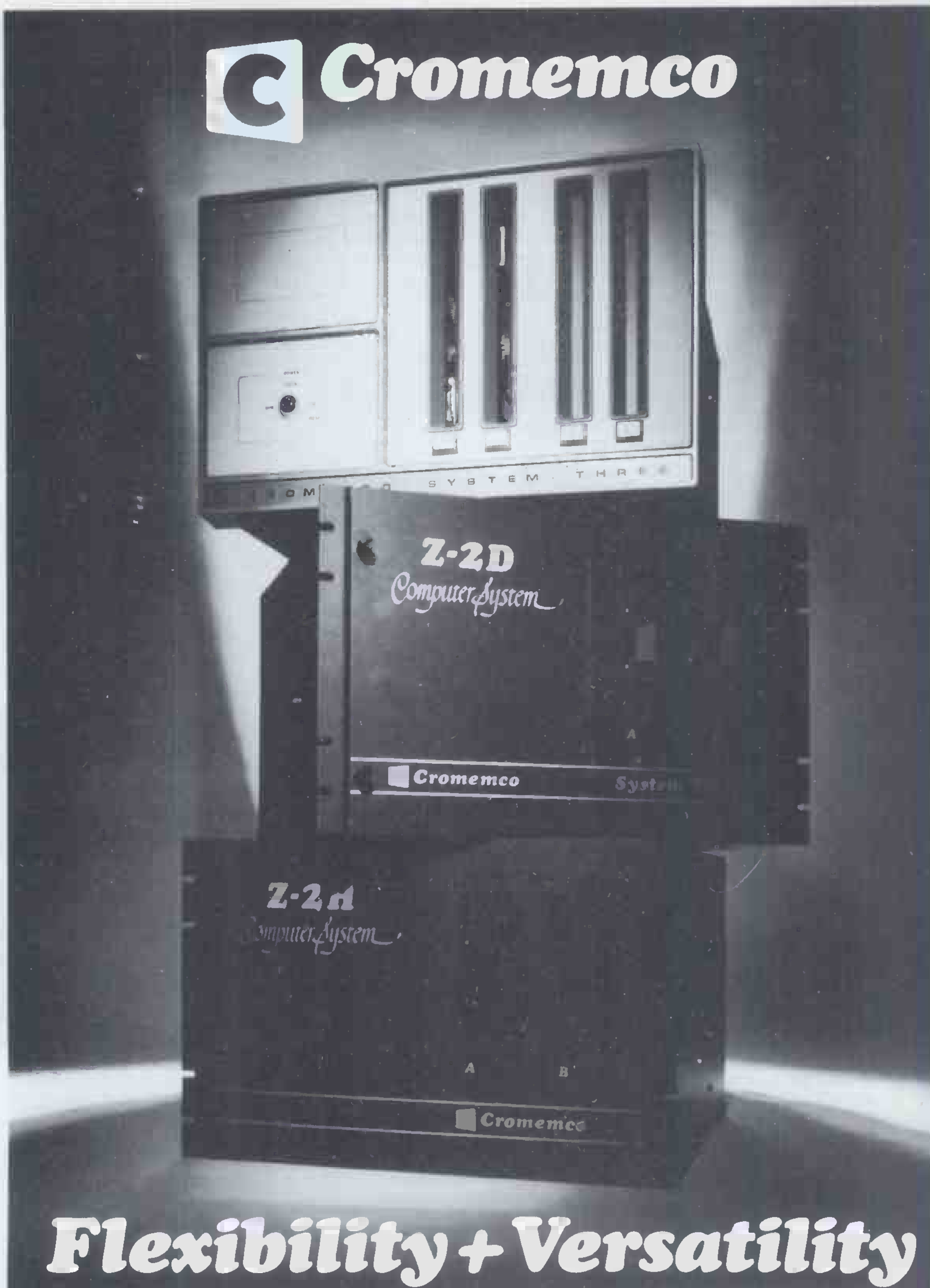

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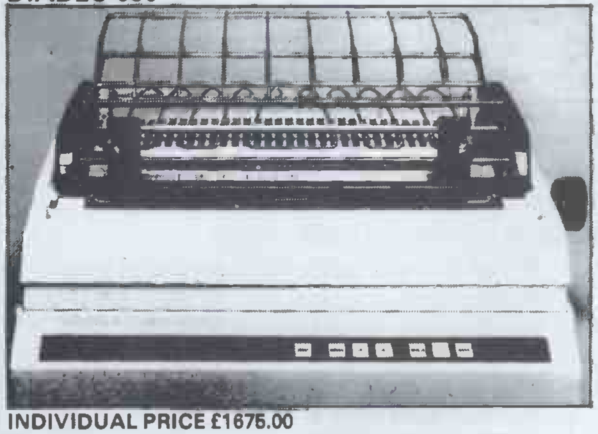

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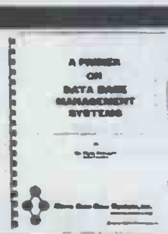

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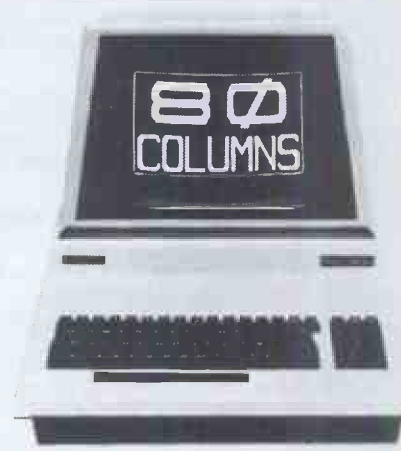

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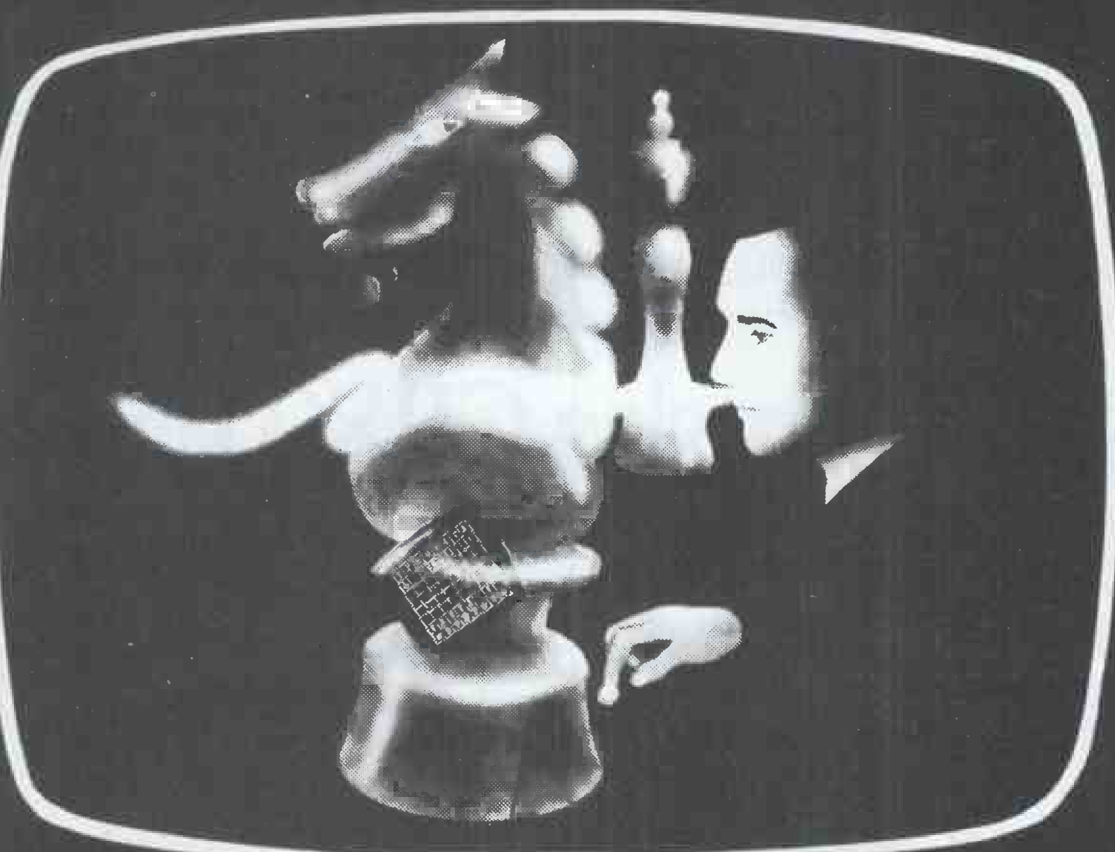

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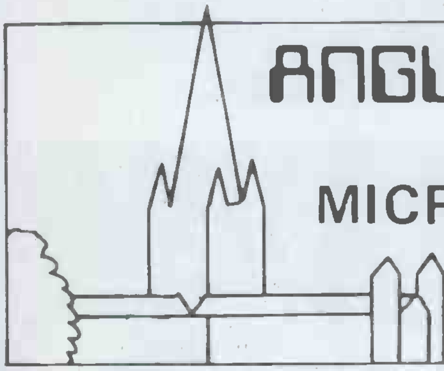

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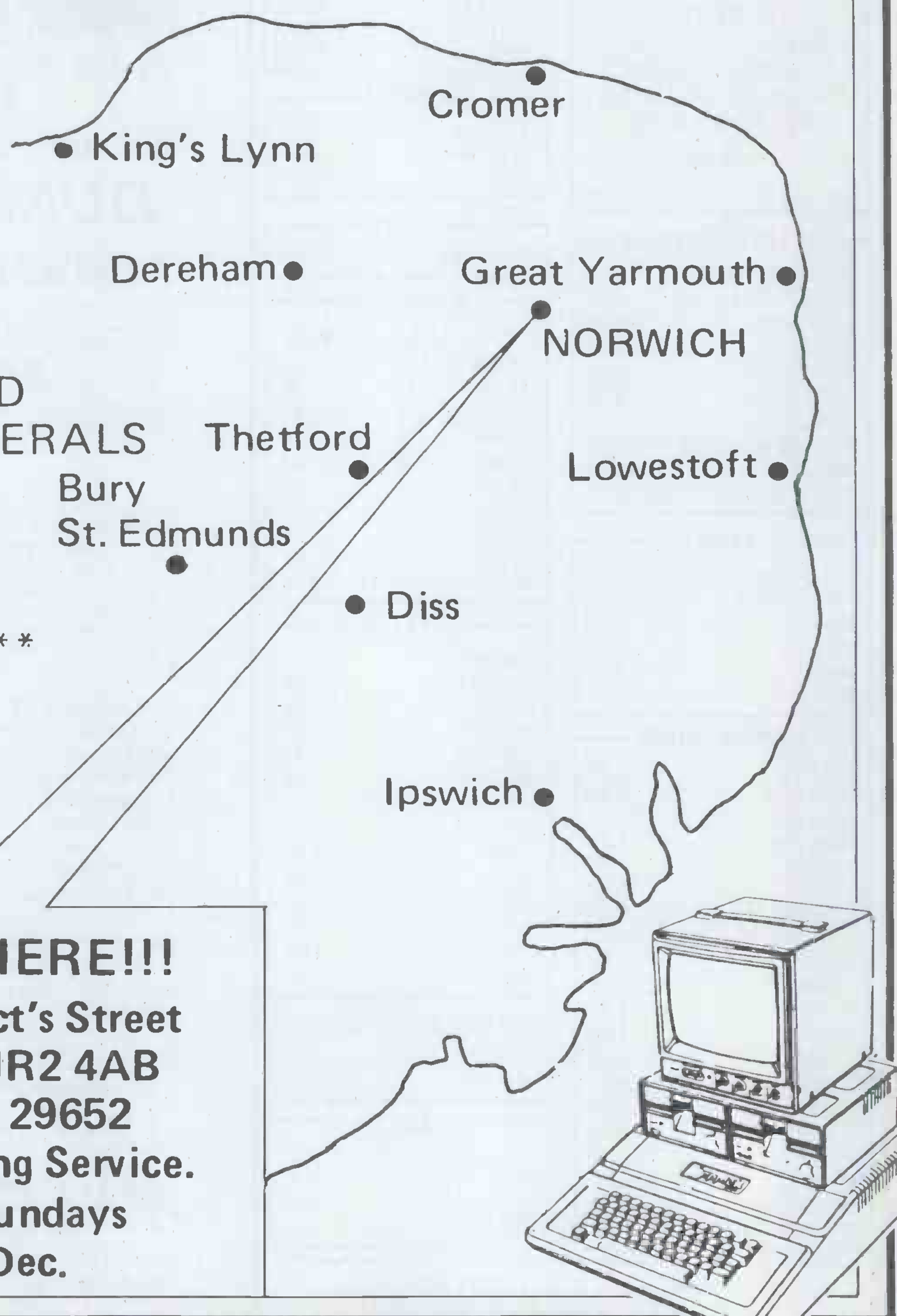

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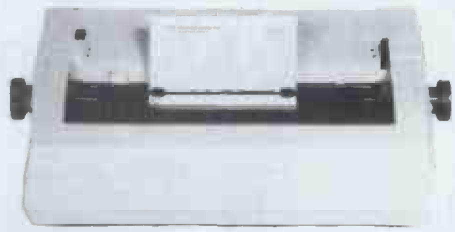

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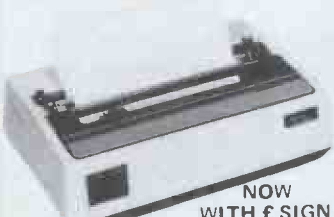

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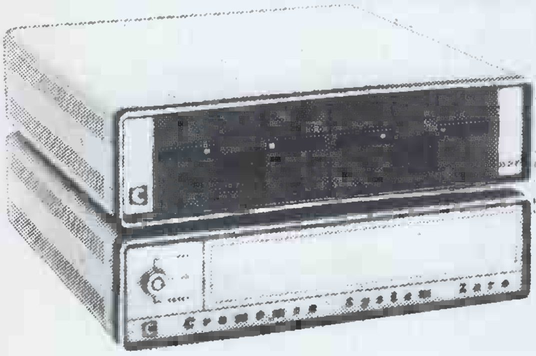

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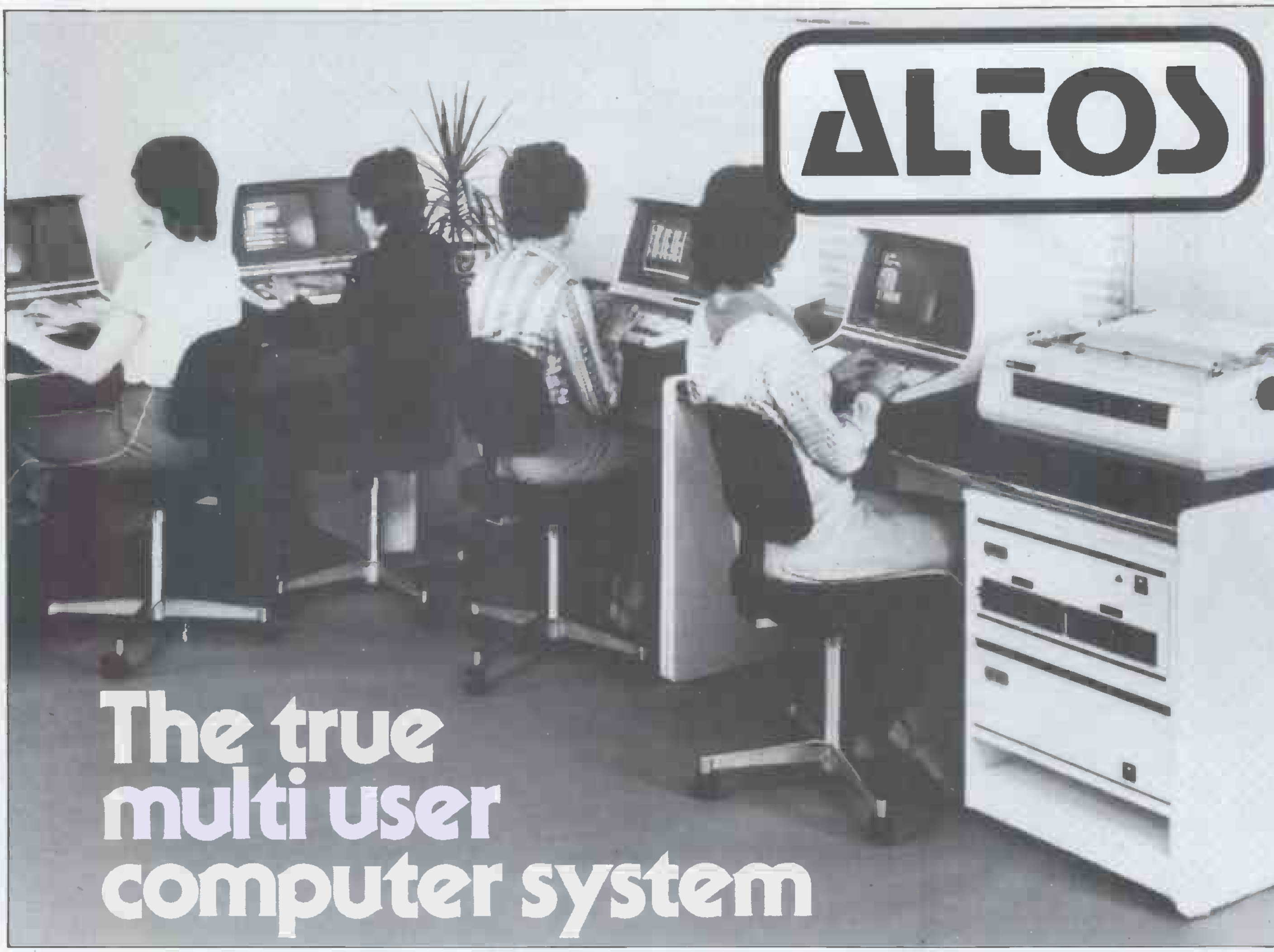

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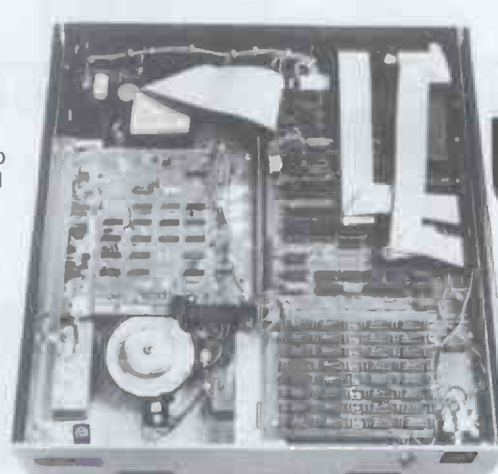

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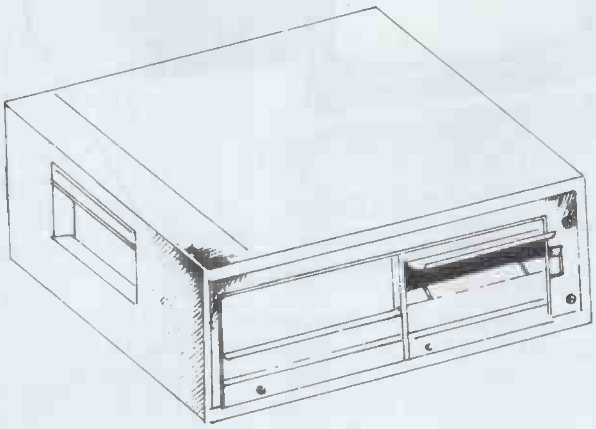

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Guy Kewney, Editor of Datalink, *brings his usual enjoyable assortment of news, rumours and gossip from the microworld.*

Poor Sole

Just give me one good reason why you or I should prefer to buy our computer from the Sole Distributor? The obvious reason (that nobody else supplies it) is not acceptable because that is true of nothing — not even IBM restricts itself to selling through its own outlets these days.

The question arises because of a curious telex, which arrived on the *PCW* news desk just after the expiry of Compec, the country's largest computer show. The telex came from Nottingham micro man Tim Keen. It was not so much a statement, more a contradiction. It read:
CONTRARY TO A RECENT PRESS RELEASE ONYX SYSTEMS INC HAVE NOT APPOINTED A EUROPEAN DISTRIBUTOR. VERIFICATION CAN BE OBTAINED FROM THE PRESIDENT DOUG BROYLE, TELEPHONE USA =)' (@-- —//).
408 946 6330.
KEEN COMPUTERS LTD HAVE BEEN APPOINTED DISTRIBUTOR FOR ONYX FOR UK

What had happened was that at Compec, a company called Graham Dorian Software Systems had announced that it was the *sole* UK distributor. This sort of thing doesn't happen often. Normally such squabbles are carried out in gentlemanly seclusion, not with enthusiastic letters to the press.

Tim Keen is not a man to let such matters pass unnoticed just because of gentlemanly traditions. If there's a fight, he tends to want to win — if you don't want blood on the carpet, move the carpet. Carpets accordingly began to be moved. Doug Broyle was telephoned, as per instructions — and he was said to be engaged. His marketing chief at Onyx Systems explained: 'One of our distributors has been a little overenthusiastic.'

What had happened (I think) was this. Once there was a bright bunch of technologists and visionaries who set up a firm called IMI. It made the world's first big capacity storage disk which was physically small enough to fit into the same box as a normal floppy disk storage unit — the mini Winchester 'hard' disk. Then it sat down in the American stock market and tore itself to pieces in a battle for control of itself.

Bits came down everywhere. Sorry, pieces, not bits. Some of the technologists left and started up other companies, some came back, and some attracted the same financiers in both cases.

One such shard was a company called Corvus, and another was a company called Onyx. Corvus was clever enough to take the IMI drive and market it to people who already had that very popular microcomputer, the Apple II. It came to Britain through the agency of — Tim Keen. He became sole UK distributor.

Onyx was equally clever. It bought the enormously powerful microprocessor chip, the Zilog Z8000 and designed a computer around it (see story below). And because big micros need big storage to make them work, Onyx included the IMI drive in the box.

Corvus liked the micro enough to buy a large quantity, for resale to shops. Onyx didn't like the idea of working with shops, so it sold through four such 'original equipment manufacturers', (so called because they supply *somebody else's* original equipment. Got it?)

One of them is an American firm, Graham Dorian. I think it, too, includes some of the shrapnel from the IMI explosion, but I can't be sure. Both Corvus and Graham Dorian, and the agents of both, are entitled to call themselves distributors of Onyx in Great Britain. Okay?

The story doesn't end there. Two more UK-based firms, currently supplying original equipment made by Texas Instruments, are going to add Onyx to their ranges. If they, too, call themselves 'sole distributor' — I'm blessed if I can see the point. If I buy something, I want to know that somewhere, there is another firm who can put it right if my source goes bust. I won't buy from a sole source. Am I alone?

The bigger they come . . .

The best news for users of the TRS-80 is that Visicalc is going to be runnable on that machine. Visicalc is not really a program as such — it is a piece of software that eliminates the need to write some programs.

Two fascinating little details about Visicalc: first, it was the winner of the most prized US micro award earlier this year (Adam Osborne awarded it his White Elephant trophy); second, the orthodox data processing business doesn't believe it exists.

When I first found that Visicalc didn't exist, I was a bit surprised. Storekeepers in the USA say that more people have bought Apple II micros just to run Visicalc than for any other reason. Mike Gurr, a veteran of that most orthodox of data processing offices, the one inside British Oxygen Corporation, now sells Apples and Visicalc and swears that no user of Visicalc has ever been unhappy with it.

When Mike was recently (November) asked to speak about small systems, angry orthodox data processors rose to their feet at the seminar, and called him a cowboy. Why? Because he was selling a program and was not 'supporting' it — that is a phrase meaning 'going round to the customer once a month, drinking coffee from his vending machine and soothing him about the number of times the software failed in the previous four weeks.'

Mike Gurr protested that Visicalc, since it didn't fail, didn't need 'support'. He wasn't actually called a liar by the dinosaurs, but . . .

The next occasion on which I found that Visicalc did not exist was inside a big oil company. A programmer for the big central computer found one of the company executives using an Apple II. 'What are you running on it — Star Trek?' he asked. The user described Visicalc. 'Can

Next time some idiot tells you that micros are only toys, show him this pic. The huge black box on the right is a Solartron 1170 frequency response analyser. The most effective device which Solartron (a big company, subsidiary of Schlumberger, which owns Fairchild) could find to process the data generated by this device was an Apple II. Solartron sells the Apple as part of the data management system.

you produce something like Visicalc on our big central computer?' asked the user and the programmer foolishly said he would try. For his pains he was told by his boss, the data processing manager, that first, Apple II computers were not authorised by the DP department, so there were none in the company (there were over 30); second, Visicalc was a dream, and no such program could be written; and third, if it could be written, it would not fit on a tin-pot video games machine like an Apple II. Finally, his promotion to the Chicago office was cancelled for disloyalty. You think I'm kidding, don't you?

By the way, the seller of Visicalc for the TRS-80 is A J Harding. I can't resist this. Harding has also 'in conjunction with ACT (Petsoft), been appointed *sole TRS-80 distributors* in the UK for Personal Software of the US.' Contact the joint sole distributor on (0424) 2230391. But try not to take the mickey — he's a good supplier.

Unique Unix

Over the next two years or so plausible salesmen will start to make more and more mileage out of the fact that they can offer a '16-bit multi-user' business system.

The question to ask them is not 'what is 16-bit?' but, 'is the operating system Unix compatible?'

The latest system to hit the headlines, the Onyx is. Another system with a claim to be considered is the South West Technical Products machine, the 6809, which has an operating system called Uniflex. And Ithaca is working on a version of its own operating system (for the Z8000 chip) which will do the same.

Now, why should you care?

On a simple level, you will have noticed, even if this is the first computing magazine you have ever picked up, that the number of references to CP/M indicates clearly that it is important.

It is important because so many people use it, so that not having it looks suspiciously like ignorance. It is also important because it allows the user of one CP/M machine to run programs written for another machine.

The question is: how?

Programs do not spend all their time calculating and computing, despite popular myth. Most computer programs spend all their time either waiting for input or looking for a pattern of numbers and letters (such as David Tebbutt, or Bumper Harris, or ticket no 345/4567.98) in one block of mass storage, and then arranging it in another block of storage (either a mass store like disk, or an output store like a piece of paper.)

The business of finding one of those patterns in a disk, or in a tape, or merely in a block of memory, is shockingly tedious and detailed. The computer has to move the reading head of the disk to the index, to find where it wants to look. It has to wait for the index to spin past it. It then has to find the track of the disk where the item it wants actually is. It then has to move the head and wait until it has got there. It then has to read the track, and wait until the start of the right record comes past. It then has to read off the disk into the right part of the computer's own internal memory. Then it finds that that was not the right part of the disk, and starts all over again . . .

Oddly enough, this is exactly what most of an operating system does. It does it in its own sweet way, and it does it reliably and simply. All the programmer needs to know is the right operating system call, and the system does it all for him.

Give the operating system the call belonging to another operating system and, if you're lucky, nothing will happen.

Unix is an operating system, designed by Bell Labs for the very good reason that Bell liked using mini-computers made by Digital Equipment, but didn't go a bundle on its operating systems. Bell, being rather bigger than Digital, decided to make its own — and by all accounts, did a better job than most.

The operating system Bell made attracted many admirers and imitators. Some, like Onyx, actually got a licence from Bell to produce a version of Unix itself (Onyx calls its version Onix, and sells Onyx systems with Onix on them to Bell itself).

The point is that the Digital Equipment mini-computer, the PDP/11, in all its versions, is a 16-bit machine. It gets information from memory and storage in chunks of 16 binary digits at a time. CP/M gets its chunks in 8-bit 'bytes' and is therefore no earthly use on a 16-bit machine. It may be possible to make CP/M look like Unix, in the same way as it may be possible to make two bicycles look like a car (you strap two side by side, bolt the handlebars to a steering wheel, and cover it with a car body) but the resulting contraption has none of the advantages of either CP/M nor Unix, and most of the disadvantages of being neither.

If someone tries to flog you a 16-bit system because it has a 'better' operating system than Unix, believe him by all means. But avoid it unless it is Unix compatible.

Anyone who has ever taken a heavy tape recorder all the way back to Tottenham Court Road or the local equivalent for a repair, only to find that the cable connecting it to the amp was broken internally, will suddenly understand why engineers need special equipment to test the 25-wire cables that connect computers to printers. This one costs £165 and tests each wire in turn, showing which are broken, which are connected to others, which are connected to the wrong pin of the plug, and so on. Details on 01-941 3604.

And incidentally, if anyone tries to sell you an operating system on the grounds that it is multi-user, be pleased, but asked for assurances that it is also multi-processor. But that, as Kipling said, is another story.

Sharp competition

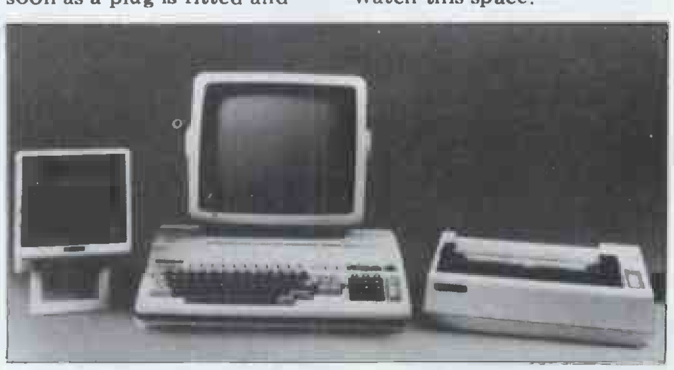
If anything is going to worry Commodore over the next year, it is going to be Sharp. The Commodore is currently top seller in this country and the new range of machines with big screens has been neatly priced, and quickly available (see 'Egg On Face' elsewhere in 'Newsprint').

However the PET, for all its virtues, is not a Japanese computer. It is an American machine, with some models made in Europe. And neither the European nor the American electronics factory has quite got the hang of making kits the way the Japanese have — that is, they aren't as reliable.

Now that Sharp has got its MZ 80K fitted out with the necessary extras (printer and disk storage) to turn it into a proper system rather than a desk-top novelty, its reputation for working as soon as a plug is fitted and distributors to take it up by dozens.

In the words of Bruce Everiss, outspoken boss of Microdigital (a Lasky subsidiary), 'There have been batches of PETs where six out of ten have needed attention before they could be sold. Of all the Sharps I've sold, maybe two have needed attention — and I've sold many more Sharps than PETs!'

Sharp's answer to the new PET, however, looks as if it needs a bit extra. Like the new PET, it displays a row of 80 characters across every line on the video screen. Like the PET, it comes with the option of a big disk store. And like the PET, it includes a workmanlike printer. However, the new Sharp PC3200, despite 64K and a snazzy keyboard, still looks a bit pricey. The disk is not as big as the much-slandered Commodore 8050 drive. And if the price is attributable to the printer, then the printer should be a lot nicer, as printers these days are good and cheap. At £3000, the PC3200 needs that bit extra — maybe reliability will do it? On the other hand, maybe Commodore has made the 8030 PET more reliable? Watch this space.



Sharp's new PC3200 system

Egg on the face

Considering how beastly I was to Kit Spencer of Commodore in this column two months ago, he was astonishingly polite when he phoned.

I knew what he was going to say. 'You're going to tell me that the new disk drive, the 8050, was available roughly a week after I wrote my piece saying it was late,' I told Kit.

He was, and he did: 'We were late on the printer,' he said, in anguished tones, 'and ever since, people have been expecting us to be late on everthing.' True. 'We just can't win. If we announce it well in advance, we're pre-selling. If we keep it secret until it's available, nobody believes we've got it.' True. 'Well, at least I hope we'll talk to each other a bit more in future,' he ended. I hope so too. Still, not too much harm done, because at the time of writing, orders still outstripped available disk drives by quite a bit. By the time you read this, the backlog might be cleared a bit and you may be able to get one.

Burning chips

Beginners in the computer field often ask shyly: exactly what is the use of read-only memory — how do you get something in them to read? The answer, of course, is that they are no good at all without some means of getting program or data in. And normally, this costs money, either through a company which offers a programming service or through the purchase of a programming machine.

One supplier of such chips, Celdis in Reading, has decided to leap to the aid of people with neither service nor programmer to hand. Celdis is supplying all PROMs with free programs in them. You, naturally, supply the program and Celdis engineers load them. This offer is available on all orders, no matter how large or small, promised Dave Watson at Celdis. He may see something of a boost in memory sales. Details on 0734 582211.

Charity chess

PCW's computer games expert, David Levy, recently raised £2000 for the Bournemouth Symphony Orchestra by playing 30 chess games simultaneously.

The BSO receives only enough state funding to support ten of its members, a situation which Levy describes as 'tragic'. He made the exception to his 'no exhibition matches' rule because of his love of classical music. Of the 30 games, he won 24, drew two and lost four.

'Yer Honour, I wuz driving wiv doo care an' attention, when suddenly, I wuz distracted from my scrutiny of the M4 by the enchantin' chimes of that well-known ditty, "Oh Danny Boy", rendered in 'eart-breakin' syncopation by me Casio M12 musical alarm watch, which my wife 'ad programmed in on account of it was St Patrick's Day. Transfixed by the magical appearance of the notes on the LCD five-line musical stave (which appears on the front of the watch display, yer Honour) I would still have been competent to continue proceeding along the highway but for the unfortunate occurrence of the rhythmic response from me foot, what began tapping all involuntary on the brake pedal, causing loss of road adhesion. . .'

Chatty chips

Until now, getting a computer to talk was a job that left you little choice. Either you bought a standard Texas Instruments speech chip, or you had a hard time, or it cost you plenty.

A 'considerable advance' is a new General Instruments chip which gives a choice between lots of low quality chatter, or fewer beautifully-pronounced words.

It gives a maximum number of 3825 'sequences' of synthesised speech, says General Instruments (these sequences are normally words or phrases) and the quality 'is normally significantly better than telephone voice quality' — it approaches that obtainable on Radio One.

The snag is that you have to connect it to a computer board yourself, or use General Instruments' own PIC micro — ah, you don't have one? No, me neither, and I don't know where you'll find it. Ask GI on 01-439 1891.

Name change

When Oxford Computing dreamed up a writing pad which entered data directly into a computer, the name Datapad suggested itself. Unfortunately, somebody failed to discover that the same name had suggested itself rather earlier to a company called Quest. I hope that somebody enjoys the hot water. Meanwhile, Oxford Computing has renamed its OCL Datapad as the OCL Saker. Less obvious what it does, perhaps. Still, at least it is just as obvious as before that Oxford Computing is in Reading, on (0734) 587138.

Local S/W support

When someone tells you that you need 'support' for a product, you know one thing: it doesn't work. In the case of computer programs, this is only forgivable if the program was written for you and you alone. Nobody can catch all the faults in a piece of software all by himself. So it is a very sensible idea of a group of software writers to get together to arrange mutual support (sounds disgusting) for the 'tailored' products. The idea is that a small producer of programs joins the league and when a customer living more than 50 miles away wants a copy of his software, he doesn't supply it himself but gets his local colleague operator to supply it.

Tailored software, by the way, is software which is cut from a basic pattern on a design of cloth which can fit everybody. The local supplier just puts in the details needed for the local application.

According to one of the founders of the new Software Producers Association, Peter Wills, 'The range of computers covered by the association is wide and currently there are programs available for most general business applications. There are also systems available for the more specialised areas such as agriculture, garages, engineers, auctioneers and market research agencies, to name but a few.'

The Association aims to 'set very high standards' and is prepared to back them up by offering a money back guarantee on all products. Mind you, I can think of a lot of suppliers who would draw the line well before they got that far. And I have to admit that there are many doubts as to whether tailored software, however well supported, is really worth the extra money it costs, by comparison with off-the-shelf stuff which

PROGRAMMED FOR FUN

The Sharp MZ-80K personal computer can handle serious business as well as the next microcomputer. But it can also be programmed for fun.

This masterpiece of low-cost, easy-to-use, micro-processor technology takes over where TV games end, becoming a sophisticated source of endless hours of family entertainment. And for youngsters, of course, it has added educational value, providing a very useful introduction to the computerised world in which they will live and work.

A comprehensive catalogue of fascinating computer games is now available for use with the MZ-80K: races, battles, quiz games, exploration, showjumping, space adventures; trials of skill and concentration, pitting players against each other or against the computer. Exciting, entertaining, educational, and with such variety of appeal that the incentive to play is never dulled.

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Details from Peter Wills on 0272 312079, or David West on 061-832 6792. Wills works for Mercator Management Consultants in Bristol and West for Chess Consultants in Manchester.

Telesoftware

It may turn out to be easier to 'tune in' to a program for your computer than to pick out a tape, load it and start it up, especially if you don't have the right tape to hand.

The matter is, at least, being investigated. The project is a huge collaboration of various people starting with the BBC and working out. The man at the centre, who wants to hear from anybody else with ideas on the subject, is Mr L Mapp, research fellow at Brighton Polytechnic. The way Mr Mapp describes the project, it could be the first real use for those brief pages of news that the BBC and ITA broadcast in their teletext services, Ceefax and Oracle (apart from putting subtitles on films for the benefit of the deaf). Instead of getting lines of print, the receiver would get a computer program, complete with instructions to the computer on how to load and run it.

Mr Mapp thinks it will help teachers. 'Currently,' he tells me, 'using a microcomputer to assist in teaching requires a good knowledge of computer programming — finding a suitable program, transferring it to a computer's memory and then checking its reliability, is often a daunting task.'

What isn't clear yet is whether we are going to get a new microcomputer out of all this. The Beeb is known to be planning a 'teach yourself micros' machine and this project is based on ten prototype 'receivers' — that is, television sets with microcomputing abilities, made by Mullard.

Three years ago, this would have been a splendid way of launching a British microcomputer. Now it may be too late, and I predict the project will either switch to a standard existing micro — the Newbrain? — as the basis for its existence, or will go the way of the Open University computer.

I hope it survives. Just think of what the BBC and ITV could do for program distribution! And if they did it properly, just think of what that would do for compatibility standards. Details from Mr Mapp on 0273 606622.

C/P Net launced

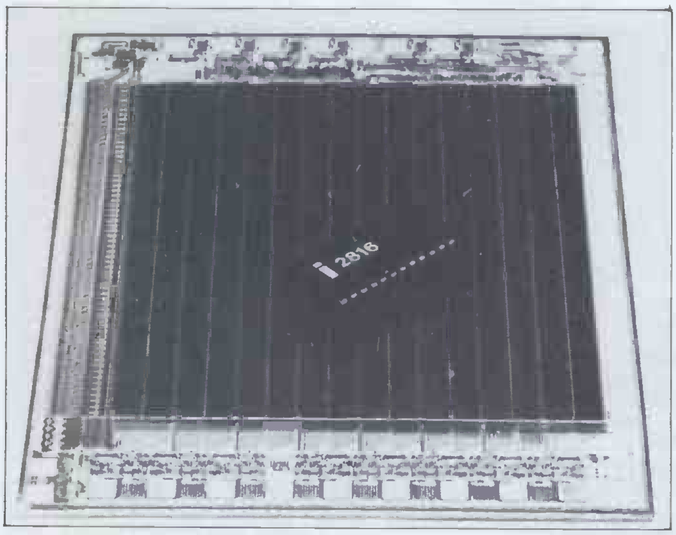
Telling somebody who has just pushed the budget to the limit to get a microsystem that, 'you should have asked yourself which network it uses,' may be regarded as unnecessary provocation. If you can't really afford one, why bother about the cost of a whole lot joined together? And to these people, the announcement of CP/Net will appear to be so much irrelevant hot air.

The object of launching this network is not to allow each computer caught in it to send messages to another. It is to save money. It works in the same way as sharing a taxi saves money — you have to have four or five people all together, going the same way — but it works.

CP/Net comes from Digital Research and is now officially here as the ultimate version of CP/M.

CP/M gave the user storage capacity on disks. MP/M gave two or more users on the same computer their own slice of that computer. CP/Net gives every computer user his own slice of disk storage, printers, modems or any other expensive, seldom-used luxury. Details are available from the European agent, Vector International, at Research Park, B-303 Leuven in Belgium, tel 32 016 20 24 96.

But like present CP/M versions, CP/Net will only work on 8080/8085/Z80-based micros. If you want a network for a PET, contact Kobra, whose MU-PET system has been sold to 60 network users in the two months after it was launched. Mu-Pet allows up to eight PETs to share one or more Commodore disk drives and any compatible printer. When somebody configures a big (hard) disk to look like a PET disk, then Mu-Pet will look wonderful, because the big disk will cost much less per byte than floppies. Details on 01-579 5845. For Apple users, see last month's item on Nestar and contact Colin Crook or Ian Powers on 0895 59831.



This is a picture of a hell of a lot of very special transistors. They are Intel's new electrically eraseable permanent memory, the closest step so far to a memory chip that retains its memory when the power fails but functions normally. Putting data into this new 16 kbit chip (2 kbytes) takes absolute ages.— a 21 volt pulse is needed for 10 milliseconds. A computer that had to store data at that speed would never get anything done, so clearly that side has a long way to go. But at least it is no longer necessary to pull the chip out of the computer and bake it under ultra-violet light to get rid of the data when it isn't wanted. Instead, it takes 20 milliseconds to erase eight bits with another electrical pulse.

Cobol for Apples

The fact that a company like Micro Focus has produced a Cobol compiler for the Apple II is not an invitation to its 150,000-odd owners to learn how to write programs in Cobol. It is a concession to reality.

Reality is the fact that Cobol is an old language, not very good at performing the tasks that today's micros are best at. It is at least as awful (in purist terms) as the Basic all we micro owners use and five times as hard to find faults in programs written in it, and ten times as hard to correct them. Okay, so that's just opinion — but it's a common one.

The reason it is important is simple: most of the world's professional full-time software writers know how to write in Cobol and in nothing else.

Their employers, seeing 150,000 Apples rolling around, would like to start producing programs to run on them — and all their current programs are written in Cobol.

Micro Focus produced the first Cobol compiler for the Intel 8080 some time ago but that micro is not the chip inside the Apple. To get the Micro Focus onto the Apple, they had to wait for Microsoft, who launched a little plug-in unit called the Z80 softcard, which actually puts a new microprocessor into the Apple — a micro on which Micro Focus's Cobol will run. So, for that matter, will Microsoft's Cobol — but the word so far is that Micro Focus (a British company) has a rather better Cobol than Microsoft's. Talk to Micro Focus on 01-722 8843.

Microwriter-based WP system

Typoists tend to make mistakes. Users of the ultra-clever six-finger typing keyboard (see our December review) tend to make mistakes too and it's sensible to get a computer to sort them out.

A system for connecting the Microwriter to a computer has been developed by South West Technical Products. The computer concerned is the SWTPC machine, and the software which handles the connecting is a word processor called Autotext. This goes further than just handling the input from the Microwriter, they say; it also allows it to be used as part of a flexible filing and word processing business system. For instance, names and addresses may be handled in combination with text, to produce personalised overdue account letters and other correspondence where a different amount of money can be inserted into the text of each individual letter. Details on 01-491 7507

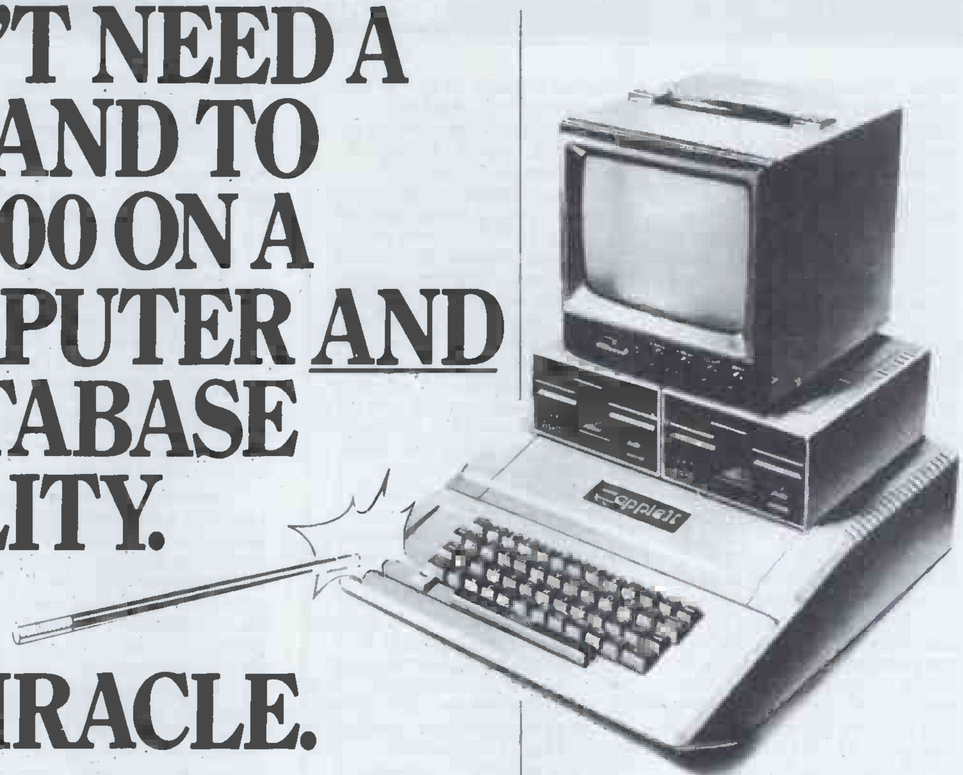
Zilog seeks compatibility

'We want to ensure that all software for the Zilog Z8000 micro, whether written by Zilog, independent vendors or others, is transportable and compatible,' said a top Zilog man in the UK recently.

This sort of statement about any other micro, if made by the proprietor, would be dismissible with some colourful metaphor about breaking wind in a gale, but with the Z8000 there are two good reasons for taking Zilog seriously.

First, all the software theories on which the original designers of Zilog's programming languages based their chip designs have been fully catered for in the Z8000. It was Charlie Bass's theory that all Zilog languages should link to each

YOU DON'T NEED A MAGIC WAND TO SAVE £7,000 ON A MINICOMPUTER AND GAIN DATABASE FLEXIBILITY.



JUST A MIRACLE.

When 2-8 Apple micros share up to 40Mb of Corvus hard disc capacity through a Constellation host multiplexer, you get a Miracle – no less. A Miracle is the answer to the bottlenecks that can happen with a mini-network. And more. A Miracle can outperform a mini-network and save you money all along the line.

Stack up a 4-Apple/Miracle system against a mini system with 4 passive terminals and you've hit on an intelligent way of saving yourself £7,000.

So much for the sizzle. But what about the hard facts?

THE HEART OF THE SYSTEM

At the heart of the Miracle is the Constellation host multiplexer. This allows 2-8 host micros to share high-speed access to one common Corvus disc drive. The micros are connected in star configuration and each of their interfaces uses the standard Corvus bus. And with the Constellation at the centre of things all the micros in the network are active.

There's also room for expansion to a multi-level network: as many as eight host multiplexers can be linked together which, in turn, allows up to 64 micros to share the disc. A user can implement Miracle using 2-8 micros and later upgrade with no penalty in cost or software effort.

HARD DISC STORAGE

The big thing about the Corvus hard disc drive is that it can normally be accessed twenty times faster than floppies. In real terms this means 2-3 minutes for sorting a complex file instead of 15-20 minutes.

Corvus is a fixed disc 10Mb storage device which has a closed-loop filtered-air system to provide enhanced reliability in a contamination-free environment. The disc controller, based on the Z-80 processor with 16k of RAM, provides the intelligence for the system without the costs and overheads of a dedicated central computer; and the ROM-resident software is interfaced to both BASIC and the new Apple PASCAL operating systems. You can use as many as four Corvus disc drives in a Miracle system to give a total capacity of 40Mb.

BACK-UP TRANSFER

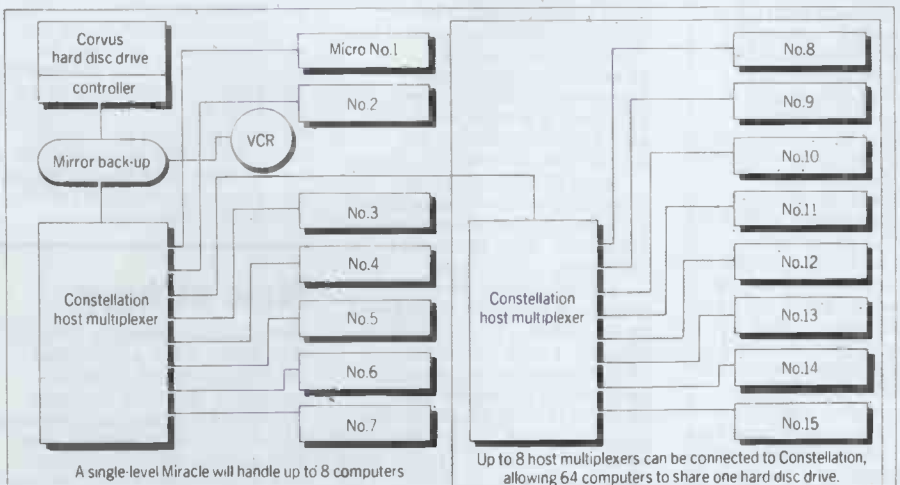
When it comes to back-up transfer you've no problems with a Miracle: the unique Mirror system, which is included as standard, dumps up to 300Mb on to video tape at 1Mb per minute.

All this is just the beginning of the Miracle – because its multiplexer opens up no end of possibilities for sharing peripherals and communicating with other Apples in the system. 3-4 devices can be connected to each Apple in the system: for example a printer, an interface for graph plotter and digitiser, a light pen, a graphics terminal or a pair of floppy discs.

A MIRACLE FOR EVERYONE

So much for the Apple-oriented Miracle. But what if you're not an Apple user? The good news is that a Miracle system can be built with other micros: S100 computers, TRS80, and Commodore in any mixture you like.

In short, a Miracle can happen in all shapes and sizes. Send for our brochure and we'll show you how.



A single-level Miracle will handle up to 8 computers

Up to 8 host multiplexers can be connected to Constellation, allowing 64 computers to share one hard disc drive.

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other through the operating system so that sections of Basic code could link to sections of machine level direct code in ROM and to sections of code called up, say, from disk.

These theories apply (rather less fruitfully) to the Z80, which was not Zilog's ideal machine but merely their way of getting into the market; that is, it was more than half a copy of the Intel 8080 (and still is). More to the point, everybody who uses the Z80 has gone too far down many paths of their own choosing to pay much attention to Zilog's theories.

On the big Z8000, it may not be too late for Zilog to influence us all. And the bold bid which Zilog has made is to establish 'calling conventions' for programmers. These are designed to enable Z8000 programs written in any language to call Z8000 programs written in any other language, just as Bass dreamed when he designed PL/Z (a language).

The standards specify practices. That makes them very hard to impose on users, who tend to blunder into these things and work out what their customs and practices were later, looking back. They specify how one language should pass parameters to another language, how the registers should be used, and how Zilog itself has done these things in the software it has written so far.

Now the important thing about this is that, naturally, we humble home programmers are hardly ever going to bother our heads about how we pass parameters or handle registers. But the people who write the languages we will one day use do. Compiler writers get very worked up about register usage and any successful establishment of good habits now could be enormously useful to Basic Bangers in three years' time.

If Microsoft and Personal Software and Microdatabase Systems and all the other software kings pay attention, of course.

Details from Phil Pitman on Maidenhead (0628) 36131.

In the lab

The criticism levelled at the first Commodore PETs and the feeling in some quarters that such toys should not be allowed to taint a scientific environment did not seem to herald an auspicious future for these machines in the scientific laboratory. The situation was not helped by the suspicion among some managers that the main reason their junior personnel requested such things was to play 'Star Trek' during tea breaks — and beyond.

Despite such obstacles, however, the PET and similar machines have now found a place in the scientific laboratory and are increasingly mentioned in research papers. Research into certain aspects of nuclear magnetic resonance spectroscopy being carried out by L E Erickson of the National Research Council in Ottowa requires a magnetic field of specific strength and direction. Such a field can be provided by using three pairs of coils mutually at right angles and a recent paper describes the use of a Commodore PET to control the set up, After the field strength and direction required have been input by the experimenter, the PET performs the necessary mathematical transformations and uses the data to control the power supplies of the three pairs of coils. A feature of the program is that it compensates automatically for the earth's magnetic field.

The interface uses 12-bit digital to analogue converters and data is transferred to the power supply interface by a 20-byte serial, bit parallel transfer. Odd-numbered bytes are for synchronisation of the transfer and even-numbered bytes are composits of address and data. The program is written in Basic and the entire transfer takes 0.3 seconds. The author notes that this would be much faster if machine language programming were used to control the timing.

Geoff Turner

Nets working

Personal computer networks are at last appearing in Britain. Networks have been booming in the States for 18 months or more and are a well-established feature of the micro scene over there. By the time you read this, Britain will have two, one in Hull and one in Milton Keynes.

First off the mark was Frederick Brown in Hull, whose network opened in September. He has a 48k TRS-80 with four disks, linked to a modem and available to all callers.

The other system, being set up as *PCW* went to press, is run by the National TRS-80 Users Group and also (naturally) has a TRS-80 at the centre of things.

Access to both systems is free and available to anyone with the necessary hardware. You need a micro (not necessarily a TRS-80) and a modem, although you could get by with a terminal.

Both systems can presently cope with only one user at a time and both offer a similar service: a bulletin board, on which you can leave messages — either personal to and accessible by one other user or 'global' — and a library of programs which you can download and execute/save on your own machine. The programs are in Microsoft Basic for maximum machine independence and at the time of writing Frederick had a dozen on his system.

Use of these networks naturally depends on the availability of low-cost modems, which have to be approved by British Telecom — no easy (or cheap) matter. Hopefully, now that two networks are running, the demand for cheap modems will increase and we'll see some on the market.

Frederick reports that he has half a dozen regular users who live locally, a couple in Scotland and others in France and Holland. He also gets the occasional trans-Atlantic link-up from personal computer users in the States!

The Hull service is available on Tuesdays and Thursdays, 7—10pm and at weekends from 12 noon to 10pm. For further details ring Frederick on Hull (0482) 859169 — but not during the network's operating hours or you'll get an earful of modem carrier.

For details of the TRS-80 User Group Service, contact Brian Pain on (0908) 566660 (office hours).

CBM announces new micro

The nicest thing about the PET, when it was first announced, was the keyboard. After that, the video screen.

That may be a bit hard to swallow today, but four years ago, when the first prototype appeared in Europe, there simply was no other machine available with a keyboard that had an alphabet on it. The Motorola D2 kit, with 16 keys, was seen as the only serious rival for the Kim 1 (also 16 keys) until you got into the ludicrous price ranges of the Altair, or the newly-announced Research Machines 380Z. Anyway, the PET had a whole keyboard and a whole screen, not just a row of watch read-out digits.

Now Commodore is launching a machine without a screen. Is this clever? we ask ourselves. And the answer is: 'At under £200, yes.'

The machine, the Video Interface Computer, is going to be called VIC. It looks as though it will be just what Texas Instruments would have made its home computer if it could have done: colour, sound, programmable function keys, PETbasic, and plug-in programs. When? VIC, 'first being launched in Japan, is intended to be marketed in the UK towards the middle of 1981,' says Commodore. I can't wait.

Cheapo DB

At £23 it must be the cheapest-ever database system. By the definitions enclosed with the announcements, it can't be all that bad to use. And nobody will stock it.

'Our dealers have advised us that they consider a retail price of £150 would be more appropriate, in relation to similar products,' claims the aggrieved company which produced it, Spider Software. It's the Apple dealers who are causing the problem, say Nick Spicer and Dick Williams at Spider. Well, they don't say so specifically but their utility database runs on an Apple, so it must be.

The dealers have a point. As Spider observes, 'a full demonstration of the database's capabilities may take as long as half an hour, resulting in a relatively low profit to the retailer, and in the possible loss of more lucrative sales.'

One can't help feeling that some compromise solution must be possible but Spider absolutely refuses to raise the price. 'Much as we are in business to make a profit, this program uses standard routines which we have developed for bespoke business software,' the Spider pair say intransigently. 'And as such, we consider that D/DATABASE is essentially a loss-leader and an advertisement for our services. Naturally we appreciate the dealers' point of view. . . '

They won't raise the price 'artificially' because 'we cannot justify a higher price and this would defeat the whole object of the exercise.'

And here's the bit that hurts: they won't take a full page advertisement explaining the reason for the low price and showing what a marvellous product it is, because they can't afford £300 to launch 'an almost profitless product.'

Make of that what you will. One day, we may be able to review this miraculous product that allows you to get 116,352 characters worth of storage onto the Apple disk. But until then, Spider is at 98 Avondale Road, South Croydon, Surrey CR2 6SB, phone 01-661 2365.

New stringy

Perhaps the 'Stringy Floppy' designers were a little too ambitious when they announced this data storage device as a cheap replacement for a disk. At any rate, the UK dealer, MBS Terminals, has now announced a rather simpler version of the endless loop tape, a version which connects through an RS232 interface. Details on Byfleet (09323) 49511.

APPLE COMPUTER SYSTEMS MICROSENSE COMPUTERS

Apple Price List

Product Code	Description	Price (£)
	HARDWARE	
A2S1016P	APPLE 16K VIDEO OUTPUT ONLY	695.00
A2M0003	DISC DRIVE WITHOUT CONTROLLER	299.00
A2M0004	DISC DRIVE WITH CONTROLLER	349.00
A2M0016	16K ADD ON RAM	69.00
	CARDS & ACCESSORIES	
A2B0001	PROTOTYPE/HOBBY CARD	15.00
A2B0002	PARALLEL PRINTER INTERFACE CARD	104.00
A2B0003	COMMUNICATIONS CARD	130.00
A2B0005	HIGH SPEED SERIAL INTERFACE CARD	113.00
A2B0006	PASCAL LANGUAGE SYSTEM	299.00
A2B0007	CENTRONICS CARD	130.00
A2B0009	APPLESOFT FIRMWARE CARD	116.00
A2B0010	INTEGER CARD	116.00
MHP-X003	MOUNTAIN HARDWARE CLOCK/CALENDAR CARD	168.00
MHP-X006	MOUNTAIN HARDWARE SUPERTALKER	179.55
MHP-X007	MOUNTAIN HARDWARE ROM PLUS BOARD	127.89
MHP-X015	MOUNTAIN HARDWARE ROMWRITER	106.05
A2B0017	EUROCOLOUR CARD	113.00
E2B101	APPLE BLACK & WHITE MODULATOR	14.00
A1-02	A1-02 DATA ACQUISITION CARD	192.00
10-5-16	ALF MUSIC SYNTHESIZER CARD	103.00
10-5-17	ALF TIMING MODE INPUT BOARD	14.00
13-3-2	ALF ALBUM MUSIC DISKETTE NUMBER ONE	12.00
13-3-4	ALF ALBUM MUSIC DISKETTE NUMBER TWO	12.00
13-5-5	ALF ALBUM MUSIC DISKETTE CHRISTMAS	12.00
H/SP/LAB	HEURISTICS SPEECH LAB	122.00
A2M0019	PROGRAMMERS AID 1	27.00
A2M0027	AUTO START ROM PACK	38.00
A2M0029	GRAPHICS TABLET	462.00
H/CON 70	HEURISTICS CONTROLLER 70	57.00
H/SP/LINK	HEURISTICS SPEECHLINK 2000	168.00
E2B108	IEEE INTERFACE	212.00
	SOFTWARE	
A2D0005	CONTRIBUTED SOFTWARE VOLS 3-5	60.00
A2D0006	CONTRIBUTED SOFTWARE VOLS 1-2	27.00
A2D0009	MICROCHESS 2.0 CHESS DISK	15.00
A2D0010	DISC UTILITY PACK	15.00
A2D0012	APPLE BUSINESS CONTROLLER PROGRAM	340.00
A2D0013	APPLE POST PROGRAM	27.00
A2D0018	APPLE BOWLING DISCETTE	9.00
A2D0025	APPLE CASHIER PROGRAM	194.00
A2D0026	APPLE WORD PROCESSING PROGRAM	42.00
A2T0013	MICROCHESS 2.0 CHESS CASSETTE	15.00
E2D001	VISICALC DISC & BOOK COMPLETE	125.00

Product Code	Description	Price (£)
	DOCUMENTATION	
A2L001A	APPLE II REFERENCE MANUAL	11.00
A2L0002	6502 HARDWARE MANUAL	9.00
A2L0003	6502 SOFTWARE MANUAL	9.00
A2L0005	APPLE II BASIC PROGRAM MANUAL	6.00
A2L0006	APPLE II REFERENCE MANUAL	6.00
A2L0012	DOS 3.2 MANUAL	6.00
A2L0018	APPLE II BASIC TUTORIAL MANUAL	6.00
	GENERAL ACCESSORIES	
A2D0000	(10) BLANK APPLE DISCETTES	32.40
A2M0009	VINYL CARRYING CASE	16.00
AD/LB	MINI DISC LIBRARY BOX	2.64
MD5172	DISCOFLEX FILING CASE – MINI	12.64
APP1	APPLE DESK TWO TIER	145.00
APP2	PRINTER TABLE	92.00
APPLETEL	APPLETEL SYSTEM	595.00
DIST/APP	DUSTCOVER FOR APPLE II	9.95
E2B013	APPLEJUICE RESERVE POWER SUPPLY	157.00
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A2M0034	SILENTYPE 80 COLUMN GRAPHICS PRINTER	349.00
A2C0001	10 ROLLS OF THERMAL PAPER FOR SILENTYPE PRINTER	28.00
CENT 737	CENTRONICS 737 PRINTER C/W ADAPTOR	450.00
TIGER/G	PAPER TIGER PRINTER WITH GRAPHICS OPTION	598.00
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TIGER/D	GRAPHICS SOFTWARE FOR TIGER PRINTER	20.00
TIGER/P	TIGER PAPER 2,000 SHEETS 11" x 9.5" 1 PART	31.43
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LP5	PAPER 2000 SHEETS 11" x 15" S/PART	14.06
LP9	PAPER 3000 SHEETS 8" x 12" S/PART	14.85
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VM910	9" BLACK AND WHITE VIDEO MONITOR	127.00
VM906	9" HIGH RESOLUTION BLACK AND WHITE VIDEO MONITOR	148.00
VM/C	CABLE FOR VIDEO MONITOR	9.00

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for

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Personal Computer World

Spring in San Francisco from £440

Enjoy a two-centre holiday in sunny California, 1 — 9 April, 1981 just in time for the 6th West Coast Computer Faire.

Lounge on Santa Monica beach, visit the first ever computer store or maybe even take a peek at Hollywood. Follow this with a few days in San Francisco visiting the Computer Faire and possibly pop down El Camino Real to Silicon Valley.

All this, and much more can be yours if you take advantage of Meridian Tours' special offer to PCW readers, details of which are now being finalised.

Three holidays are planned, each of which ensures that you are in San Francisco for the duration of the Faire, which must be the biggest micro-dedicated show in the world. The first holiday comprises one night in Los Angeles at the first-class Sheraton Miramar at Santa Monica Beach followed by six nights in San Francisco at the Civic Centre Holiday Inn, just round the corner from the Faire. The second holiday provides the chance to spend three nights in Los Angeles and four in San Francisco while the third allows you to 'do your own thing' for a week following one of the above holidays, simply returning to base for the journey home.

The holiday price includes all flights, hotel accommodation, supervised transfers between airports and hotels, entrance to the Faire, a copy of the conference proceedings and compulsory insurance. The cost does not include transport to and from Gatwick, meals abroad or additional accommodation for those wishing to stay an extra week.

Car hire can be arranged at special rates by Meridian before departure and special excursions may be booked with their local representatives while abroad.

Having said all that, this promises to become quite an event in the PCW year; it's bound to be fun — even for those who aren't too interested in computers. They can make the most of San Francisco with its Golden Gate Bridge, cable cars, Chinatown, Fisherman's Wharf — not to mention a more recent phenomenon, lobby watching in the Hyatt Regency.

For further information and a booking form write to West Coast Trip, PCW, 14 Rathbone Place, London W1P 1DE.

This holiday is being organised by Meridian Tours Midlands Ltd who are bonded tour operators (Air Tour Operator's Licence No. 700B)

Meridian

COMPUTERTOWN UK!

NEWS

ComputerTown UK is a nationwide network of voluntary computer literary centres.

CTUK! Sutton-in-Ashfield is up and running. Its first night attracted between 80 and 150 people

By any account it's a wonderful start — congratulations to you all.

Eleven computers were made available — five Atoms, two Sinclairs, a UK 101, a 6800, an Apple and a Sharp — and people of all ages and from all walks of life came along to join in the fun. The pre-launch publicity was a bit haphazard — a poster in the library put up the previous day, a (very) brief mention on Radio Trent and, probably most successfully, word of mouth.

With a dab of Superglue and a couple of strong brackets the Sutton organisers have installed an Atom in the library, permanently available for anyone on the list of 'authorised' users. Training sessions are being run by a pair of 15-year-olds Chris Holloway and Darren Flint.

Phil Stone, a director of local firm, Intercom, brought along the office Apple and drew a large audience by running 'Lemonade Stand' and with demonstrations of his stock system.

Shortly after the event we were sent clippings from four local papers plus a note from the librarian:

'The suggestion of staging a ComputerTown UK! publicity evening, plus the feature of having a computer permanently on show in Sutton-in-Ashfield library, sounded very attractive — we like to think of the library as a progressive establishment and are always anxious to encourage events and unusual activities which will bring people through our doors. It would also help to change the rather dowdy image that libraries seem to project. It was obvious that an event like this would have the greatest appeal to teenagers who, as far as libraries are concerned, are the most difficult group to recruit as users.

'Thursday was chosen, as our least busy evening, for the main computer demonstration and the machines were set up in a public area just inside the main doors. This proved an immense draw and the area was hectically busy all evening. I would have reservations about staging anything on this scale again in a public area, since it could have easily detracted from our main purpose — book supply. To move it to a non-public area would, I suppose, have ruined the object of the exercise, which is to bring computers to the general public.

'The Atom which is now permanently available within the library has had heavy usage, particularly at lunch-time and during the evening, with youngsters who are qualified to operate it demonstrating it to, and training, others. The library staff have very little involvement other than in giving a tape and a manual to people whose names are listed as "approved" users. Having watched this exercise with some interest, there do appear to me to be some slight drawbacks — some of the approved users are using the machine for purely selfish reasons and make no attempt to train others. Also, some are hogging the machine and not allowing others a chance to try their skills. On the whole, however, the experiment has been a great success and I am very pleased that the library has taken part in it.'

So there we have it — the librarian's story. I'm sure that it would help to show this issue of CTUK! News to any librarian thinking of giving support to CTUK! The problems mentioned — those of hogging machines and not helping others — should be fairly easy to overcome — in Menlo Park library they maintain a log of machine use. In busy periods people sign on for half-hour slots and for that half hour they can do what they like with the machine but at the end of the time they *must* hand over to the next person on the list. Up to two additional people can sign on for the same slot if they want to watch or maybe they do some sort of deal with the person who booked as prime user. Often people would rather watch others fooling around than miss out completely. 'Validation' sessions, as they are called in America, take place at set times and comprise an hour of formal teaching. In this way, the body of approved users keeps growing (and the pressure for machine time).

A number of lessons have been learned at Sutton. The ones not mentioned so far are:

— On an introductory evening, restrict the number of programs being run to one per machine. This is your only hope of getting a newcomer off the machine because, if you keep changing the programs, (s)he'll be there all night.

— Don't start off as big as Sutton.

— Knock up a booklist for the librarian. If the books are available this will draw in new readers like nobody's business.

— When training people, make sure that is the trainee and not the trainer who is actually at the keyboard.

There is a definite need for some 'this is a computer and this is how it works' type of software — any offers?

Now for the rest of the news. We've had several letters from people interested in starting local ComputerTowns, including some from those in the business who feel that they'd like to make machines and premises available to the project. The first is from Mike Baker who is setting up an Ealing ComputerTown He has already hooked the interest of his borough librarian and is to see him in a day or two — unfortunately we will have gone to press before we hear how Mike got on.

The next letter comes from the Ohio Scientific UK User Group. Tom Graves writes to say that he plans to use the Wordsmith premises (they print the OSI newsletter among other things) and, with support from Mutek's Dave Graham and Steve Hanlan from Beaver Systems, they will be starting their CTUK! in Street, Somerset. They tell us that the local Currys manager has also shown interest and said that he would try to enthuse Currys' Bristol computer department. Already Tom has a C2, a C3 and one, or possibly two C1 systems. At the moment the main requirement is for volunteers because they won't be able to start running the project until mid-January. Anyone interested, regardless of machine loyalty, please contact Tom on Street (0458) 45359.

Edward Teague expects to open CTUK! Romiley soon. His phone number is 061-430 7255

P J Colmer wants to start a CTUK! in the Salisbury area. He is a fifth-form student and at the moment doesn't have a computer. He and his friends are willing to put in the effort in Salisbury — is there anyone out there who'd like to join in? All letters direct to 'Ivanho', Woodgreen, Fordingbridge, Hampshire, or telephone Breamore 551.

Euan Fyfe writes from Chiswick to offer his services. We have put him on to Malcolm and Jo who are also in Chiswick. We look forward to hearing things from you soon.

Mr Jefferson of Piercebridge, Darlington already makes his PET available to children at his remedial teaching school but in the Christmas holidays he plans to try it out on the village children as well. We suspect you may have just started a Piercebridge ComputerTown, Mr Jefferson. Anyone interested write to 19 The Green, Piercebridge.

COMICS sounds like a ready-made ComputerTown. In fact in Newcastle they are in the process of setting up a computer literacy charity called 'Interface'. Anyone in Tyneside who'd like to join in please contact Pete Rowan, 10 Lambton Road, Newcastle Newcastle-upon-Tyne, NE2 4RX.

Robert Clifford is anxious to start a group in the South Benfleet area. We've put him onto the SE Essex computer club but anyone else interested should write to Robert at 52 Woodham Road, South Benfleet, Essex, SS7 5DG.

Andy Fenner is an enthusiastic newcomer to computing. He'd like to help with a ComputerTown in the Ilford area. Anyone out there thinking of starting a ComputerTown should contact Andy at 47 Kingsley Road, Berkingside, Ilford, Essex.

Martin Kennelly reckons the ComputerTown idea is 'the greatest' and he's getting cracking on a group in the Allestree, Derby area. He's about to buy a Tandy and he reckons the local church will make room for him. Anyone wanting to join in the fun should contact Martin on Derby (0332) 550408 or write to 18 Welwyn Avenue, Allestree, Derby, DE3 2JQ.

Our thanks to all those people mentioned who seem so keen to make CTUK! a reality.

Finally some good news from ComputerTown, USA! which has been awarded a grant from the National Science Foundation — \$224,000. . . DOI please note!

And that about wraps up the news for this month. Keep writing in with details of your local CTUK! activities and don't forget — we aim to cover the country with ComputerTowns so we still need several thousand more volunteers. Write to ComputerTown UK! 14 Rathbone Place, London W1P 1DE. Please *don't phone* the *PCW* offices because we run CTUK! in our spare time.

COMMUNICATIONS

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.

Interesting ideas

While I enjoy reading the reviews of the more elaborate equipment coming on the market, I should like to see Benchtest reviews or some such thing on the popular machines that have been around for a bit. Prices, the competition and your style of review have all changed so how about doing the Apple, PET, TRS-80, etc, again? I should also like to see an in-depth appraisal of the stringy floppy type of storage system compared to disk units, some of which now seem to be available for not much more than the floppy tape systems.
Peter Tootill, Liverpool

Thanks for your suggestions. You'll be pleased to hear that we've already started work on the first one — Ed.

Wanted-programmers

The letter from Terry Rigby (November 1980) on the MZ-80K he won last year, contained the remark, 'I wonder how many people like me have a computer but don't have a real application.' As head of a university department I have the opposite problem; ie, a fair number of problems which would benefit from the use of computers but neither the time nor the money to do so.

For example, in our department we have a number of small computers (Olivetti, Apple, Nascom, Sharp) and access to the university mainframe computer (Vax) but are hard pressed for time to develop (a) special input/output devices for these, and (b) programs both to run these devices and for other purposes.

If it is indeed correct that there is a pool of skilled builders/programmers of computers in this country, I would like to suggest that we (and others like us) would be most happy to cooperate with them to find a use for this talent. Would you, or one of your readers, like to organise this?
Prof J F Lamb, Head of Department of Physiology & Pharmacology, St Andrews University, Fife.
Anyone interested write direct to Professor Lamb at the above address — Ed.

Bouquets and brickbats

Thanks for an interesting publication. I appreciate particularly:

Your impressive array of *specialists*. Your publication is one of very few (in my experience) which appears to seek out an expert to cover each separate topic — right from assembler level programming to 'Chip Chat' with all the meaty coverage of hardware and software in between.

The appearance of 'Transaction File' indicates to me a real interest in the *reader*. Most publications concentrate on projecting their advertisers' and potential advertisers' images to 'best' effect and, while I can understand that this is, to most people, 'good' business sense, I find that your clear wish to provide a useful and informative publication shows through on every page. This more than any other single feature makes *PCW* my favourite computer publication.

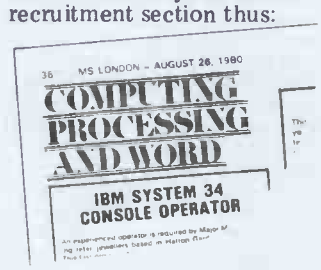
I hope you will continue to publish 'Computer Answers' or its equivalent. It is most useful in helping me keep abreast of the *real* state of the technology, ie the *truth* behind the glossy advertisements. Not just the Skeleton in the cupboard, but the frequent pleasant surprises which some products reveal through Sheridan's page. I'm also pleased to see his insistence on finding experts to answer readers' queries.

One comment I have on some micros — why is it that some manufacturers bow to the convention of 'Qwerty' configuration keyboards and then promptly make it almost unusable by non-standard key positioning? I will be the first to applaud the introduction of a faster keyboard layout but until then let's have the proper 'Qwerty' layout with standard key-spacing and inclination.
Michael Bews, Liverpool

Mjdkf llkdirhcci hfjhfn jh jhd qoypid! — Ed

New technogoly

You will be glad to hear that *PCW* is not the only perpetrator of Bludners. *Ms London* recently headed its recruitment section thus:


36 MS LONDON – AUGUST 26, 1980

COMPUTING PROCESSING AND WORD

IBM SYSTEM 34 CONSOLE OPERATOR

T J Grant, Bushey Heath, Herts

ACC lives

I would like to apologise to Mr Bendall (November *PCW*) on behalf of the ACC for the lack of communication with my predecessors. The ACC is *alive and kicking*, having awakened from a somewhat dormant period. I would also like to answer the queries he raised in his letter, point by point:

1. Firstly, I would like to thank him for his various articles for *Accumulator*, the newsletter, none of which have reached the current editor (Derek Fordred). If he would care to send any future articles to either Derek or myself I will endeavour to ensure that they are acknowledged/published;
2. The ACC year 79/80 was extended to cover the period to September 80 and hence to include issue 6 of the newsletter. The current year 80/81 started 1 October 80 and ends on 30 September 81. The current rate of subscription is £3.50 per volume; however this is to be increased to £4.50 per volume of *Accumulator* (subject to ratification at the EGM, 15 December, Conway Hall). Further details of membership and membership forms are available from the membership secretary Jim MacDonald (send an SAE please);
3. Last year's membership actually exceeded 1500;
4. The AGM was duly notified to the members in the last issue (issue 6) of *Accumulator*, and was held on 9 October 80;
5. The new executive committee is: Chairman, Peter Whittle; Gen Secretary, Phil Warn; Treasurer, Alan Secker; Membership Sec, Jim MacDonald (1 Carlton Court, Studley Grange Rd, London W7 2LU); Newsletter Editor, Derek Fordred (72 Mill Rd, Hawley, Dartford, Kent);
6. The 80/81 editions of *Accumulator* will be published in November, January, March, May, July and September.

The ACC does not charge an excess for overseas members (however, as you can well appreciate, even surface postage is considerably more expensive to destinations outside the UK).
Peter Whittle, Chairman, ACC

Microwriter reply

As you have undoubtedly learned to expect, no matter how favourably you treat an inventor's brainchild, his parental expectation for unstinted praise always exceeds the objective evaluator's supply of favourable adjectives. With this in mind, may I first thank you for nice things you have written about the Microwriter and then comment on some of the slight negatives.

First — not terribly important — the 'Memory Full' does not crash the machine, even in this software version, although you correctly point out that our updated program, which is on line and should be available very soon, will improve this routine and practically every other limitation you mention. For your present information, however, when you fill the memory and are so informed by the display, you can come back to the text point simply by pressing 'Control—H'.

But I most regret your comments on pricing of the Microwriter and comparison to the Tandy price. Yes, your point about mass production is true but notwithstanding, the omission in your logic of your comparison is the fact that we provide our customers with much higher-priced CMOS components, which make the Microwriter fully portable.

I emphasize the point on price because there is nothing quite like the term 'over-priced' to chase away potential customers — and that's the basis of our survival, isn't it?

Cy Endfield, Microwriter Ltd

Quickie reply

If the version of Basic on the Ohio Superboard is similar to that of the CBM then here's an answer to the 'Ohio Quickie' in October's *PCW*.

PEEK(S)=49 is a logical expression which delivers true (-1) or false (0). Thus V=PEEK(S)=49 means V=(PEEK(S)=49). This is quite obvious on the Algol-type languages which use := for assignment and = for relations.

U P Cheah, Walsall

Time-sharing hobbyist

I have read *PCW* ever since the first issue, and have always found the articles excellent. However, I have one complaint. You have never given a thought to the computer enthusiasts like myself. I do not own a micro. Quite honestly I cannot ever see a time when I will own one. I have instead for many years bought time from various time-sharing systems — in some instances the organisation whom I had asked about buying time has allowed me free access to their system, albeit limited to certain times of the day and usually all day Sunday, which for an enthusiast like myself is ideal. I must admit that my user number has usually had a low priority code attached to it and I have usually been limited to 100 pages of memory but it gives me all the power I can use.

Surely there are others like myself who have had the 'good fortune' not to have been caught up in the micro-revolution but are still involved in computing as a hobby. I would appreciate any contact with kindred spirits.

One minor difficulty caused in part by the home computer is the sudden and dramatic increase in the cost of second-user terminals. Not many years ago it was possible to pick up terminals for £50-100. Now the similar equipment is on sale for £300-400.

P H Charlton, Hull, North Humberside

101 clear-up

The following subroutine may be of interest to any UK101 owners who, like myself, have been looking for an easy way of clearing the screen (ie, without entering a whole string of numbers in DATA statements):

```
1000 POKE 129,255:POKE
     130,211
1010 POKE 131,255:POKE
     130,211
1020 A$="sixteen spaces"
1030 A$=A$+A$+A$+A$+
     A$+A$+A$+A$+A$+
     A$+A$
1040 RETURN
```

Vince Early, Orpington

Buying blues

There is no doubt that the small computers currently available on the UK market represent good value for money. It is a pity that the selling of such advanced technology has more in common with the 19th than the 20th century.

As a prospective purchaser of a small computer, I have been, as they say, investigating the market. Mail order has caused several acquaintances near heart attacks and big telephone bills; terms like 'rip-off' and 'swindle' have been used. Many firms launch advertising campaigns long before they are in a position to deliver; one hears of power supplies (rather essential!) being three months in the coming when the computer (and its guarantee) arrive within a week or two. And why, in this area of digital devices, cannot your advertisers add VAT, postage and packing, and all those little extras that are needed to run the machine? £150 announces one — actually nearer £200 is needed to *obtain* the machine.

I decided to avoid these problems by attempting to buy a machine in a shop and set off for the Edgware Road. I needn't have bothered. Not only is almost everything out of stock but little interest is shown in the customer. In one shop I observed a gentleman performing prodigious feats on a small machine for at least ten minutes before fortuitously discovering he was a sales assistant. No one asked whether I wanted anything and I left without the slightest notice being taken of my presence. Curiously enough they did have a small machine I might have been interested in, but no matter. By comparison, buying hi-fi in the Tottenham Court Road is a positive pleasure.

Colleagues in the business advise me to wait a while — or forever?

Professor J C Marsden, Tunbridge Wells, Kent

Anti-LIST

While writing a program for a small local firm I was asked to write a program which couldn't be listed — only RUN. At the time I was using an Ohio Superboard and I found that an amendment to the pointers used by the LIST routine did the trick. The first line points to the address of the next line and so on. So, by zeroising this first pointer, only line one will be listed. The program will still work since these pointers are not used when the program is run.

As the lowest line number on a Superboard is 0, I suggest that you put a REM statement in at this position. A POKE 769,0 will zeroise the pointer, while POKE 769,7 will restore it.

Users of other machines should be able to use this method — it's simply a case of finding out where programs are stored in memory and studying the first few bytes for the pointer.

B Mistry, Bradford

Those with PETs may get some useful tips from the 'Get Well Soon' article later in this issue — Ed.

Squire's squawk

Poor old Commodore. No fewer than four separate digs at them in your November issue.

There has been much cause for criticism in the past but the interesting point is that the company has been making huge efforts to remedy these problems. *Printout*'s postbag provides a pretty good barometer of Commodore's performance. The number of letters of complaint received during the last couple of months has declined sharply. These days even their documentation is readable.

Credit where credit is due might encourage some of the other manufacturers to put their houses in order.

Julian Allason, *Printout*

That's funny. Kit Spencer rang us to say almost the same thing — Ed.

A Toady trick

I fear that Trevor Lusty may have been paid more than his due for his program in your November issue; he has used the old PET programmer's trick of increasing the printer line feed length to make a program look longer. Compared with another PET program in the same issue, Mr Lusty's is 1½ times the length. Well, I suppose that will teach you to dig at his native publication with almost unsolvable anagrams.

David Boreham, Fife

Sharp crash

Regarding R L Tucker's query (*PCW* Nov '80) about why his MZ-80K occasionally crashes when LIMIT MAX is used, Sharp's reply seems a trifle coy.

There is, in fact, a bug in Sharp's cassette Basic Interpreter. When the internal clock is set using the TI$ function part of memory used by the LIMIT MAX command is overwritten. So this is a likely problem on any cassette-based MZ-80K.

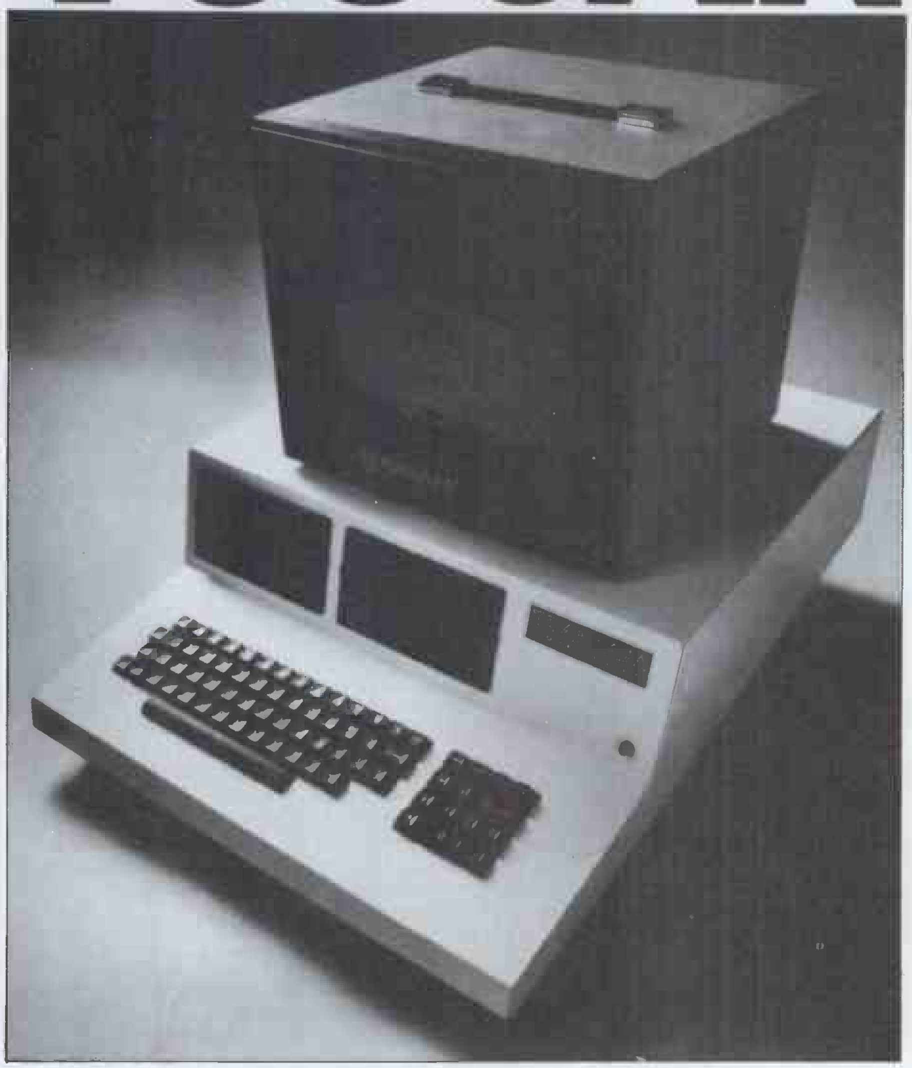
How to overcome it? Surely Sharp didn't suggest GOTO 1200, which the Monitor will simply ignore. The instruction is GOTO $1200. A misprint perhaps? In any event, a 'cold Hart' is 'cold comfort' to anyone wishing to reset maximum memory while retaining an existing program. My suggestion to R L Tucker and other others experiencing this problem is to forget about MAX, determine the top of memory value for your particular configuration and use that value with the LIMIT command instead. For a 24k RAM machine the value is 28672 (4k monitor + 24k RAM = 28k or 28672 bytes) and in this case the command is LIMIT 28672.

It works for me everytime.

E W Hare, Haslemere

BENCH TEST

TRANSAM TUSCAN



Lyn Antill builds and tests an all-British system.

The idea of the Tuscan is stunning — you start off with a kit costing less than £200 and keep building it up until you have a full size 64k, twin disk, S100, CP/M machine. The improvements can cost as little or as much as you want to pay at any one time — from £10 or less for a couple of extra RAM chips to £350 for a disk controller and one drive. The finished machine has a very professional appearance and the specification looks good, too. You can stop off at several different stages in the building process and have considerable choice as to the eventual configuration.

Transam developed the idea after evaluation of its previous computer kit — the Triton — which is a multiboard system. One of the novel features of the Tuscan is that the 8k Basic system is accommodated on one board, which also holds slots for up to five additional S100 boards, all of which will fit into the one case. The 8k Basic board holds four Basic ROMs, 8k of user RAM, the processing logic and the video logic.

You can, in fact, have a smaller system than the 8k Basic, because Tuscan will work on a 2k Monitor ROM (called Mitsi) with 1k of RAM. This is suitable for such applications as process control. You don't even need to buy a keyboard if you can borrow a terminal to plug into the board while you're programming it. Several colleagues of mine have made the kits to control laboratory equipment; unfortunately none of them has, to my knowledge, succeeded in designing the interface to the equipment, so I can't yet comment on the Tuscan in this role.

A route up from the Basic, or a more expensive alternative to it, is the 32k resident Pascal system. This is another novel idea and the Pascal looks very good. (Transam wrote the TCL Pascal for the PET.) Program storage could still be on cassette. Programming teachers dream of the day when Pascal takes over from today's Basic; perhaps the Tuscan is a further step in realising that dream.

If you don't want resident Pascal, you can just go the whole way to a disk system, possibly starting off with just one disk while you save up for the other. To do this you need at least 32k of memory, a disk controller and one or two disk drives. The cabinet has room for two 5¼in disk drives, or a separate drive is available for twin 8in disks. Printer connections are provided, and if you want a graphics terminal this can be arranged with an appropriate memory-mapped video control card.

Building the minimum system

The assembled and tested version only costs an extra £40, so don't bother reading this section unless you relish the prospect of soldering (and much head-scratching when things don't work first time).

To place my comments in context, I must point out that I had never held a soldering iron before, let alone used one on a computer, nor did I know anything about electronics or microcomputer hardware or logic. My object in building the kit was partly educational — as a teacher of computer studies, I wanted to know what went on inside a computer and this seemed a good way of finding out. It also seemed like a cheap way of getting a computer for myself. I knew I could never go out and write a cheque for £1500, which was the absolute minimum for the sort of system I wanted, but this way I could buy a bit at a time.

Sue Eisenbach had seen the Tuscan kits while they were still in the design stage and thought that they would form a suitable basis for a 'Build your own Micro' course — which she duly set up. So it was that a mixed group of scientists gathered together in the physics lab and got to work, with advice from two electronics experts. Transam said that the kits took six hours to build, so we doubled that, allowed a bit extra for tea-breaks and interruptions and a bit more for sorting out mistakes, and set aside three days for the course. This was a mistake. We spent the whole three days soldering, working out what all those little things that looked like sweets were and whether we had all the right ones, squabbling about who'd pinched whose soldering iron, and muttering darkly about incomprehensible manuals.

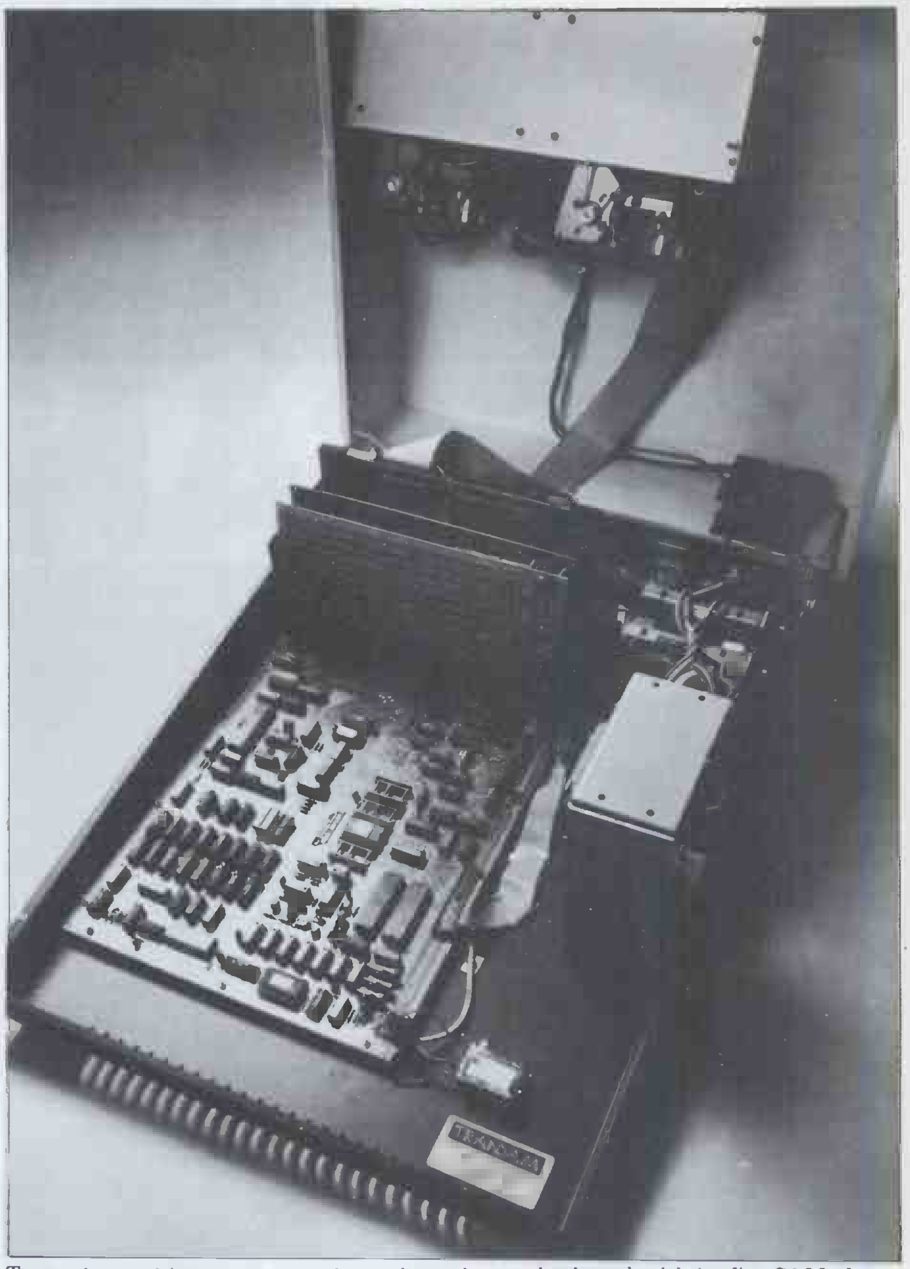
We should have all taken home a copy of the Hardware Manual the week before so that we could have worked out in advance what it was that we were supposed to be doing and what equipment we might need.

Working on the board was great fun but we all found the power supply downright frustrating. I would certainly recommend buying that ready-made as the saving is minimal. We didn't really know which gauge of wire to use. If we'd been able to do our sums, we should have been able to work it out but it would have been nice to be told. A fourth day was spent fiddling around, going back to Transam for extra pieces of ribbon cable, etc, checking each other's work and moving the bits we'd soldered into the wrong holes! Even at the end of this time several people hadn't completed their power supplies or connected things like keyboards.

Then came the agony! It was time to try the boards out. There are two problems in dealing with a board as large as this: several people found it awkward to handle and were concerned lest they crack it and lose all their money's worth, or at least that components put in earlier would take too much of a battering as later ones were dealt with. (The manual does indicate what order to do things in.) The other problem occurred to us as we queued up to use the one monitor — you can't check the work as you go along! From some there were cries of ecstasy as the welcome Mitsi message appeared, while others groaned as a strange tartan pattern came up. (This is an initialisation error caused by things like setting the Power On Jump switch or the System switch incorrectly.) I kept quiet, as my board showed no signs of life whatsoever.

The manual gives no real clues as to where to start looking for faults. It's a case of looking at all 101 sockets and the components slotted into them for bent pins and faulty soldering, for ICs inserted the wrong way round and for any items that might have been misplaced. Another week of careful checking went by before it was decided that four of the boards had faults on them, one of which turned out to be a bent pin after all. Transam admitted it had had faults with the first batch of boards but was able to put ours right within a week. (And that was before it knew I was doing the Benchtest, just in case you're suspicious!)

The housing for the Tuscan (and the Triton) is expensive at £85. Our engineers were convinced that the board and power supply could probably be fitted into a much cheaper home-made box by anyone with access to metal-working or plastics moulding facilities. But they admitted that the size, strength and shape required for holding the keyboard and disks as well, and for supporting the TV or monitor screen, could not easily be provided for less. And, anyway, it *is* handsome.



Tuscan's case hinges open neatly to show the motherboard with its five S100 slots

Fitting the board into the case ought to be straightforward, but the documentation completely overlooks the fact that some of us don't even know what a dipole switch is, or how to connect coaxial cable or the wires to the tape-recorder. The guys at Transam were always very helpful answering my questions. Perhaps when enough other people have asked such questions, they will put all the answers into an expanded manual.

Another thing to bear in mind when assembling a kit is that you have to specify every single thing you want to buy, down to the last nut and bolt. This probably means that you will be making several visits to Transam for the bits you've forgotten, or having a long chat with the salesmen about what you're going to need for the application you have in mind. Also, nuts and bolts and sockets and wires may not be expensive in themselves but they do tend to add up, and so does VAT at 15 percent.

Hardware

As well as my own system, with 8k and resident Basic, Transam provided a system with twin 5¼in disks. It also markets a Centronics printer in matching trim.

The Tuscan is based on an 18 by 11in single board. The case provided by Transam is 24in deep by 18in wide by 8in high. It is metal with a white, textured finish and has a good, solid feel to it. It is quite big and heavy; too deep, in fact, to sit comfortably on my desk.

The CPU is a Z80A which will run at 2 MHz or 4 MHz. Most of the machines are currently being set up to run at 2 MHz because the faster 2516 EPROMs are difficult to obtain. A complete system at 4 MHz would only cost about £100 more. The board can hold up to 8k of ROM and 8k of RAM. A total of 64k memory can be accommodated, with the top 8k being ROM and the rest RAM. Static or dynamic RAM cards can be added to make up the 48k extra.

The video logic on the board gives a screen size of 16 lines of 64 characters. This is not memory-mapped, although there is a line buffer. The EPROM character generator provides 128 characters including upper and lower case letters and 32 'blobby' graphics characters. This can be re-programmed to give a user-defined character set. Output is to a monitor or, via a UHF modulator, to a domestic TV set. The clarity of the characters left something to be desired on my 6in portable TV but they were fine on Transam's 9in monitor. The onboard video works at 1200 chs/second. There is a 'wrap around' effect on the screen which you are warned about in the manual. This is normally only encountered when the cursor is flashing at the extreme left of the screen and results in a flashing point at the extreme right.

Transam is working on a system with output to a colour monitor. Other I/O facilities are: RS232 serial in/out switch selectable up to 4.8 kbaud; 8-bit parallel input port; 8-bit parallel output port; software and hardware selection of I/O devices; eight levels of vectored interrupts; and spare uncommitted ports for user definition.

The disk drives are Shugart SA400 or SA800 compatible, using IBM format soft-sectored single or double density disks. Up to four disk drives may be used which can be either 5¼in or 8in or any combination.

Two keyboards are available to fit into the case, one of which has a numeric keyboard and cursor keys. The smaller, 56-key keyboard, which is only anchored at its four corners, bends a bit as you strike the keys, although I understand that there is a standard cradle that can be fitted to support it if it is likely to get too much of a pounding. The 71-key board is perfectly trim. My own machine — and another new one I tried out — developed keyboard faults as it warmed up. Characters appeared on the screen when the keys had not been touched, or failed to appear when the key was struck. This may have been caused by key sticking, or, as Transam suggests, be due to a faulty batch of keyboards from the suppliers. I have seen several different machines in use which had perfectly adequate keyboards, including the Benchtest machine which took a good hammering, so the problem is obviously not inherent.

If you are going to use a machine with resident Basic or Pascal, then you will need a cassette on which to store programs. Transam doesn't supply a specific cassette player to go with their systems, or even any of the wires, although they will give advice on buying and interfacing a cassette player of your own. They are hoping to make use of stringy floppies in the near future.

Software

There is an 8k Basic available in ROM, a 10k disk Basic, a 32k resident Pascal (with the first 8k in ROM) and a disk Pascal. These are all TCL's own software. Once you have built the full CP/M system, then you should be able to take your pick of all the CP/M software, although Transam hasn't got anything running yet. (Some CP/M programs rely on memory mapping, which isn't available with the on-board video but requires a separate video card.)

Basic

The 10k disk Basic is intended to be a superset of the 8k resident Basic with additional commands for handling disk files.

I was a bit surprised when the INPUT statement on the resident Basic jumped up to the top left-hand corner of the screen each time and over-wrote whatever was there, including its own '?' prompt. I forgot to ask Transam whether this was intended, but it had me worried until I realised that it should be preceeded by CLS which clears the screen. This doesn't happen on the disk Basic. Spacing of input and output can be done quite nicely with TAB and SPC, and the '?' prompt can be replaced with one of your own choosing for any INPUT statement, making for a sensible dialogue with the user.

The Basic is fairly standard with a good range of mathematical functions. It has a precision of 6½ digits, allowing for rounding of the last digit. There are no matrix manipulations per se, although multidimensional arrays (up to 256 dimensions!) are permitted, always provided there is enough memory. I ran out of space using three dimensions with anything larger than DIM M(9,9,9), and DIM M(4,4,4,4) was the largest four-dimensional array I could manage, but I was only using a 32k system. To use string arrays of more than 50 characters, it is necessary to CLEAR space for it early on in the program.

Long names are permitted for variables, although only the first two characters are treated as significant. Upper and lower case letters are interchangeable in variables and in commands. Tuscan has a neat way of storing the Basic without any spaces and putting them back in again when it lists the program. This is done to save storage space without reducing program readability. The manual gives a long list of ways to avoid wasting space, including that particular trick which is anathema to teachers of programming — avoiding REM statements. Unless you are programming entirely for your own amusement, when lost time and faulty programs cost nothing, then it is cheaper to buy more memory than to waste time struggling through a long program with no REMs.

Good string handling instructions are provided: you can pick any number of characters from the beginning, middle or end of a string, or find out whether a particular smaller string is present within it. A SWAP statement swaps the contents of one variable with another, or one string with another. This is very handy when sorting.

I ran into two problems with the file handling, both of which Transam's programmer was able to sort out for me. The first one was that I got a DATA ERROR when I tried to read records which contained both strings and variables. This was resolved by putting a ',' between each data item as it was written to the record, just as one would when typing several items on the screen at once. As a writer of commercial programs I was delighted to see ROPEN, RGET and RPUT to open a file for random access, get records from it and write records to it, eg, RGET 1,15,A$ will get the 15th record on the file on channel 1 and place it in A$. Unfortunately, a copying error in my disk caused it to hang on ROPEN. The master disk in Transam's workshops did this perfectly but I wasn't able to try out the random files as well as I would have liked — file handling is central to most of my programs.

One very nice feature of TCL Basic is the amount of work that can be done in command mode. DIR is available from Basic, files can be opened and closed, and you can use it in calculator mode, eg, PRINT (274/47.5 + 43*0.75) will work out the answer and print it on the screen. It is also possible to CALL one program from another. This enables one to create libraries of useful routines.

Pascal

Unfortunately I didn't get a chance to use the Pascal, but the description in the manual of the facilities it offers looks very promising and TCL Pascal certainly enjoys a good reputation.

Packages

There aren't any yet, although Wordmaster and Wordstar are being worked on and others are in the pipeline.

Documentation

The hardware manual is critical for anyone building their own system. It has been written by and for people who know what they are doing. The level at which the explanations should be pitched is obviously difficult to determine — if it sounds too easy you'll skip what you ought to be reading and if it's not easy enough you'll get lost.

I had expected to find the instructions for making the board to be the most difficult but in fact they were the clearest. Perhaps the writer was aware that this was likely to provide the greatest difficulty and had taken extra care. The instructions for the power supply were sketchier but this didn't concern the physicists in our group, who worked straight from the wiring diagram: although I was able to understand what they were

Benchmark timings:
These are for the slower 2 MHz version of Tuscan rather than the 4 MHz, which should have given correspondingly better results. (All timings in seconds.)

BM1	2.3
BM2	13
BM3	26
BM4	27
BM5	32
BM6	48
BM7	68
BM8	6

doing, I would never have had the confidence to do it that way myself. The instructions for the UHF modulator appear to be wrong — at least the way I read them, which I did several times until the salesman suggested I try it the other way round. The keyboard connections were easy to follow but I despair of ever connecting my tape recorder (it's probably one of those things which is easy when you know how — but I don't). The user-definable ports are left entirely to your own imagination. Of course they could be used in a great variety of ways but it would help if the manual gave you some idea of the sort of information that could be fed down them and what the machine could be expected to do with it, what instructions could be used to interpret it, etc.

The 'How it Works' section is for experts only. How many users are really likely to know the significance of such a pin being high or low? Many will, but there will also be many who won't but would like some enlightenment on the subject.

The only documentation I can compare this with is Heathkit, who charges considerably more for its manuals (and its kits, come to that) but which are very much more detailed and much easier for the non-expert to follow. Perhaps Transam should investigate the market for such an 'Idiot's Guide'.

I shouldn't have had any difficulty with the Assembler language section — for five years of my life I wrote all my programs in Assembler and converted them myself into hex — but I didn't actually get any Assembler programs going. Those of my colleagues using the minimum Tuscans for process control are going to need a much fuller guide to Assembler programming than this. My first Assembler manual for a system little bigger than this occupied a complete volume and told you everything you needed to know about every instruction.

Resident Basic is described in the general software manual and there is a separate volume for disk Basic. These are on a par with most people's Basic manuals, ie, they are brief and presuppose a knowledge of the language, meaning I can never find the instruction I'm looking for. I am not complaining about this manual in particular but about micro manuals in general. They always look as though they were put together in a hurry (which they probably were) but never seem to get tidied up even after the first rush of new products has settled down a bit.

The Pascal manual is a pleasing exception, written as an introduction to the language as well as a manual and providing plenty of examples of the instructions as used in programs. I suppose Transam worked on the assumption that most people will already be familiar with the hardware and with Basic but that most will be coming fresh to Pascal and will therefore need more help.

At a glance

FIRST IMPRESSIONS	
Looks	*****
Setting up	*****
Ease of use	*****
LANGUAGES	
System Software	****
Basic	****
Packages	N/A
PERFORMANCE	
Processor	***
Cassette	not reviewed
Disk	****
COMPATABILITY	
Hardware	***
Software	***
DOCUMENTATION	***
VALUE FOR MONEY	****

***** excellent, **** V. good, *** good, ** fair, * poor.

8k Resident Basic has the following commands and functions:

PRINT	TO	STEP	TAB	DEF
CLS	OR	AND	—	END
DATA	XOR	+	@	GOSUB
EDIT	*	/	ASC	INPUT
FOR	<	=	CHR$	LIST
GET	FN	PI	HEX$	LET
IF	SPC(	COS	LEN	OUT
LINE	ATN	FRE	RND	RUN
NEXT	EXP	INT	SQR	REM
ON	INP	PEEK	VAL	STOP
RETURN	LOG	SIN	MID$	SCR
READ	SGN	TAN	>	WIDTH
SWAP	STR$	RIGHT$	<=	ELSE
TRACE	LEFT$	STRING$	>=	
NOT	INSTR	AUTO	>	
CALL	THEN	LPRINT	<>	
DUMP	VDU	LOAD	RESTORE	
ERASE	CLEAR	OFF	RANDOMISE	
GOTO	DIM	POKE	SAVE	

The following additional commands are in the disk Basic

GET #	CLOSE
INPUT #	RENAME
LINE INPUT #	RGET
PRINT #	ROPEN
CREATE	RPUT
OPEN	DELETE

TECHNICAL SPECIFICATION

CPU:	Z80A 2 MHz or 4 MHz
Memory:	1k — 64k RAM 2k or 8k ROM (for Monitor or Basic)
Keyboard:	Full Qwerty 56ch or 71chs with numeric pad and cursor keys.
Screen:	Monitor or TV through UHF modulator 64chs x 16 lines with on-board video
Cassette:	Supply your own, and your own connecting wires.
Disk Drives:	Up to 4, any combination of 5¼in and 8in single or double density.
Printer:	Dolphin BD80, Centronics 730 or 737 (with proportional spacing)
Ports:	RS232 serial and parallel. modem I/O. User definable.
System S/W:	2k MITSI in ROM for minimum system. Built into resident Basic and Pascal. 2k TUBS — ROM for running CP/M disk.
Languages:	Assembler, Basic and Pascal

Potential use

This machine is aimed at anyone who wants to start small and work up. The 8k Basic system is roughly comparable in price and performance with the 8k PET but lacks its compactness and the convenience of the built-in screen and cassette. The twin disk system is again broadly comparable in price and performance with, say, the Superbrain, but again lacks the built-in screen. Where the Tuscan scores is on its versatility — starting with something almost at the bottom end of the market and going up almost to the top. I wonder when Transam is going to bring out a multi-user Tuscan?

I would imagine that three separate types would be interested in the kits — electronics wizards who just like building things, engineers and scientists who want to control laboratory equipment and people with limited finances and great expectations. Prominent in this last group would seem to me to be school teachers. They are likely to have access to equipment such as voltmeters and would benefit, as I did, from the knowledge of computers gained by making one. However, I do feel that such people would need more help from the documentation.

TCL Pascal is something of a pacemaker. Will the micro user be jolted out of his Basic mentality? The resident Pascal system could be just the thing to do this. Certainly there are many of us who believe that good, reliable, portable packages will not really be achieved, at least not at the right price and in the right quantity, until they can be written in Pascal. Basic is too muddly and one version differs too much from another.

Prices

The best thing about Tuscan prices is that they keep going down — in last summer's price list, 48k of dynamic RAM was £398 and now it is £285! A remarkable reduction by any

GOTO page 134

PRINTERS UPDATE

This is an update (not a replacement) of the printer survey we published in last August's *PCW*. Since that time, a number of new machines have appeared and we've included as many of these which a) have come to our notice and b) we've been able to get details of.

One encouraging trend is that prices seem to be dropping all the time, particularly at the lower end of the market, which is good news for the home/small business user. For a while now we've been moaning about the disproportionately high cost of printers compared to that of mechanical typewriters (which contain several hundred expensive-to-make moving parts). At last, though, prices are beginning to reflect the relative simplicity of some printers — Centronics, for example, has just dropped the prices of its 730 and 737 models (see August) to £375 and £425 respectively.

Daisywheel printers are also getting cheaper. The Ricoh RP1600, for example, is now available from at least one shop for £900 retail, compared to its £1300+ price tag of mid-1980. And if you're prepared to sacrifice speed, you can get even cheaper daisywheels but be warned — the 17 characters per second printing speed of these low-cost machines can seem painfully slow if you're doing a lot of printing!

Finally, a new market is beginning to appear in the form of 'intelligent' electronic typewriters with computer interfaces. These can be used off-line as a normal typewriter or on-line as a letter-quality printer or even as a terminal.

PRINTERS UPDATE

		Access Data Communications (0895) 30831		Adler Business Systems 01-686 8344		
Model		ADC 1251	ADC 2401	P80	P360	P250
Print mechanism type		DM	DM	DM	DW	DM
Line or character		Both	CR	CR	CR	CR
Speed cps	Max	125	240	80	17	250
	Min					
Lines/min	Max	70		60		120
	Min					
Characters/line	80	■				
	132	■			■	■
	other		136	120	198	
Characters/inch	horizontal	10	10	10/12	10	10/12/15
Lines/inch	vertical	6	6	6	6	6/8
Proportional spacing			■	■	■	■
Bidirectional printing		■	■	■	■	■
Justification			■		■	
Multiple copies		■	■	3	5	4
Ballistic head		■	■	■	■	
Matrix format		7x9	7 or 9x9			9x7
Change print size		■	■	■	■	■
Change type font		■	■	■	■	■
No. in character set		96	96	96	100	96
Headlife (million chrs)		100	200	100		300
Descenders			on 9x9	■	■	■
Underlining		■	■	■	■	■
Ribbon life (million chrs)	normal	0.5	1.6	2		2
	carbon					
Mobius loop type?			■	■		■
Graphics		■	■			
Bidirectional movement		■	■	■	■	■
Pin feed				■		
Tractors		■	■			■
Dual tractor						■
Paper widths	Min	2½	4			
	Max	10½	15½	9½	15.5	
Friction feed				■	■	
Sheet feeder						
Paper cutter						
Serial interface		■	■	■		■
Max baud rate		19,200	19,200	9600		19,200
Buffer	Opt.	2.8k				2
	Fixed	750	10k	256		0.5k
Parallel interface		■	■	■	■	■
Parallel transfer rate (ch/sec)						
Self-test		■	■	■		■
VFU				■		■
Switchable forms length		■	■			
Punched tape						
8 Channel cartridge						
Electronic + No. channels						
Paper-out sensor		■	■			
Measurement in inches	width			16.3	20	24
	depth			10	13	17.7
	height			6	5.5	8.27
Approx weight (lbs)				15	26	50
Cost		£560	£1350	£450	£650	£1300

Key:
DM Dot Matrix
DW Daisy Wheel
DR Drum
SW Spin Wheel
GB Golf Ball
CM Comb
CH Chain
PH Print Head
P Pressure Sensitive
E Electro Sensitive
TH Thermal
* Half Space Facility
Optional
Standard

PRINTERS UPDATE

	Anderson Jacobson Slough 25172			Dataplus 0245 30030	DRG (0934) 415 398		Diablo (04862) 71337	Epson 01-422 5612
Model	AJ880	AJ860	AJ832	TX-80 Graftrax	Star-writer	Citizen 5700/5800	630	MX-80
Print mechanism type	DM	DM	DW	DM	DW	DM	DW	DM
Line or character	CR	CR	CR	CR	CR	L	CR	L
Speed cps Max	40	120	30	150	25	120/180	40	80
Speed cps Min	30	30	15				32	
Lines/min Max				70				105
Lines/min Min								46
Characters/line 80								
Characters/line 132								
Characters/line other	218		158			224	198 @ 15cpi	
Characters/inch horizontal	10-16.5	10	10/12	10	10/12	10/12/16.5	10/12/15	10-16.5
Lines/inch vertical	2-12	6	6	6/8	6/8	6/8		8-72
Proportional spacing								
Bidirectional printing								
Justification								
Multiple copies	5		5	4	4			
Ballistic head								
Matrix format	7x5			7x5, 7x7		9x9		9x9
Change print size								
Change type font								
No. in character set	96	128	96	96	96	96	128	96
Headlife (million chrs)			2	50				100
Descenders								
Underlining								
Ribbon life (million chrs) normal			0.5	2			3	3
Ribbon life (million chrs) carbon			0.1				0.235	
Mobius loop type?								
Graphics								
Bidirectional movement								
Pin feed								
Tractors								
Dual tractor								
Paper widths Min	2.5	2.7	2			5		4
Paper widths Max	14.5	14.5	15	10	15	17	16.5	10
Friction feed								
Sheet feeder								
Paper cutter								
Serial interface								
Max baud rate	9600	1200	300	9600			9600	9600
Buffer Opt.	700		2000				2k	
Buffer Fixed		350	256			256	768	Line
Parallel interface								
Parallel transfer rate (ch/sec)				9600				
Self-test								
VFU								
Switchable forms length								
Punched tape								
8 Channel cartridge								
Electronic + No. channels						TOF		
Paper-out sensor								
Measurement in inches width	22	23.5	23	12.5	24	24.8	22.5	14.7
depth	16.4	10.5	23	15.5	14	15.7	18.25	12
height	6.5	21.5	34	5	8	8.1	8.25	4.2
Approx weight (lbs)	22	43	90*	20	40	50	60	12
Cost	£699-899	to £2045	£2350	£295	£1185	£1295-1495	£1675	£425
			*inc stand	Graftrax option £40 Any int. other than Centronics £40				

Key:
DM Dot Matrix
DW Daisy Wheel
DR Drum
SW Spin Wheel
GB Golf Ball
CM Comb
CH Chain
PH Print Head
P Pressure Sensitive
E Electro Sensitive
TH Thermal
* Half Space Facility
Optional
Standard

PRINTERS UPDATE

	Facit (0634) 401721					General Electric 01-702 4100	Mannesman Tally 0734 580141	
Model	4520-21	IPS 5000/80	4525	IPS 5000/132	4526	TermiNet 2030	M80 MC	MT1602
Print mechanism type	DM	DM	DM	DM	DM	DM	DM	DM
Line or character	CR	CR	CR	CR	CR	CR	CR	CR
Speed cps Max	100	125	150	125	150	60	200	160
Min						10	140	
Lines/min Max	60							
Min								
Characters/line 80							@ 10cpi	
132							@ 16cpi	
other								
Characters/inch horizontal	12	10	10	10	10	10/13.2/16.5	10-16.5	10
Lines/inch vertical	6	6/8	6/8	6/8	6/8	2-12	6/8	6/8
Proportional spacing								
Bidirectional printing								
Justification								
Multiple copies							6	6
Ballistic head								
Matrix format	9x7	9x9	9x9	9x9	9x9	9x7	7x7,9x7,9x9	
Change print size								
Change type font								
No. in character set	108	96	96	96	96	128	128	96/192
Headlife (million chrs)	100	200	200	200	200		100	200
Descenders								
Underlining								
Ribbon life (million chrs) normal	6	10	10	10	10	3	5	2
carbon								
Mobius loop type?								
Graphics								
Bidirectional movement								
Pin feed								
Tractors								
Dual tractor								
Paper widths Min	8.6	3	3	3	3	2	4.5	4
Max		11.5	11.5	15	15	15	8.5	15
Friction feed								
Sheet feeder								
Paper cutter								
Serial interface								
Max baud rate	9600	9600	9600	9600	9600	1200	9600	9600
Buffer Opt.		2k	2k			4k	1k	
Fixed	712			2k	2k	516		655
Parallel interface								
Parallel transfer rate (ch/sec)								100k
Self-test								
VFU								
Switchable forms length								
Punched tape								
8 Channel cartridge								
Electronic + No. channels								
Paper-out sensor								
Measurement in inches width	14.6	18.3	18.3	24	24	22	22	25
depth	6	14	14	14	14	18.5	18.5	19.7
height	15.6	7	7	7	7	5.5	8.7	8.7
Approx weight (lbs)	21	30	30	35	35	22	48	66
Cost	£583	£774	£938	£910	£1052	n/a	n/a	n/a

Key:
DM Dot Matrix
DW Daisy Wheel
DR Drum
SW Spin Wheel
GB Golf Ball
CM Comb
CH Chain
PH Print Head
P Pressure Sensitive
E Electro Sensitive
TH Thermal
* Half Space Facility
Optional
Standard

PRINTERS UPDATE

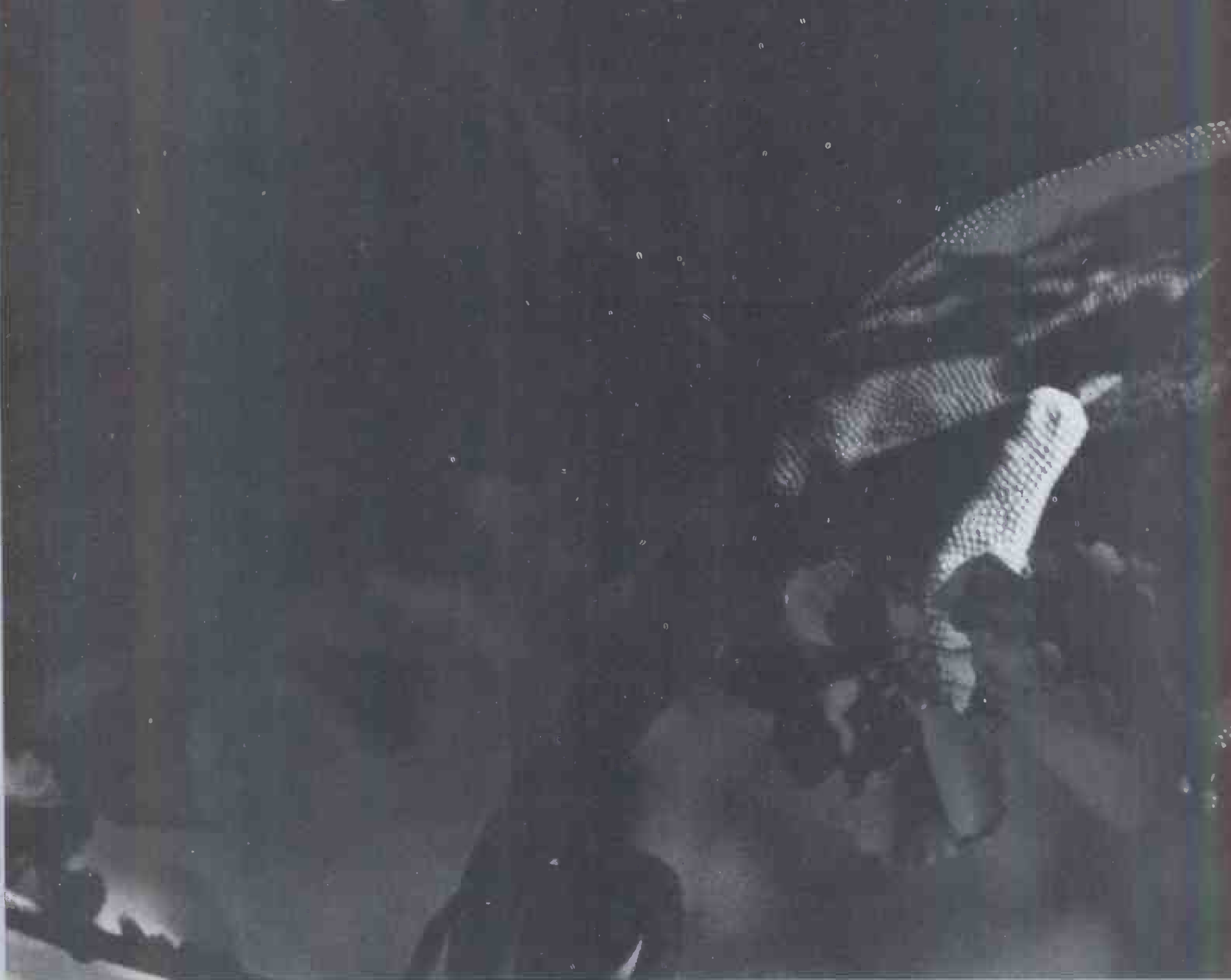
		Mannesman Tally 0734 580141	Pertec (0734) 582115			Qume (0734) 584646	Roxburgh 079 73 3777	
Model		TZ200 Q	P80	P360	P250	Sprint 3/45	8480C-FF	8480C-TF
Print mechanism type		DM	DM	DW	DM	DW	DM	DM
Line or character		L	CR	CR	CR	CR	CR	CR
Speed cps	Max		80		250		100	100
	Min			17		45		
Lines/min	Max	200			100			
	Min	125	52					
Characters/line	80							
	132							
	other		120 opt	158/198	158/198			
Characters/inch	horizontal	10	10	10/12/15	10/12/15	10/12	10	10
Lines/inch	vertical	6/8	6	6	6/8	6/8	6/8/12	6/8/12
Proportional spacing								
Bidirectional printing								
Justification								
Multiple copies		6	4	6	6		2	2
Ballistic head								
Matrix format		7x8,7x10 5x7,5x9	7x9		7x9		9x7	9x7
Change print size								
Change type font							PROM	PROM
No. in character set		96	96	100	96	96	224	224
Headlife (million chrs)			100	50	100	20	100	100
Descenders								
Underlining								
Ribbon life (million chrs)	normal	12	2	3.5	2	0.2	2	2
	carbon							
Mobius loop type?								
Graphics								
Bidirectional movement								
Pin feed								
Tractors								
Dual tractor								
Paper widths	Min	4						2.5
	Max	15	10	15.5	15.75	15	10	10
Friction feed								
Sheet feeder								
Paper cutter							Tear bar	
Serial interface								
Max baud rate		9600	9600		19,200		4800	4800
Buffer	Opt.	1k			2k			
	Fixed		256	1k	512		80	80
Parallel interface								
Parallel transfer rate (ch/sec)		100k						
Self-test								
VFU								
Switchable forms length								
Punched tape								
8 Channel cartridge								
Electronic + No. channels								
Paper-out sensor								
Measurement in inches	width	28	16.3	21	24	22.5		
	depth	24.5	10.2	13	18	13.5		
	height	11	6	5.5	8.3	7		
Approx weight (lbs)		110	16	29	55	28	19	21
Cost		n/a	£478	£666	£1311	$1900	£253	£280

Both available in March 1981

Key:

DM	Dot Matrix	PH	Print Head
DW	Daisy Wheel	P	Pressure Sensitive
DR	Drum	E	Electro Sensitive
SW	Spin Wheel	TH	Thermal
GB	Golf Ball	*	Half Space Facility
CM	Comb		Optional
CH	Chain		Standard

In the microcomputer jungle
The Sharp MZ-80 system now with



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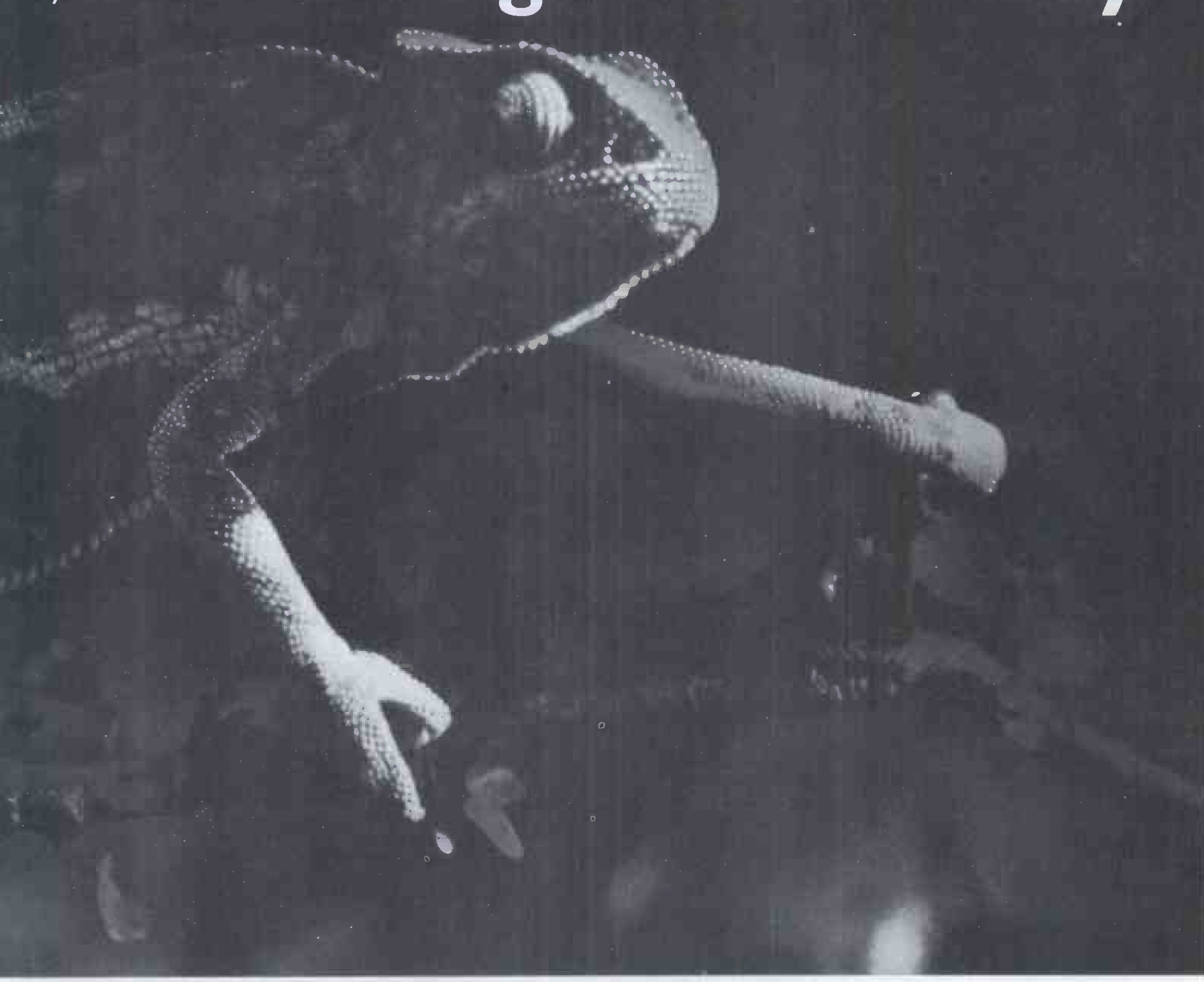

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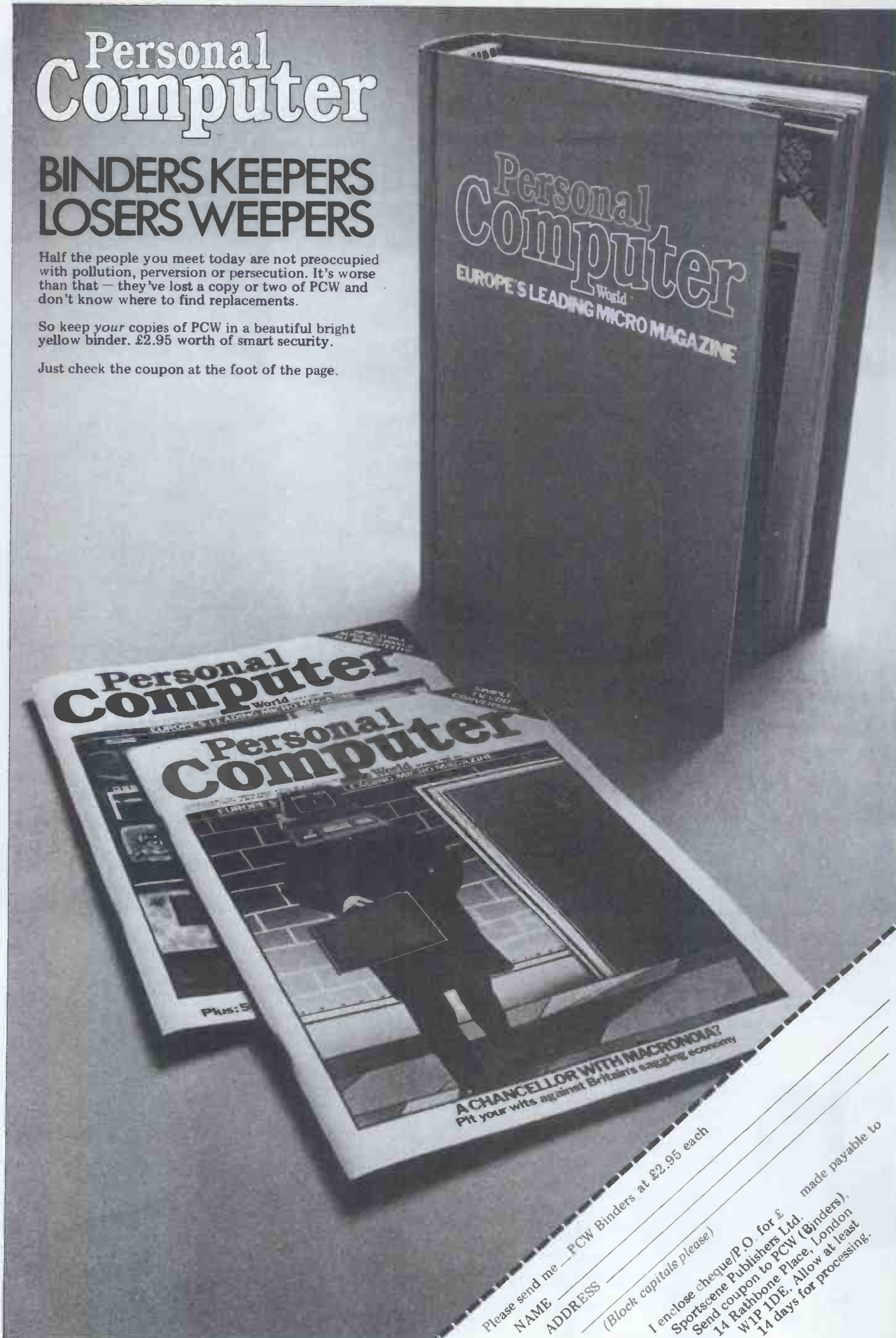
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Joanne loves MAVIS

One of the nicest applications of microelectronics is to the problems of the handicapped. For the first time in history the blind can 'see', the deaf can 'hear' and the mute can 'speak'. Here is one example of such an aid. Julia Howlett reports.

Joanne is five years old and a severe spastic — she's unable to speak or make controlled movements, which poses many problems for a bright youngster, both at school and at play. Until February this year Joanne's main means of communication was by eye movement, pointing at symbols, which she manages very successfully and at great speed. She was also at that time just learning to use a switch-operated typewriter called POSSUM. The input to a POSSUM can be varied according to the type of disability and in Joanne's case, I think, she was using two buttons in the beginning.

Since February, Joanne has been the proud user of another device, called MAVIS (Microcomputer-based Audio/Visual Information System). This is a specially-designed personal computer, developed at the National Physical Laboratory in conjunction with Loughborough University, under the guidance of the late Dr Chris Evans, and funded by BP. Trials so far have been very successful and all the prototypes currently under test have been built to full production specification. Joanne is one of those taking part in these field trials.

MAVIS was designed to enable the development of handicapped children through both formal education and through play. Until recently Joanne has used the system mainly for play, manipulating colours on the attached TV screen and making tunes with the built-in music function. As her skills develop, she'll be able to have a go at drawing and take part in computer games with the rest of her family.

Joanne's formal schooling began in autumn 1980 and to prepare for this her teachers were given instruction in the system's use. MAVIS enables her to achieve a greater degree of independent communication than was ever possible using the eye-pointing method. Joanne manipulates a switch rather like a windscreen wiper to select from coloured symbols displayed on the TV screen and for the first time in her life she finds that she can scribble and 'turn' the pages of a book. This sort of activity is very encouraging for Joanne and gives her the motivation to explore the system further. Who knows — there's no reason why MAVIS shouldn't be used to send electronic signals to any device capable of acting on them. Remote control of moving toys seems like an ideal application for a child like this. The possibilities are clearly endless.

One of the good things about MAVIS is that it doesn't need a computer specialist hovering around. Mums and dads, teachers and kids are all able to use it with very little training. At the same time there's no reason why someone who's interested shouldn't write their own programs, thus widening the potential still further. Standard offerings are word processing, games, music facilities, environmental remote control, switch control and wordstore typing packages. Since parents and teachers are not always willing or able to prepare software packages, the aim is to give the user maximum independence by providing these prewritten packages. The system is easily portable (thank goodness for micros!), providing the maximum continuity between Joanne's home and school environments. In effect this is Jo's electronic exercise book and is both simple and enjoyable to operate.

Another MAVIS system has been installed at Banstead Place assessment centre, which caters for several disabled school leavers who are experiencing difficulties in going on to further education or employment. Banstead uses the system for a variety of purposes including assessment, in which the screen equivalent of a form can be filled in by students who would be unable to do this in any other way without help. It is used in teaching both literacy and numeracy as well as specific topics such as the Highway Code. Since television has been the main source of out of school entertainment, the arrival of MAVIS has been something of a welcome relief since it offers the opportunity to play games and really communicate with each other.

Results coming in from these trials are being used to influence future MAVIS developments and will be of great benefit when planning the use of computers for the disabled. These devices will become a fundamental part of the lives of disabled people around the world, being used at home, at work and in their recreational activities. And Jo, with her parents, is a pioneer in these new techniques. Watching her progress will reveal vital information in the struggle of all disabled people to achieve independence and minimise their frustration.

If you know of an area in which microelectronics could be used to help the disabled, turn to page 71 for details of an essay competition in which you could win £100.

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SECRETS OF SYSTEMS ANALYSIS

PART 5: CHOOSING A MACHINE

So far in her series about installing a microcomputer in a business, Lyn Antill has described the lengthy but very necessary decision-making processes which you should go through before even looking at actual computers. This month, Lyn discusses the next decision-making stage — finding the computer which best suits your application.

As I pointed out at the end of the previous article, you cannot isolate the choice of the machine from the choice of the software that operates on it. The two are complementary — only the complete computer system can solve your problems. Having said this, however, I shall be dealing with the two separately, partly for reasons of space but partly also because the micro and the software may be coming from different sources.

Background material

Now, it goes without saying that you've been reading all the *PCW* Benchtests and if you've succeeded in digesting all that material then you probably feel like a walking encyclopaedia on the subject of microcomputer hardware. Or do you? Perhaps you actually feel more confused than ever. The very fact that a Benchtest tries to answer everybody's questions makes it less likely that it will give a full answer to the questions you are asking. It's possible that you don't agree with all the answers. Even if the reviewer likes the documentation, for example, it doesn't necessarily mean that you will. Again, reviews are written soon after the machines make their first appearance and there are often teething troubles which are later ironed out, giving the impression that the machine is less reliable than it turns out to be in practice.

Reviews of machines won't tell you what you should buy but they do have several useful functions:
— they introduce you to what's on the market;
— they highlight some of the good and bad features;
— they give an indication of the sorts of questions that should be asked;
— they contain factual information about the machines and the suppliers.

Other people's machines

There's nothing quite like seeing a thing working to decide whether or not you like it. Of course, with a micro we come back to the problem of distinguishing between what is specific to the machine and what to the program, but some things can be clearly distinguished. If you don't like certain messages that appear on the screen, then that is the fault of the program, as it is when calculations are not done to your liking, or files kept quite as you want them. Other features are obviously those of the machine — the amount of noise it makes, its size, portability, robustness and physical appearance.

For other features, the causes may not be so obvious. A program may appear to be slow and for this there is a variety of possible causes — a slow machine, inefficient programming, inefficient language (Basic programs are slower than programs in compiled languages, such as Cobol), slow VDU, or it may just be that the program is doing lots of things you didn't know about. (The converse is true of many demonstration programs which are doing very little that is not immediately apparent on the screen, thus appearing very quick and efficient.) Many machines come with the screen built-in and so you are stuck with what's offered, but others can be attached to a variety of terminals — in which case, don't judge the quality of the micro by the VDU, and vice versa.

Another thing that can only be assessed on a working machine is the keyboard and anyone who spends a lot of time at a keyboard is very fussy about the feel of the keys and their layout. For example, some of the terminals at the Polytechnic where I work have the 'Break' button very close to the 'Return' and students are continually disconnecting themselves because their finger slipped. Silly things like this can lead to great irritation and time-wasting.

Good features on a keyboard, like function keys and cursor control, are only good if your program uses them. CAP-CPP, for example, writes for a very wide range of machines, so its programs ignore features such as these as it cannot rely on any particular machine having them, or using them in the same way. The same is true of many bought programs. So don't be carried away by the salesman's raptures — ask to see how you yourself will be able to make use of any special features and decide if that usefulness is worth the extra price. If the keyboard will be used by someone else (eg your secretary), then let him/her make the decision.

If someone else likes — or dislikes — their machine, this does not oblige you to agree with them. For instance, at the Polytechnic we've recently bought some Ithacas and we have all been struck by the same feature — the row of switches and flashing lights. The computer scientists were ecstatic, and I was horrified. Now I don't want to say that the Ithaca is either good or bad, merely that different people look for different things and that the sort of non-computer business people I work with do not usually want to be reminded that the nice little black box that does the accounts is actually a *computer*.

Micro shops

The marvellous thing about micros, as opposed to any other sort of computer, is that you can just go into a shop and look at them. So make sure you do just that! Have a good look, chat to the salesman, collect all the free sales literature you can. You can only make a good choice if you know what is available and who you like to deal with.

There are two extremes of reaction to avoid. Either the thought of having to computerise is so awful, or you are so shy, that you can't face the thought of having to go through the door more than once and, afraid to ask too many questions, you take the first system that appears to do the job. Or else you are so enthralled by the first system you see that you never ask whether there is anything else that can do the job better or cheaper. Just remember that it is your money you are parting with, for ~~the~~ hardware *and* the software, and even more for the time it takes to get your own work set up and running on the new machine. Your time and effort won't appear on any bill but it could be the greatest cost of all.

In London we have a wealth of micro shops — no doubt this is true of other large cities — but not everyone is so fortunate. At the *PCW* show I met a businessman from the Channel Islands who was sure he would be buying a PET simply because they were the only machines offered on his island. It was only a short flight to the Apple dealer but if the computer went wrong at the start of a foggy spell his business would grind to a halt because the serviceman would not be able to fly over. Still, if he only knew what other shops were offering he would be able to keep his PET dealer up to the mark and would know what he could reasonably expect of him in terms of delivery, support, etc.

Talking to salesmen

We all know the caricature of the salesman — fast talking, only interested in taking your cash, telling you all the good things you didn't want to know and ignoring all the bad things you did, or trying to bulldoze you into buying something you don't know you want. Sue Eisenbach tells the story of a time she went to collect a machine for a Benchtest and was having a very interesting conversation with the guy in the shop when she happened to mention that she wanted to buy some equipment. Instantly he went into 'sales mode', stopped talking to her as an intelligent human being and went into his standard patter, even forgetting to mention that the machine he was offering her wasn't even working properly!

Of course, not all salesmen are like this. I know some who are super — really trying to find out their customers' needs and provide the best equipment, advice and support. These are the ones who stay in business.

But even the best salesman cannot meet your requirements if he doesn't understand them, which is why you should have armed yourself with your list of user requirements, constraints and ideas for potential solutions. Explain these as concisely as you can, using a 'top down' approach — eg, 'Hello, I'm thinking of buying a computer system.' Well, you *might* have wanted to buy some blank cassettes or to complain about something.

'I run a motor accessories shop which employs two assistants,' tells him that you want a business system rather than a computer game, and also the size of business he's catering for — you don't want a Sinclair, nor something with four terminals.

'I'm having trouble with stock control: we try to record every item that is sold so that we know what to reorder but often find items have been missed off the reorder list so that we are out of stock' — now he knows that you want a stock control system not a payroll, giving him an opening for discussing the way in which the system he offers could solve your problem.

If he says, 'I have the very thing here,' he probably hasn't — he still hasn't got enough information to go on. But even if he *does* say this, you have your list of volumes of transactions, information to be stored, reports to be produced, etc, so that you can ask intelligent questions about the system he is demonstrating.

'How many separate stock items can this record? What analysis of figures can it provide at the end of the day, month, etc?' As you go through the factual questions you will get some of the answers you need. You will also get clues to follow up — supplementary questions, things you weren't sure about, things you didn't like.

If he does go into 'sales mode' and starts reciting that well-rehearsed patter, what should you do about it? That rather depends on how naturally polite you are. Many people find it rather difficult to butt in, preferring to accord a speaker the courtesy of listening to the end, even if he is not telling quite what they wanted to hear. Others are sharp enough to be able to interrupt and get an immediate response, but most of us are likely to feel out-talked.

Perhaps one way of coping with this situation is to listen (after all, there is usually quite a lot of information put into the patter) and to make a mental list of all the things he is *not* telling you. We all do this to TV adverts: 'Most cats prefer. . . ' 'Prefer it to what?' we ask ourselves. Use this technique on the salesman. One can then politely enquire 'What about. . . ?', giving him the chance either to fill in the gap in his patter, or to admit that perhaps the system left something to be desired in that respect, and offer some alternative.

Ideally, you want to see a demonstration of the program on the very machine you are being offered, but this is rarely possible. Only a limited number of demonstration machines can be set up in the shop and they will only have small data files. You will have to decide how different machines will fulfil your requirements. There's no easy way of doing this but be a little sceptical of bland assurances and try to make sure that your screen really will be brighter, your disks faster, your print clearer, or whatever.

What can a salesman tell you about a machine?

My technically-minded friends will probably answer 'Not very much!', because they are only thinking about technical information. There will be technical questions to be answered — like 'Can this micro be interfaced with that VDU?' — and a technical expert or a manual will have to be consulted, but there are very important questions that only the salesman can answer:

— 'How much does it cost?' (including all the extras you will need to run the programs you had in mind).

— 'What is the delivery time?' — the time it's actually going to take, rather than the one they quote on the adverts. 'By the time you read this it will be in your shops,' usually implies that the advertiser thinks printing magazines is a very much slower business than it really is. Even when he points to a micro on the shelf, make sure that all the extras are there, too.

— 'What sort of guarantee do you offer?'

— 'What about maintenance contracts?'

— 'Will your engineers install the machine for me and, if so, will there be a charge for this?'

Talking to engineers

This can be very difficult for the businessman — you don't know what questions to ask and, even if you do, you don't know what to make of the answers. My main problem has been that the engineer is primarily interested in theory rather than practice. For example, if a businessman asks: 'Can this printer be used on that micro?' he actually means 'Is there a standard connector and do you have it in stock?' whereas the engineer is answering the question 'Could it be done?' and not thinking too much about whether he could find the time to work out the connection and wait for the required parts to be delivered.

The only real advice I can give (apart from continuing to increase your own technical knowledge by reading *PCW*) is to decide what questions you really want to have answered and to stick at it until you get answers.

'What is the mean time between failures of this product?' (ie, how long, on average, does this work before going wrong?). In fact, this is a difficult question to answer because so many of the products being sold are new on the market and there has not been time to gather such statistics.

'How long does it take to repair the most common faults on this product?' (including the time it takes the engineer to get there and to obtain spare parts if necessary).

'Is there a standard connection between the micro and this printer (VDU, disk drive, etc)?'

'Have you actually got this configuration working somewhere?'

The practical problems that arise when setting up a microcomputer system are frequently trivial and irritating and can be very time-consuming both in engineer hours and in working hours lost on the micro. If your engineer already has this configuration working in a few other places, you know that he should be able to get yours up, too. This may well influence your choice of machine, if the advantage for you of having the thing up and running quickly outweighs the advantage of the updated version that your engineer hasn't tried yet (but is dying to have a chance to). If you are in this situation you may decide to be sceptical about his enthusiasm for the new product.

Don't let him blind you with science, but if he can put across technicalities in words you can understand, then listen.

The choice

This will depend on a lot of factors, including things like software, which we haven't discussed yet. It is not a choice that can be hurried because there is so much more involved than in buying, say, a car. A computer system is a composite of several pieces of hardware — and some software. The thing to do is make a list of all the possibilities, remembering to write down all the bits required for each one. This will serve as a checklist to make sure that nothing has been forgotten (there always seem to be more extras than you bargained for), to enable you to work out the cost of each option and to list its advantages and disadvantages.

You may find that one system stands out as the only real possibility but often there's not all that much to choose between them. In that case, don't agonise over which is the *best* one; go for the one you fancy, but not until you have read next month's article on Choosing Programs!

COMPETITION

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 .

£100

We are offering a prize of £100 for the best article of around 2,500 words, 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, and Adrian V Stokes, Chairman of the IYDP Technology Working Group. A third judge will be announced soon.

Please send your entry to IYDP Competition, 14 Rathbone Place, London W1P 1DE, to arrive not later than 30 April 1981, enclosing a suitable SAE if you would like it returned.

Personal Computer World

1981

International Year of Disabled People

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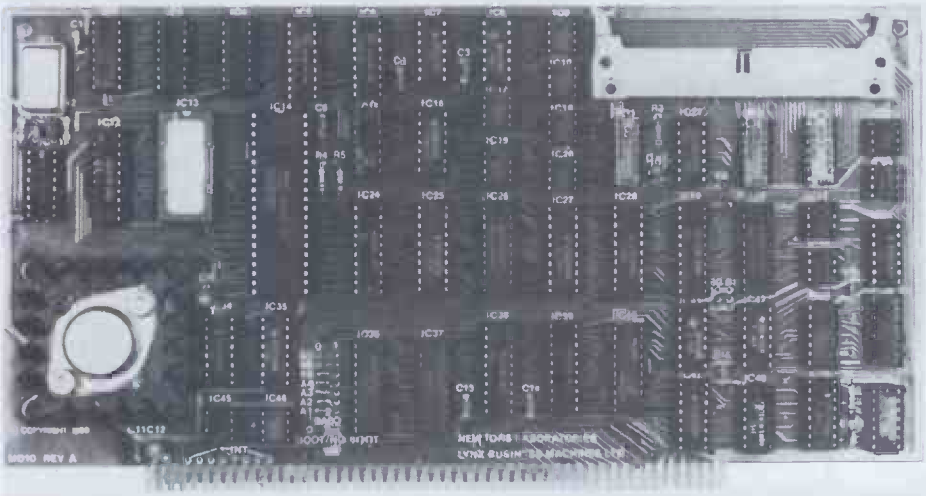

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NEWTONS Laboratories now supply ex-stock complete subsystems consisting of the controller and 10Mb AMPEX disc drive for £3995 (1-off end-user) including a rewritten BIOS for CP/M 2.2. The controller board alone costs £600 (1-off end-user). The disc drive alone costs £3395 (1-off end-user). Manual only £10. OEM and quantity discounts are available. Dealer and export enquiries (not USA) are invited.

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BOOKFARE

'Something for everyone' is this month's motto as Malcolm Peltu reviews a bumper book bundle.

Business before people

This month's Bookfare follows the computer industry's traditional equivalent of putting the cart before the horse. Books about the *business* come first and get more prominence than a book about the needs of computer *users*.

I have decided to adopt this approach because I feel the number of books under review about the business of computing (six) require enough space to do them justice (or injustice). I also feel that *PCW* readers might perceive that books about choosing one's first computer or applications are more important than ones concerned with the psychological and sociological aspects of human/computer interaction. In the short term they are probably right, just as hobby freaks are right to take umbrage with my recent attacks on Basic.

I hope, however, that the long-term human and strategic aspects of computer development will eventually be given their due priority, after which disclaimer, here goes with a look at the six latest pillars of business computing wisdom.

A good place to start is with the facts. And there is one clear fact about the use of small computers in business — there is a lot of money involved. In probably the best in-depth study of the current state of microbusiness affairs in the UK, *Microcomputer Systems in Business*, edited by Derek Pedder for BIS Pedder Associates, provides a valuable insight into the product, market and usage trends of small systems in the UK. One startling statistic summarises the microcomputer boom: in 1976 there were 274 systems installed in the UK, valued at less than £15,000; at the end of 1979 there were 44,510, which, according to other Pedder statistics, is over 50 percent more than the total number of installed computers over £15,000. By 1984, Pedder estimates there will be almost 400,000 microcomputers in the UK at an average growth rate of about 55 percent in the installed base.

In 1977 there were only 18 different types of computer under £15,000 installed in the UK; by 1979 there were at least 137, with the variety of options continuing to grow at a rapid rate. As Pedder comments, 'If user choice has so far been a complex (or hit and miss!) task, it is likely to become even more so in the future.'

With the value of the 1979 installed base something like £115 million, and likely sales in the next few years averaging at least £200 million, it is hardly surprising that new manufacturers and systems suppliers are being attracted like piranha fish to a crowded swimming pool.

Although microcomputers have been nourished by the domestic and hobbyist user, the target of systems suppliers is moving to business applications. According to the Pedder report, at the end of 1979 about 38 percent of installed microcomputers (17,000 systems) were used primarily for domestic and personal tasks. By 1984, however, Pedder expects that only about 6 percent (25,000 systems) will be in the domestic/hobby category (the survey does not include education as a separate category).

Even given that new cheapo packaged systems like the Sinclair ZX80 are giving a fresh boost to the home computer market, it is clear that suppliers will be placing increasing emphasis on the lucrative business market, particularly in manufacturing industry where the number of microcomputers in use is expected to grow from 4000 (9 percent) in 1979 to 150,000 (38 percent) in 1984, and in professional and scientific services, where over 87,000 new systems are expected to be sold.

These figures, like Pedder's book, are of prime interest to the computer suppliers, as an aid to their strategic planning. But their message is also of significance to all microcomputer users because they indicate the kind of marketing and systems development environment in which they will have to pick their way to find an appropriate business tool.

Pedder places the user point of view in context by identifying the suddenness of the business micro revolution: '1979 was the year the microcomputer market caught fire,' he points out. In addition to technological advances, an important catalyst was a growing awareness among potential users; the resultant fire is now spreading so rapidly that it is in danger of getting out of control. Manufacturers are having difficulty in satisfying the explosive demand at a time when skilled computing expertise is very thin on the ground.

The rate of market growth and shortage of experienced software staff mean, according to Pedder, that the widespread use of packaged application software is 'the only means by which the projected 1984 installation figures can be achieved; neither investment nor programming manpower is available to achieve this degree of market penetration with bespoke applications for every user.'

Yet, he observes, improvements are needed in the reliability and convenience of packages if software does not prove to be a dampener on users and suppliers. He also points out that the micro market has 'spawned a variety of middlemen between the hardware or software originator and the ultimate user' and that business strategies of manufacturers are in a constant state of flux.

All this leaves the potential purchaser 'with a very difficult set of decisions to take' in selecting a system, with increasing importance being given to applications software.

This is the cue to introduce two extremely useful and practical books aimed at facilitating the 'very difficult set of decisions' when selecting a system. *Buying A Business Computer* by Michael J L Turner covers the whole spectrum of choosing a new computer system, particularly if you are on your first trip into the computer minefield. *Choosing Programs for Microcomputers* by John Lane focuses on how to select applications programs for microcomputers and is based on a survey conducted by the National Computing Centre.

Both books adopt a 'checklist' approach to guiding the reader. As its foreword states, Lane's book 'is not a panacea, nor will it tell you which is the best system. However, if followed, it will prompt you into asking questions, of yourself and your supplier, that will lead you into making a wise choice.' This is substantially true and could also be applied to Turner's book, although it should be pointed out that the necessarily generalised nature of the advice in such books means that a great deal of the 'wisdom' — or lack of it — rests on the user's astuteness in applying general guidelines to particular requirements.

Turner's book is aptly subtitled 'a systematic plan for computerisation', as it emphasises the importance of creating and implementing a coherent systems strategy, beginning with defining business objects and ending with the live switchover to the computer service.

Turner provides a great deal of commonsense advice, based on practical experience of helping users to become computerised. For example, he warns against building up expectations that a computer which successfully handles one task, say purchase ledger, will automatically deliver other benefits of automation that may have been touted by salesmen.

Reducing administration costs, he says, may be the main reason for considering computerisation but it is 'rarely achieved'. A computer, however, is likely to help stabilise administration costs over a long-term period even if the workload increases.

He also warns that for some small businesses, the need for standardisation imposed by computers may be unacceptable. Smaller companies, he says, often benefit from the fact that they can cater for the idiosyncratic requirements of each customer. Turner advises, 'When you investigate the feasibility of a computer system, all these individual requirements have to be identified; a conscious decision must be taken as to whether the business can stand the degree of standardisation that will be required by the computer and what the cost of handling exceptions will be.'

In addition to generalised — but pertinent — advice like this, Turner also follows the process of computerisation step-by-step, punctuated by checklists, detailed examples of types of systems and procedures (such as a specimen invitation to tender) — all expressed in clear, basic English.

The main fault — and this is an almost universal failing of computing and systems people — is that Turner gives insufficient priority to the human factor, both in the systems design process and in the operation of the system. 'The general effects of a computer system on a company's staff are fairly well understood,' he states. But this is simply untrue.

As will be discussed later in the review of *Human Interactions With Computers* the human, sociological and organisational impact of computerisation is poorly understood. The impact on job design, staff satisfaction and motivation, industrial relations, etc, are only beginning to become accepted as an intrinsic and vital part of computerisation, although it is well known that many computers fail through lack of attention to the human factor.

Turner provides much good, sensible guidance on the *systems* side of computerisation — the problems and the opportunities, the costs and potential benefits. But he says little about human factors, such as the

best form of interactive dialogue and screen formatting from the human psychological point of view, machine ergonomics, and industrial relations consequences.

John Lane's *Choosing Programs for Microcomputers* is also essentially a book about evaluating systems characteristics, with little about the human factors in the software. Nevertheless, it is valuable and useful and a good complement to Turner's. In the third quarter of 1979, the National Computing Centre sent about 900 questionnaires to potential suppliers of applications software for microcomputers; about 100 companies replied.

The results of this survey confirm those of Derek Pedder's. About 600 different software products were identified, covering 80 types of application — from accounting to bakery administration. Many of the suppliers were newly-formed companies and 55 percent of the suppliers had employed staffs of less than five. Coupled with the fact that over 60 percent of the companies supplying software are in the South East of England, Lane points out that the level of support provided for applications packages could be very small. This, coupled with the price that the user is willing to pay for it should therefore be a significant part of the evaluation.

Despite the apparent overwhelming predominance of Basic as *the* hobbyist micro language and the relatively short time that Cobol has been available on micros, almost 30 percent of the packages are written in Cobol and under 50 percent in Basic. In addition to presenting the results of the survey and a list of suppliers, Lane also offers guidelines on how to use and get the best from applications packages, detailed examples of typical basic business packages (including guidelines on different capabilities that can be expected from differently priced systems), and an easy-to-read introduction to the basic concepts of microcomputers. As in any book that attempts to provide detailed advice to particular suppliers, including examples of costs, it is inevitable that the information can quickly become out-of-date and is likely to be incomplete even at the time of compiling, given the rapidly changing state of the market. This should be borne in mind when reading and using this book.

An interesting finding, which once again emphasises the significance of software over hardware, is that there was little correlation between the prices charged for software and the value of the hardware on which they run. Although for the hardware costing less than £5000 it was true that the cheapest software was available (generally under £500), for hardware in the £5000 to £10,000 range, software was evenly spread over the £500 to £3000 band.

Lane concluded with some invaluable advice, such as: 'Approach software with caution, assuming the worst; there are good packages around, but you cannot judge on price alone, you have to probe a lot deeper. Keep in mind what you really want the computer for before you set your mind on a particular make or model; in other words, approach selection with your own needs upmost in your mind.'

If you are a practising accountant, you will have a clear idea of what you want from a computer. The question is really whether a computer would do you any good at all; if you are an accountant and think it will, then the *Guide to Systems for Practising Accountants* would be a reasonable starting point. It provides general background to the types of computer service available (bureau, in-house, use of consultants, etc). The major part of the guide is an analysis of 70 suppliers who claim they have suitable systems (covering the whole spectrum of computing, not just microcomputers). With the proviso that this analysis could also become out-of-date, the *Guide* is a worthwhile investment if a decision has been made to use a computing service.

Successful Software for Small Computers by Graham Beech is also of benefit to a specialist market — programmers with a scientific bent — although it could have been a much more important book with wider interest had the author developed his idea in a less restrictive form.

Beech says the original motivation for the book was to answer a typical problem of students he has taught: 'I can write Basic but I cannot design programs.' Within one book he hoped to bring together a description of general programming techniques with examples of Basic programming for a particular subject, emphasising reliable design techniques.

Its value, however, is limited because the examples have a strong mathematical and scientific flavour and therefore do not appeal to people frightened by equations. The important program design techniques discussed are related to a specific Algol-like language called a Program Description Language (PDL), rather than to elucidating these ideas via more generalised insights. Having shown how a well-designed program can be written in PDL, Beech translates the PDL into Microsoft Basic, where it becomes easy to be bogged down in the trees of PDL and Basic translation without seeing the woods of good programming techniques.

A chapter in the book *Human Interaction With Computers* by Michael Jackson (see below), offers a much better insight into the overview of programming techniques, although Beech's book will be useful to some Basic programmers.

Although its cover and title claims that *Your First Computer* by Rodnay Zaks is a 'guide to business and personal computing', I can find little in it of value to a business user and I feel the novice hobbyist could also find a more satisfactory introduction. Zaks adopts the traditional hardware, bits, bytes and circuits approach to describing the nature of microcomputers. I criticised the Turner and Lane books earlier in this review because they did not emphasise the human aspects of systems enough. But at least they are written in plain language and focus on business systems.

After an initial chapter of waffle about the shape of society in the future using the wonders of microcomputing power, Zaks immediately becomes involved in talking about how to plug the micro in and get the system going. We are over a third of the way into the book before business applications are introduced, where the descriptions are heavily-oriented to program code.

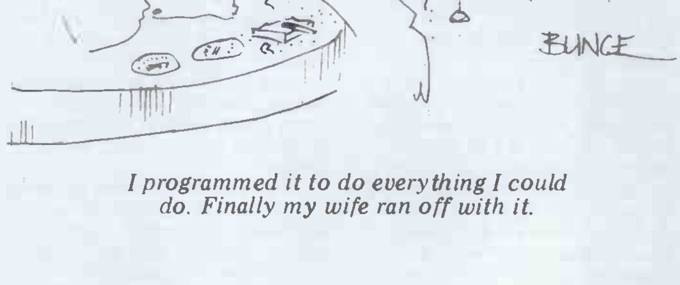
If the book is used by people developing business software, its lack of discussion of good programming techniques and software engineering will create many problems. I cannot see any businessman really wanting to write an accounts package, say, based on the flimsy advice in this book; and I cannot see many hobbyist being interested in the business applications described.

And now to what I regard as the most important book of all.

Behavioural problems

'Computers have a potential flexibility that makes them seem infinitely adaptable to different tasks. And yet this adaptability is more projected than real. Getting a computer to do what you want is exceedingly difficult.'

With these words, Hugh Smith and Thomas Green encapsulate the dilemma posed by computing power. The generalised flexibility that is at the core of that power also poses major problems to the people who have to design and use computers for specific tasks. Michael Jackson (he of structured programming rather than soul-singing fame) poses the same problem from the point of view of a programmer writing a complex software system: 'The programmer, unlike the mechanical engineer, is free to weld any part of a program to any other part or, indeed, to mix up the parts in any desired way. It need not be considered that this part is made of steel, that from glass and a



I programmed it to do everything I could do. Finally my wife ran off with it.

third from plastic. Nor does the stuff of programs provide any constraints, such as the strength of materials or a required power-weight ratio. Any program, however poorly conceived, can be made to work by ad hoc patches.

'Since the structural form of the program,' Jackson continues, 'is largely invisible to its buyers and users it is horribly easy — and tempting — to allow the quality of design to sink to a standard that would not pass muster for a moment in a motor car or bridge.'

Smith and Green are the editors of *Human Interactions With Computers*, which brings together experts from many disciplines — sociology, psychology, business administration and computing — to show how much (and how little) progress has been made 'to narrow the gap between the computer and the user, to produce packages that the user wants in ways that the user can grasp.'

Jackson provides a notable contribution to the section in the book on programming research. He explains why existing programming languages are inadequate for producing well-engineered software because they fail to distinguish between the problem being solved and the particular coding used to get one machine to solve the problem.

At the user end of the spectrum, Hugh Smith himself provides an excellent chapter on human-computer communications. Like most current writings on this subject, Smith's major contribution (and of the whole book) is to highlight those areas which should be given more attention by researchers and systems designers. He also exposes the lack of real research to provide good answers to the problems raise raised.

Technological and economic objectives, Smith says, are more easily set and carried through than social ones. 'Consequently social studies of the effects of technology tend to resemble a post mortem, ie, a search for cause and effects which can seldom be used to benefit the patient.' Until better social studies are available, he suggests, it is still worthwhile to spend 'more time thinking how we might build humans *into* systems rather than designing them out in pursuit of technical advances.'

The topics covered by Smith and other contributors indicate the scope and importance of the social and human requirements. These range from global questions, like how people perceive computers and the impacts of computer-based automation on employment levels, to systems design tasks, such as appropriate response times and assessing the merits of different forms of information retrieval dialogue.

Then there are the human aspects in specific applications systems such as medical decision making, architecture, education and decision making and in the more detailed systems development aspects, such as programming.

In some areas, Smith admits that there is very little research, such as in how well systems meet 'end user' expectations (the end user, of course, is the *real* user, ie, the typist, manager booking clerk who actually uses the system to carry out a real world task). This is extraordinary, given that the end user should be the raison d'etre of systems design.

Niels Bjorn Andersen and Leif Bloch Rasmussen from Denmark believe that increased industrial democracy will help to raise the computer expert's 'level of consciousness' about the aspects of systems design over and above the technical/economic issue. They say, 'The traditional expert strategy for systems design, with or without a hostage from the user department, is not going to work in the long run.'

Mike Fitter and Max Sime raise the crucial issue of what happens to the decision-making proces when people rely on interpreting computer processing routines, such as air traffic control, production management — or even starting (or preventing) the Third World War.

The dependence on computers for decision-making should become a shared process between man and machine, they say. But in order to achieve this, it will be necessary to ensure that the complex computer system can explain its own behaviour and 'rationale' for reaching a conclusion in a way that can be understood by the person in terms of human perceptions of reasoning. This requires a great deal of more work both in understanding human reasoning and psychology as well as developing better forms of computer 'reasoning' and man-computer dialogue.

Applied psychology also has an important role to play in improving programming languages and methodology, according to Thomas Green. For example, he says that any psychologist knows that 'slips of the pen are hard to find, just like misprints on the page.' He goes on: 'I hope that this "discovery" seems banal to you and provokes the thought "Well I don't need a psychologist to tell me that!" But the designers of Fortran overlooked it."

A mistype in Fortran could still make 'sense' to the compiler, although not the sense you wanted, he points out. A widely used statistical package (SPSS) demands that certain control records start in column 16: 'God knows how much expensive time has been wasted by this unnecessary whimsy, left over from punched cards and the Fortran input/output structures,' Green comments.

Every person involved in designing, using, selling or selecting a computer should read *Human Interactions With Computers*. Much of it might be irrelevant to the particular computing concerns facing the reader immediately. It raises far more questions than it supplies answers. Some of the contributions are woolly and some are esoteric.

But together, the contributors demonstrate that, although the technological computer revolution has begun, we are still stumbling in the dark in our attempts to tackle the most important task of getting the computer to do what *we* want it to do, where the 'we' encompasses any role that human beings can adopt in relation to using computers or being affected by a computer system.

This month's Bookfare reviewed:

Human Interaction With Computers, Hugh Smith and Thomas Green, editors (Academic Press, £6.40)
Microcomputer Systems In Business edited by Derek Pedder (Gower Press, £25.00)
Choosing Programs for Microcomputers, John Lane (National Computing Centre, £8.00)
Buying a Business Computer, Michael J L Turner (The First Computer Handbook, Whitney on Wye, Hereford, £9.75)
Your First Computer, Rodnay Zaks (Sybex, £5.95)
Successful Software for Small Computers by Graham Beech (Sigma Technical Press, £5.50)
Systems for Practising Accountants edited by Barry Knight (Computer Guides Ltd, 30-31 Islington Green, London N1, £24.00)

GET ON THE RIGHT TRACK

In the first of two articles, Jeff Barton describes how he built a micro-controlled train layout as part of his research into real time control applications.

The control of a model railway layout is one of the more 'attractive' applications for a microprocessor. One of the final year projects for my Joint Honours Degree in Computing and Electronics at Durham University has been to design, construct and program such a system. Besides its obvious attraction as an intelligent toy, the control of a train set layout is a very complex Real Time Control System (RTCS). These two articles will summarise the RTCS developed at Durham and illustrate the techniques used for automatic route generation and execution with built-in collision avoidance.

This system differs from the commercial ones on offer in that the track is controlled rather than the trains. The commercial systems require some sort of 'loco module' in each engine and superimpose the coding signals sent out by the microprocessor controller on top of the power to the track. There is only one continuous length of track and, although the power is always applied to it, an engine only responds when addressed by the microprocessor.

The system at Durham reverses this situation and locos on the layout need no modification at all. The track is split up into short, isolated lengths or sections and each section is individually controlled by the microprocessor. The section driver circuitry is designed so as to produce a TTL-compatible signal to indicate when a train is drawing power from a section. It is also possible for this signal to generate an interrupt which, as will be seen later, is an extensively-used facility.

The computing system is provided by an MSI 6800 microprocessor system (uPS) which controls the 10ft x 5ft track layout via the Train Layout Interface (TLI). An overall view of the system architecture is shown in Figure 1 and a plan view of the layout in Figure 2. There are 19 sets of points and 41 totally isolated sections of track, although only 32 are so far implemented. Each point can be switched to either direction and each section is capable of driving an engine at one of 16 speed settings in either direction under program control. The system software allows the simultaneous control of multiple trains on the layout.

Hardware

The TLI provides the necessary decoding and conversion of signals between the TTL logic levels of the uPS and those required by the layout. This is performed by eight boards. Six of these are 'module boards', each providing the necessary logic and driver circuitry to control a group of eight sections of track. The 'decoder board' performs all the buffering and decoding of control signals prior to their connection to the backplane. The 'points board' supplies the logic and driver circuitry to enable any of the sets of points on the layout to be switched to either direction. The TLI is controlled via just one 6821 PIA so the interface to processor connection comprises 16 data, four control lines and an earth. These signals are decoded by the various boards and drive the layout via two 100-core cables.

Operation

Every action which can occur on the layout is totally under the control of the operator via the console. On each program run, train movement is not possible until an explicit command is entered. The user is provided with 26 different possible command functions to enable the layout to be operated either under manual control or automatically. It is possible to display status reports on the console at any time to inform the user about any desired system parameter.

The software displays a descriptive prompt each time that input is required from the user. This means that even a first-time user can control the layout within a short length of time at the console.

The program makes the system appear to be 'intelligent'. It is possible to place a train anywhere on the layout and after instructing the program of its location, together with a variable length list of sections to pass through, the program generates a route. This route is capable of driving the train through all the specified sections (and any that interconnect them), switching points as required, until the train reaches its destination. The actual execution of this route may occur at any time after it has been created and the positions of other trains on the layout need not be the same at the time of execution as that at route creation.

The routes operate on a localised basis; this means that each runs as a separate task within the system and allocates, uses and frees sections and points as it needs them. If two trains are about to collide on the layout, the program detects this and prevents it.

When taken to the general case with a lot of routes executing concurrently, this localised method is probably the most satisfactory way of operating the system. However, the solutions for escaping from deadlocks have not yet been implemented due to lack of time. Deadlocks and the 'master task' method will be discussed later.

Automatic route generation and execution

It is obviously necessary for the program to be able to determine how the sections of track are interconnected so it can calculate how to get from A to B. This information is contained in three tables, called 'postab', 'points' and 'slips'. Each table comprises a list of pointers to the beginning of each of the variable length data entries. Sample entries for these tables are given in Tables 1, 2 and 3.

```
postab  fdb   sec00p
        fdb   sec01p
        :
        fdb   sec31p
sec00p  fcb   1,1
sec01p  fcb   1,2
sec02p  fcb   0
        fcb   3,3,3,3,3,3,3,3
        fcb   3,3,3,3,3,3,3,3
        fcb   3,3,3,3,3,3,3,3
        fcb   24,24,24,24,24,24,
              24,3
sec03p  fcb   0
        fcb   4,4,4,15,15,15,15,15
        fcb   15,15,4,4,4,15,15,15
        fcb   15,15,15,4,4,4,4,4
        :
        :
```

Table 1

```
points  fdb   psec00
        fdb   psec01
        :
        fdb   psec31
psec00  fcb   29,$11,0
        fcb   8,$11,1
        fcb   -1
psec01  fcb   0,$12,0
        fcb   11,$12,1
        fcb   -1
psec02  fcb   24,$13,0
        fcb   3,$13,1
        fcb   -1
        :
psec06  fcb   -2
psec07  fcb   -1
        :
        :
```

Table 2

```
slips   fdb   slip06
        fdb   slip09
        fdb   slip11
        fdb   slip15
slip06  fcb   5,18,$17,0
        fcb   18,5,$17,0
        fcb   5,7,$17,1
        fcb   7,5,$17,1
        fcb   17,7,$17,0
```

Continued over

```
         fcb      7,17,$17,0
         fcb      17,18,$17,1
         fcb      18,17,$17,1
         fcb      -1
           :
           :
```

Table 3

The 'postab' table is used by the route specification command to discover the next section in the route which will eventually take the train to its destination. There is one entry per section and this is of one of two types — 'brief' or 'long'. It can easily be seen that to travel from section 01 (see Figure 2) to any other section in an anticlockwise direction (referred to as the 'positive' direction), the train must always pass through section 02 next. Therefore the entry for section 01 in 'postab' is of type 'brief'. On the other hand, the entry for section 02 is of the 'long' type since, when travelling in a positive direction, the train could enter section 03 or 24, depending on the setting of point 13. This method of storing data enables easy calculation of the route by simply walking through the table. For example, if the user enters '0' and '26' as the start and end sections respectively, the program first accesses the entry for section 01. This is of 'brief' type, so the program stores the one and only next section, 02, and then looks in 'postab' at the entry for section 02. By using section 26 as an index within this entry it finds that to travel from 02 to 26 requires passing through section 24 next. This process is continued until it arrives at its destination — in this case the route is 01, 02, 24, 25, 26. Although not yet implemented, to travel in the negative direction simply requires using 'negtab' instead; this will, of course, be different since section 01 now has two possible next sections. . . and so on.

Once the list of consecutive sections has been completed, the points settings which are required to create this desired route must be calculated. Two further tables, 'points' and 'slips', contain the necessary information for this purpose. A point is simple and has possible either one entry and two exit paths, or two entry and exit path, depending on the train's direction. If a train arrives at a point switched incorrectly, no serious damage occurs as the points are spring-loaded to account for this. However, it is obviously desirable to simulate the real life case whenever possible and so the point is always switched to the correct path. A slip is slightly more complex, with two entry and two exit paths. There are four slips on the layout, at sections 06, 09, 11 and 15. Each is operated by a single, bi-directional point motor and can be considered to direct a train into the 'opposite' or 'adjacent' section, depending on their setting. If slip 06 (point 17) is set to 'opposite', a train entering it from section 05 will depart on section 18 and a train from section 17 will depart on section 07. In the 'adjacent' setting, trains from sections 05 and 17 will depart on sections 07 and 18 respectively. If a route passes through a slip section, it is necessary to treat it as a special case requiring further processing.

The list of consecutive sections is now considered to be a series of pairs of source and destination sections. Each pair in turn is applied to the 'points' table to determine if a point must be switched in order to travel from the source to the destination section within each pair. Using the route calculated above to travel from section 01 to 26, the pairs 01+02, 02+24, 24+25 and 25+26 are considered. Each section has a corresponding entry within the 'points' table. Section 01 is first considered as the source and 02 as the destination section by examining the entry in 'points' for section 01. Although this entry tells how to get to sections 00 or 11 by switching point 12, it has no information on how to get to section 02. Section 02 is then considered as the source and 01 as the destination and the process is repeated by examining the entry for section 02. Since this entry contains no information on which point to switch to get to section 01 from section 02, it can be safely assumed that no point switching is necessary to travel between sections 01 and 02. Therefore the next pair in the list, 02+24, is considered. The entry for section 02 this time says that to travel to section 24 from 02 requires point 13 to be switched to a direction '0'. The program stores this information and interchanges source and destination and looks again in 'points' for section 24 to section 02 information (the case of section 08 to section 00 illustrates the need for this usually redundant test). This procedure is continued for every pair in the list until all the point-switching information for the route has been compiled.

A value of '-2' for a section entry in 'points' indicates that the section is a slip and so requires further processing. In this case the triplet of source, slip and destination sections is extracted from the list. The table 'slips' is then used to determine the switching information.

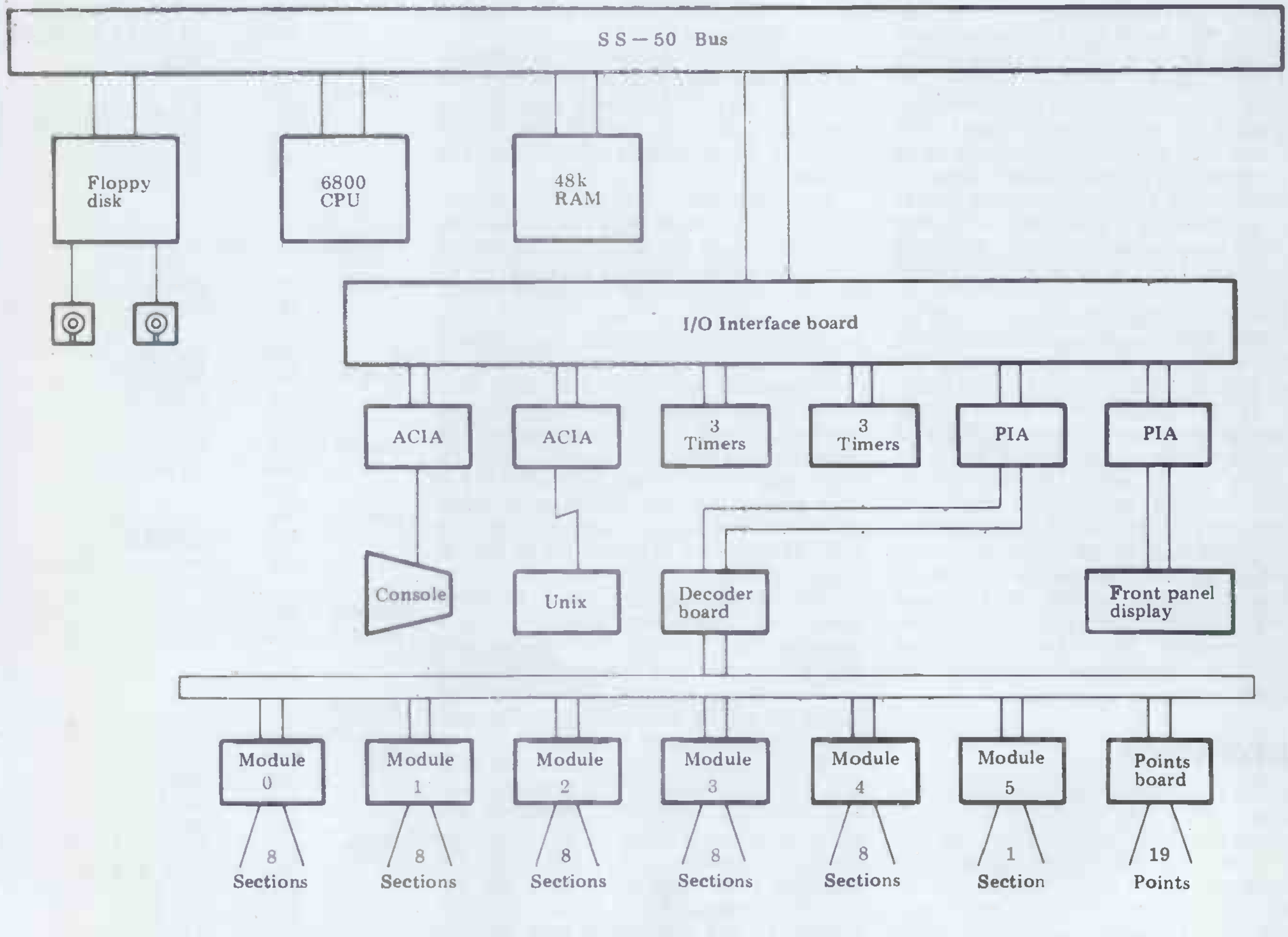


Fig 1 System architecture

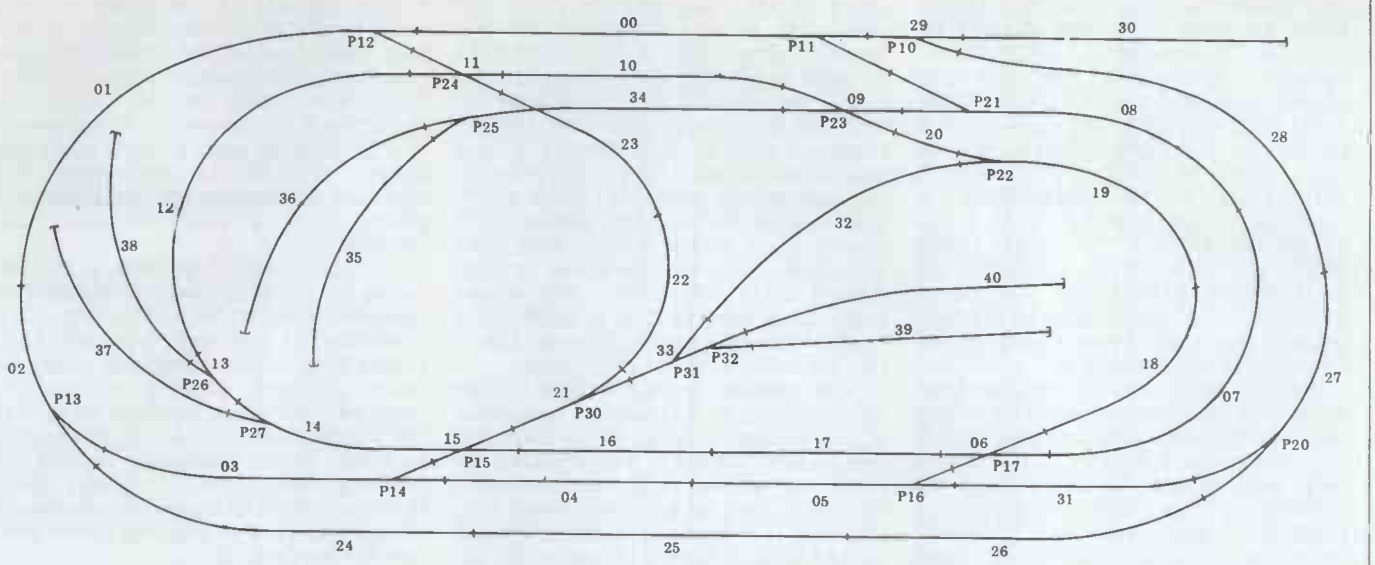


Fig 2 The train layout

START —>	01	section number
	00	direction
	09	speed setting
ACTTOP —>	02	next resource
	00	to free
	09	
	−13	point 13
	00	direction
	00	null value
ACTMID —>	24	section currently
	00	powering train
	09	speed setting
	25	
	00	
	09	
ACTBOT —>	26	next resource
	00	to allocate
	09	
	−1	end of route flag

Table 4

The final result of this processing is a data structure (as shown in Table 4) containing all the necessary information for the route to be executed. Each section or point entry in this table is of 3 bytes in length, with the first byte being the number of the resource itself. In order to distinguish between the two types of resource, the point addresses are stored as two's complement values. The second byte is the direction to which the resource is to be set, and the third byte is either the sections speed setting or, in the case of a point entry, a null value.

The most important piece of information when executing a route is the number of that route assigned to it at creation time. This is used by the subroutines as an index into the many tables of pointers and essential data so that all of these routines are shareable between routes.

As a train progresses through its route, the program maintains three tables, 'acttop', 'actmid' and 'actbot', each with an entry corresponding to the route which is an address pointer into the data structure created for that route. When the command is given to begin executing the route, all three pointers are initialised to the start of the data structure. Each time the next required resource is successfully allocated and set up (either powered up with interrupt capability enabled or switched), the 'actbot' pointer is moved down the structure by one entry (ie three bytes). When the train enters a new section the 'actmid' pointer is moved to the next section entry further down the structure and when a resource is freed by the route after it has been used, the 'acttop' pointer is similarly moved. These three pointers are therefore used to keep track of the active subsection of the route within the larger confines of the data structure.

The use of two further tables, this time containing data values, called 'ahead' and 'behind', enable the number of reserved resources in front of, and behind, the engine to be recorded. Again, these tables contain one entry per route. Both counters are initialised to zero when the route is first begun and they both have maximum values which are determined by program constants. The 'ahead' counter is incremented each time the next section in the route is allocated successfully — the allocation of a point resource does not affect the counter. When it reaches its maximum value of 'maxfor' the program moves from allocating new resources to freeing used resources.

When the 'actmid' pointer is updated to point to the next section through which the train is to pass, the 'ahead' counter is decremented and the 'behind' counter is incremented. Unless the 'behind' counter is less than or equal to 'minbak' the 'acttop' pointer is updated and the resource at which it pointed in the data structure is freed. The freeing of a section resource decrements this counter but freeing a point resource does not affect it. These counters therefore ensure that 'maxfor' sections in front of and 'minbak' sections behind, together with the section currently powering the train, are held in a 'locked' state by the route. At present both of these constants have the value '1' and so a total of three sections (maximum) are activated by the route at any one time during its execution.

The end of a route's data structure is indicated by a value of -1 for the resource entry. On reaching the end of the route, the train is stopped and all resources held by the route are freed again. A resource entry of -2 indicates that the route is to be operated continuously and so as each of the three pointers 'actbot', 'actmid' and 'acttop' reach this value they are reset to the top of the data structure again. This route would continue until either it or the program is aborted.

Besides executing the automatically generated routes as described already, it is also possible to run multiple trains on manually-produced routes. With patience, this allows the compilation of very complex 'demonstration calibre' routes. The system software treats each executing route as a task, running a program within the system. By the use of scheduling, it is possible to achieve multi-tasking and so multiple train routes may be operated concurrently in real time.

Perhaps the easiest way of considering the methods employed would be to regard the system as emulating a 'pseudo micro-programmable machine'. To avoid too much confusion, let us call the program that a task runs a 'task code program' or 't-code' rather than a program. A t-code can be any number of 'high level' instructions in length and each of these instructions is performed by a routine of 'low level' (6800) instructions. An example of a 'high level' instruction is, "SET SECTION 10 TO A SPEED SETTING OF 5" which would appear in t-code as three bytes: 01, 10, 05. The first byte, 01, is the op-code for this 'high level' instruction and the second and third bytes are the necessary operands to set section 10 to a speed 5. When the 'pseudo program counter' for the task reaches this instruction, the op-code (01) is used as an index into a jump table containing the start addresses of the 6800 subroutines which carry out the instructions. For this particular instruction the routine obviously requires two operands — a section number and a speed setting. It therefore accesses the two bytes following the op-code by using the 'program counter' and then updates the current route's entry in the 'program counter' table so that it contains the address of the next 'high level' instruction. Then, after updating the speed tables to modify the speed for the desired section, it returns to decode the next high level instruction as determined by the pseudo program counter.

There are currently 27 different 'high level' instructions which a route task can execute. They vary in length from the single byte instructions such as 'NO-OPERATION' (op-code = 00) and 'UPDATE STATUS ON CONSOLE' (op-code = 11) to instructions requiring one operand such as 'SLEEP X TIMES 40ms' (op-code = 14) and 'EXECUTE ROUTE X' (op-code = 17), to two-operand instructions like the one already described and 'SWITCH POINT X TO DIRECTION Y' (op-code = 07) to the longest three-byte operand instructions such as 'SET SECTIONS X THROUGH Y TO DIRECTION Z' (op-code = 04) and 'IF X IS LESS THAN OR EQUAL TO ZERO THEN JUMP TO ABSOLUTE ADDRESS YZ OTHERWISE CONTINUE' (op-code = 25). The 'x', 'y' and 'z' refer to the first, second and third bytes following the op-code for the instruction.

Besides being able to exercise total control of the layout from within such a task, additional facilities are provided. It is possible for a t-code to initialise a loop counter and, by successively decrementing this and performing a conditional jump, carry out a circular route for a certain number of times before continuing with a different part of the route. Absolute unconditional jumps are also provided for. One of the third-year projects for next year is to write a high level language and compiler for controlling routes.

Collision avoidance

The task of detecting that two trains are about to collide is performed by the routines concerned with the allocation of resources to a route. Whenever a train needs a point to be switched, or a section to be powered on, in order to continue its travel, an attempt is made to reserve that resource in the systems tables. If the resource is free it will be allocated to the route and the train allowed to continue. If the resource has already been reserved by another route then to proceed would result in a collision. The section currently powering the train which made the unsuccessful reservation attempt is therefore set to a speed of zero, stopping the train. The route task is then suspended for two seconds, after which a further attempt is made to allocate the resource. If this is also unsuccessful the cycle is repeated until the resource becomes free and the route is able to both reserve it and resume execution. This process relies on the assumption that the route which had already reserved the resource will free it again within a finite time. The allocation of these resources is performed on a first come, first served basis, so at present it is possible for a freight train to delay an express train — this is a refinement for the future.

The present implementation of an automatic route maintains a lookahead of one section in front of the train and one section behind it. These values can easily be altered but for maximum efficiency they should be as small as is practical. If a very long train is to be run on the layout, then it is obviously important to ensure that sufficient sections are kept reserved behind the engine to prevent another train hitting the last few trucks. However, if the train causes 'locks' to be placed on sections it does not need, other trains will be unnecessarily delayed and the likelihood of a deadlock occurring is greatly increased.

If there are sufficient trains on the layout to form a 'nose to tail' queue with each route waiting for a resource to be freed by another, it will not be possible for any of the routes to continue. This is a 'deadlock', to which there are many solutions. One of the more desirable ones is to prevent them happening in the first place. This could be done by some sort of 'master task' being responsible for ensuring that a resource is only given to a route if that route can successfully terminate within a finite time. This method entails checking that the rest of the route to be executed will be free when required. If a large number of routes are running concurrently then this master 'overseer' will spend most of the processor's time examining the possible future contentions with other routes. This vast requirement for processing power would not be possible with a single processor system and so to implement this approach introduces all the additional problems of a multi-processor configuration.

Another method involves each task trying to solve its own problems if it discovers itself to be in this state. The execution of the complex code then occurs only when a deadlock arises instead of each time a resource is requested. However, this may mean that the routes spend most of their time escaping from deadlocks instead of reaching destinations. It seems likely that some form of compromise between these two types of solution would provide the best results.

The ability to determine the existence of such a deadlock is by no means easy to implement and the methods of escaping from it more difficult still. Reversing into sidings or backing over points together with dynamic re-routing of the train are some of the obvious possible methods yet these introduce further complications. If a route tries to solve a deadlock by reversing and thereby causes another deadlock, how is this one to be solved? It is obviously impossible for the route to escape from this situation by itself, but does it signal this to the other routes and let them try to provide the answer? Or does it call for the temporary execution of a master task as described above? At present there are no facilities for any form of intercommunication between tasks and each executes in a totally isolated environment. The need for signalling between concurrent tasks is an essential requirement and is under investigation.

Next month Jeff will look at how the system handles scheduling and routing.

GATEWAYS TO LOGIC

CHAPTER 6: THE MICROPROCESSOR

Derrick Daines continues his series on teaching microcomputing to others

We have reached the point where a computer can shunt data about automatically, like a toy engine shunting trucks. What is now needed is knowledge of how the data gets there in the first place, how it is brought out and, by no means least, why these processes are so vital for our future. But first we need a long cool look at the microprocessor.

Looking at the microprocessor from the outside reveals nothing. We see an integrated circuit with a lot of pins sticking out of it — nothing more. However, concealed within that black, uninteresting package is every device that we have so far learned about, and more. Again, we must be selective. A lot of the stuff that is in there is not necessary for our students to learn about unless they wish to specialise, so here I will confine myself to the essentials.

To begin with, it contains those good old favourites, the A and B registers. These are the registers upon which arithmetic functions are performed — in binary, of course. There is an Arithmetic Unit, which does the actual adding and subtracting, and the Control Register recently met. Other registers will be mentioned as the need arises. In addition to these short-term memories and gating circuits, there are also masses of gates needed to shunt data about and the multiplexing or decoding circuits which determine which gates are to be opened and which closed. Some micros also contain their own clock and clock counter, while others require an external clock. All require an external crystal for accuracy, since this item is very bulky.

By anyone's standards, that's a whole lot of goodies to be packed into one small container and it is one of the miracles of modern technology that this has been done. We have already introduced our pupils to the enormous feat of miniaturisation, but it does no harm to stress it.

In our discussion of the Control Register, we simply stated that the next instruction is fetched from memory but of course this cannot be fetched from anywhere. The instructions must be in sequence or chaos results. In fact any part of the computer memory can be used to store data or instructions and frequently the two terms are interchangeable, so a Program Counter is required to keep track of where the next instruction is to be fetched from. Unless it receives instructions to the contrary, the Program Counter is notched up '1' after each operation, so that consecutive instructions are normally at consecutive addresses. The special instructions applicable to the Program Counter are of course the JUMP instructions met already. The Program Counter is otherwise just a register like the others.

The Index Register is also inside the micro and is one of those gadgets that once you have it, you wonder how on earth you managed without it. Normally it is incremented by 1 every time that we do an operation such as multiple addition, which makes it easy for the computer to multiply or divide. Like the Program Counter, the Index Register is directly accessible and may be loaded with any number at any time.

The Condition Code Register tells us indirectly of the state of various registers, such as if they are negative or overflowing, etc. This is of interest mainly to the programmer in his development of the program, so I do not intend to refer to it again. Interested readers are referred to the literature applicable to their particular micro. General readers may note that it is there, and then forget it.

Similarly for the Stack Pointer — another special-purpose register within the micro. Briefly, it points to the address at the top of a stack of data and is chiefly used when the computer jumps to execute sub-routines; that is, frequently used portions of program.

Instruction codes

A little reminder here would do no harm. The salient facts of computer operation are that, by transferring a word of binary bits from memory to the Control Register, the circuitry decodes them as instructions to open this gate and that. This causes one instruction in the program to be carried out.

Table 1 gives a carefully-selected number of hexadecimal codes. Again, there is no need for the general reader to remember all this stuff — particularly as each micro has its own instruction codes — and just grasping the main idea is sufficient. The instructions given are for the Motorola 6800 micro and also given are mnemonics for each instruction, which will be mentioned again shortly.

To follow what happens, let us take a simplified view of one or two instructions. The LD(A) instruction (86 in hex) is read by humans as 'Load accumulator A'. The micro also takes this as meaning, 'with whatever number is immediately following.' Therefore a complete hex instruction might be 86 00 (load A with zero) or 86 8E (load A with hex 8E).

Hex Instructions (for 6800 Microprocessor)

Hex	Mnemonic	Instruction
1B	ADA	Add Accumulator B to Accumulator A
89	ADC(A)	Add to Accumulator A whatever is coming next. Carry if Nec.
8B	ADD(A)	— Ditto, but do not carry
24	BCC	Branch if carry clear
25	BCS	Branch if carry set
27	BEQ	Branch if equal (result of previous test)
2C	BGE	Branch if greater than or equal to zero
2F	BLE	Branch if less than or equal to zero
2B	BMI	Branch if minus
26	BNE	Branch if not equal
20	BRA	Branch always
8D	BSR	Branch to sub-routine
0C	CLC	Clear carry
4F	CLA(A)	Clear accumulator A
81	CMP(A)	Compare accumulator A with the following number.
5A	DEC(B)	Decrement accumulator B by one.
5C	INC(B)	Increment accumulator B by one.
7E	JMP	Jump to the address following.
86	LDA(A)	Load accumulator A with the number following.
01	NOP	No operation
39	RTS	Return from sub-routine.
10	SBA	Subtract accumulators.
82	SBC(A)	Subtract from accumulator A, the following number.
97	STA(A)	Store accumulator A at the following address.
3F	SWI	Software interrupt — halt.
16	TBA	Transfer contents of accumulator A to accumulator B
17	TAB	Transfer from A to B

Table 1 A selection of instruction codes. Note that the full instruction set for the 6800 microprocessor is very nearly 200 different instructions, covering almost every conceivable requirement.

When the instruction is encountered, it is stored in the micro's Control Register, thereby opening the appropriate gates and at the same time signalling the micro to wait for the next binary word which, as the gates are ready open to receive it, is shunted into Accumulator A.

At this point, pupils might wonder how the computer knows the difference between the 86 (instruction) and 8E (data). The short answer is that it knows by the context. Once it had received the 86, it waited for the data to follow.

Sometimes it does not need to wait. For example, instruction 16 (binary 0001 0110) tells the micro to transfer the contents of Register A to Register B (thereby erasing any previous contents of B, incidentally). Now once the micro has opened the appropriate gates and counted eight pulses, the job is done and the next instruction is fetched.

Similarly, some instructions are three words long. For example, CE tells the computer to load the following numbers into the Index Register, which is long enough to hold two hex words. Therefore a complete instruction might be CE A04A, which means, 'Load the Index Register with the value A04A.' Inherent in the instruction CE is a code that instructs the micro to expect two words.

As to the question, 'Does the micro ever get things mixed up?' — ah ha! Therein lies a tale! The short answer is that no, the micro never gets things mixed up but the programmer does. For example, if he wanted the program to jump to where it would read 86 8E (load A with 8E), but made a tiny mistake so that the program missed the 86 and fetched the 8E instead, the micro would understand that as, 'Load the Stack Pointer with the next two hex words.' It doesn't take much imagination to see that in these circumstances the program would go wrong, with the micro reading data as instructions and vice-versa. This process is known as 'bombing' and usually results in the entire stack of memory being loaded with rubbish. This is perhaps the major reason why people fight shy of machine code, as the hexadecimal method is called.

In Table 2, I illustrate a short program in machine code, suitable for the Motorola 6800 micro. It presumes a keyboard input and a VDU output (see later for explanation of these terms) and as the earlier program for the cardboard computer did, simply multiplies any input number by four. The product appears on the VDU and is in hex.

If the reader does not have access to a computer, please don't worry. As I have said, it is not my intention to instruct on how to program and as long as the reader can see points of similarity between Table 2 and Figure 10 of Chapter 3, that is all that matters. The following notes will help to explain the program and illustrate some points of interest.

The first column of Table 2 lists the memory locations in which the instructions are stored. Note that they are in hex. The program contains one, two and three-word instructions and the memory list must take account of this, since of course only one word may be stored in each memory.

The second column lists the hex instructions. (Remember that *two* hex symbols make one word.) In the case of hex instructions that are more than one word long, the actual data stored is given after a space. Thus in the first few memories the following are stored:

Memory	Hex	Binary
0100	CE	1100 1110
0101	00	0000 0000
0102	00	0000 0000
0103	BD	1011 1101
0104	E1	1110 0001
0105	AC	1010 1100
0106	16	0001 0110

and so on.

The third column contains the mnemonic and, on the right of that, are comments for the use of the programmer and anyone who reads the program. Even the most experienced programmers use this area a lot as it helps enormously to come back to a program later. I usually make a habit of including arrows for the same reason.

The reader will understand most instructions quite readily. The BD or jump to sub-routine instructions cause the micro to jump and execute special short routines held in memory addresses E1AC and E1D1. These are provided by the manufacturer in a special dedicated chip called a Read Only Memory (ROM) for the obvious reason that the micro can read memory contents but cannot alter them by sending in new data. I shall have more to say about these devices later. The first sub-routine halts everything until an input is received from the keyboard; the second causes a printout of the contents of Accumulator A.

The BNE instruction (Branch if Not Equal) may, however, cause some furrowed brows. If we're jumping back seven instructions, why the FA? The answer lies in a clever little provision by the manufacturer of the micro. Following a Branch instruction, data from 1 to 7F is read as a FORWARD jump while from 80 to FF is read as a BACKWARD jump, counting down.

Finally, the 3F instruction is vital. Without it, the micro would read whatever else happened to be in that memory location and would execute it. The chump doesn't know when it's finished, you see. Inevitably the whole thing would 'bomb'.

For a variety of reasons I have a personal preference for machine code programming over any other computer language. I find it precise, economical, and altogether highly satisfying. I use it whenever I can. Of course other people will have their preferences, too, but I stress my own here to encourage those who may be put off by apparent difficulties and talk of programs 'bombing'. Firstly, the difficulties are more apparent than real and like most difficulties tend to disappear when one gets down to the job. Secondly, even if the program does 'bomb', nothing has been damaged. All that has happened is that the memories are loaded with rubbish — that and nothing else. One simply reloads the program.

Under the age of 11, no programming of any kind should be attempted by even the brightest children and one should not expect machine code programming to be attempted by anyone under 13 or 14, but the broad outlines can be learned by children in the middle school. That is to say, they should be aware of the hex coding of instructions and have a general idea of how these instructions are carried out by the micro.

Compilers

It very soon occurred to some bright folks that there was no reason why the computer should not be used to write programs — that is to say, treating an objective program like any other form of data to be worked on. With memory stores running into thousands, it seemed that some could be put aside to form a sort of look-up table so that the human user could input the mnemonics of Table 1 and get in return the machine code applicable. It proved to be very easy of realisation. From there it wasn't very difficult to having the computer write out the entire program in machine code from the sorted list of mnemonics provided by the user. The stumbling-block of JUMP instructions was hurdled by the simple expedient of applying a unique code word at every point *to* which a jump was made as well as *from* which a jump was made. Thus all that the program did was run through the objective program twice — the first time assembling all the hex instructions and the next time counting the length of jumps. When the program was finished it could either be printed out for use elsewhere or on another occasion, or be transferred to memory ready for immediate use.

Notice very carefully that the second (objective) program was produced as a complete program in its own right. Once it had been compiled, the original compiling program was no longer needed.

Interpreters

The essential point to grasp about an interpreter computer language is that it is working all the time. As the name

Sample Program

0100	CE 0000	LDX	Load index register with zero
0103	BD E1AC	BSR	Fetch number from keyboard, into Accumulater A
0106	16	TAB	Copy it in Accumulator B
0107	08	INX	Increment Index register by 1.
0108	1B	ADA	Add contents of B to A
0109	8C 0004	CPX	Compare Index with value 4
010C	26 FA	BNE	Branch if not equal.
010E	BD E1D1	BSR	Print out value of accumulator A
0111	3F	SWI	Stop.

Table 2

```
10 LET X = 4
20 INPUT Y
30 PRINT X * Y
40 END
```

Table 3 Sample Basic program

```
30  PRINT X * Y
10  LET X = 4
40  END
20  INPUT Y
```

Table 4 Runs exactly as program in Table 3

suggests, the interpreter stands between the machine and the human operator, constantly translating inputs and outputs from one to the other. Such a computer language is termed 'high-level' and there are many such available today. Fortran was the first on the scene, but there are also Cobol, Basic, Lisp, Pascal, Pilot and many others, some of which are applicable to one manufacturer's product only. Every language has its own vocabulary and syntax and is like learning any other language such as Latin or French. (One would be perfectly entitled to put on forms, 'Languages spoken — Computer'.)

Of all the widely-used high-level languages at the present time, Basic is the easiest to learn since it uses a number of well-understood English words and phrases such as RUN, STOP, GOTO and so on. Because of this, Basic is a firm favourite among those learning programming for the first time. Every manufacturer of home computers offers it — some in several versions, with more and more facilities on offer.

The great advantage of interpretive programs is that they relieve the human operator of the necessity to keep track of data. No longer is there any need to tell the computer to put this data in that register or take this data out of any particular memory — the program does that automatically, while the human operator can concentrate on the overall strategy. If we want two numbers multiplied, we say so. The interpreter does the rest.

It should be clear that an interpreter is a highly-specialised machine code program in which a programmer has already done all the hard work. His program decodes our English inputs into hex instructions. It is his program that keeps track of all the registers, memories and what-have-you. His program keeps notes of where everything is.

Compare Table 3 with Table 2. The two programs do exactly the same job of multiplying by four any number that is put in, and printing out the answer, but how much easier it is to understand the Basic program of Table 3! How much quicker to program it!

Before we go on to compare the two programs in a little more detail, a few notes should be made for the benefit of readers who are new to it all.

Each line in Basic must have a statement number. I have given them the numbers 10, 20, 30 etc, but they may be any numbers at all, up to 9999. When the program is run (by typing RUN, incidentally), the Basic interpreter executes the statements in numerical order. If the program of Table 4 was entered, it would be executed exactly as Table 3. The advantage is that extra statements can be inserted at any time without the necessity of retyping the whole program.

The statement LET X = 4 causes the interpreter to pick a memory location of its own choosing, load it with the value 4 (translated into binary) and label the memory 'X'. The label is stored in a special section so that whenever the program encounters the variable 'X', it goes first to the memory store to find where it has put the value it has labelled.

The same applies to the next statement, except that an INPUT statement causes the program to wait for a value to be input from the keyboard, exactly as the BD E1AC instruction of Table 2. The value is then dealt with as before.

Line 30 is self-explanatory, but notice that an asterisk is used for the multiply sign, to prevent confusion with an X. As for line 40, some versions of Basic don't even need to be told to stop. When no more instructions are available, they stop of their own accord. Other versions insist upon it and won't run until a STOP or END statement is inserted.

The operator types the program exactly as per Table 3 (or 4) and then types RUN. The result is exactly as in the previous program examples — a question-mark for a prompt and when a number is typed in, the computer prints out four times the number.

At first sight, Basic might appear to be quicker and simpler and use less memory, but this is simply not so. The very simplest Basic takes up nearly 3000 memory stores by itself, while a good working version will use 8000. The very best versions occupy no less than 16000 memory stores, but these are very sophisticated versions indeed, with some very advanced features not likely to be needed by many people, although with the plummetting cost of memory, today's luxuries become tomorrow's necessities. More and more manufacturers are offering Basic as a plug-in extra, with a subsequent saving in memory anyway. As an indication, most home computers are provided with an initial memory store of 4000-8000 and these can be easily added to.

A much more important difference between machine code and Basic is speed of operations. Basic can take up to 1000 times the operating time of machine code for the same function. The reason why is not hard to find. The complete program of Table 3 is loaded into memory almost as it is — each symbol translated into binary. While running, the Basic program must access each memory — maybe thousands — to find the next statement to be obeyed. Then it must bring out all memories pertaining to that statement, decode them, sort out the data part(s) from the instruction part(s) and go through thousands of similar operations before it can obey the instruction.

Figure 1 might help to make the situation clearer. The micro itself works in binary. The running Basic interpreter works in hex, while the user's program is superimposed on Basic and utilises English and decimal arithmetic. Every single letter, symbol and number of each instruction must be translated step by step all the way down to binary, worked on and then re-translated all the way up. The achievement is astonishing, especially when one considers that for 99 percent of the time the user is unaware of any delay whatsoever because the peripheral devices are not as fast as the interpreter.

Nevertheless, there are times when one is rudely aware of how slow the interpreter can be. The writer has more than one Basic program that is so slow that one has time to drink a cup of tea while waiting for a response. There is no doubt that if speed is required, machine code provides it. One would expect some improvement in the speed of interpreters in the future, but even without it there would always be considerable scope for Basic. For one thing, it is excellent at number work and for another, it is supreme as a learning tool.

On balance, it is my conviction that in the world of tomorrow the greatest impact will come from machine codes and their derivatives, the language of the microprocessor. The reasons for this conviction will I hope become clear later in this series.

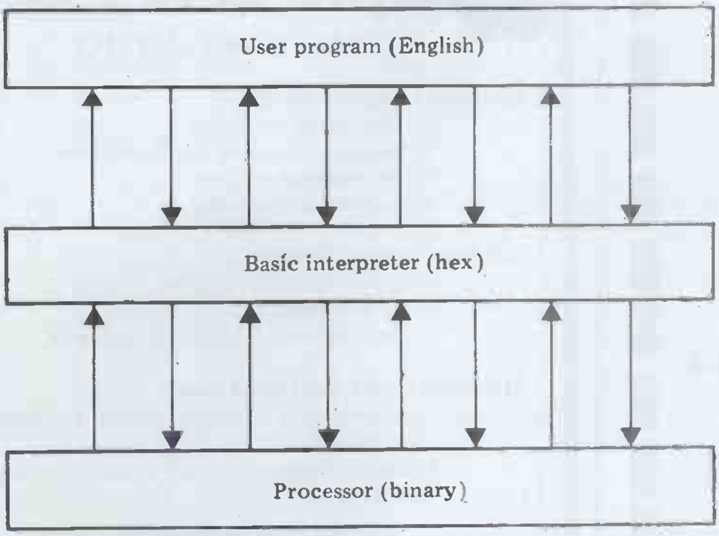
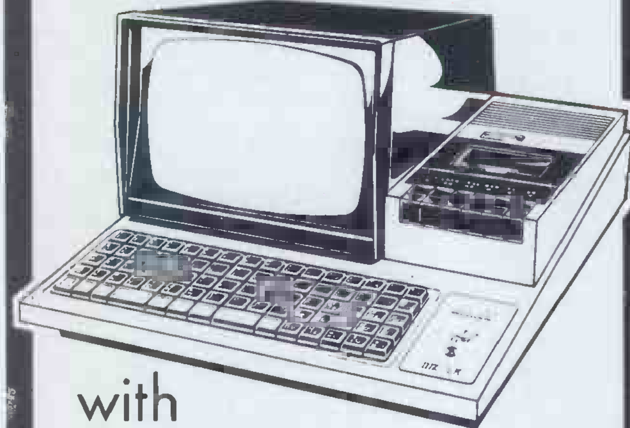


Fig 1

SHARP

MZ-80K



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YOUNG COMPUTER WORLD

Compiled by Derrick Daines

Kit comments

I was informed recently that a computer kit is 'easy — just like Airfix.' The young man expressing this view had never assembled a computer kit before, so it was really quite arrogant of him. As might be expected, he had cause to regret his rash words when his assembled computer refused to oblige with a screen prompt and he was forced to seek help.

In a way, he was right — a kit is a kit and if you follow instructions the thing should go together quite well. The trouble is that not only is there a constructional element to the task but an electronic element, too. Now, given great care, some skill and a little luck, the assembled kit should work perfectly as soon as it's switched on, so why do so many constructors need help?

I regard kit construction as a task involving the correct solution of a multitude of puzzles. Components need to be correctly identified, for example, and manufacturers of electronic components don't help with their frequently confusing markings. Then there's the need for neat soldering. Just the tiniest solder splash can prevent a computer from working, or even destroy expensive ICs. A solder splash can also provide puzzling symptoms of malfunction, sometimes intermittent, which are the worst faults to locate.

Manufacturers of kits may not thank me, but I also have to point out that assembly instructions are usually inadequate and often misleading. I cannot criticise too freely, however, because I know from experience how difficult it is to write instructions that are clear and yet concise. Then again, the writer of the instructions must start assuming knowledge on the part of the constructor, otherwise he would have to begin by telling you how to plug a soldering iron into the mains and switch on! (Even then, I suppose that someone would complain that it didn't explain what a soldering iron was and why wasn't one provided with the kit?)

Then there's that difficult-to-quantify commodity — experience. The experienced constructor will have a multitude of little dodges to help him in his task, wrinkles that no-one is going to bother to write down because, individually, they are trivial but which together are labour-saving and usually successful. They are the stuff of experience and, as tyros in a card game find out, experience doesn't come cheaply.

I told the story of my young friend to a chap even older than I and he sighed heavily. 'Ah, the arrogance of the young!' he said, shaking his head. I don't think there's much difference between arrogance and confidence — and I'm in good company: Winston Churchill once said, 'I am confident; you are arrogant; he is pig-headed.' Without the confidence to try, I am sure that many tasks would never even be attempted, let alone brought to successful conclusion. An old saying has it: 'He didn't know that it couldn't be done — so the fool just went out and did it.' He must have been young.

So — if you fancy constructing a computer kit, go right ahead. As I said, with great care, some skill and a little luck, you'll succeed. Notice, however, that I mentioned only a little luck and a lot of care. The job must be approached with respect — it is most definitely *not* 'just like an Airfix kit'!

Teachers' PET

Teachers and administrators with a PET computer will be interested in the Schools Administration System offered by the Mellor Computer Consultancy, 125 Longhurst Lane, Mellor, Stockport. Using student records as a database, the system produces lists of all kinds, standard letters, labels and figures for the DES Form 7. It also produces the analysis of exam results, option pools for the Secondary Third Year and even substitution lists for absent staff.

It looks good to me. Apparently the work was commissioned by Manchester LEA, and Mellor will be pleased to send you details or give demonstrations.

Queueing

If you have ever helped out in a shop or in any place where the public come and go, you will have noticed that you are 'run off your feet' at one time and then, suddenly, things go quiet. That's just how it is here. After the last few months, with programs and letters dropping on my mat by every post, suddenly there there's a breathless hush!

Unless I've said something to upset every youngster who reads YCW — it must simply be the fickle finger of random events. It does mean, however, that I cannot include a 'Programs Received' section this month, 'cause there ain't none! (Bang goes my chance of making a take-over bid for *PCW*!)

Like the shopkeeper scurrying to serve everyone as quickly as possible, I have made it a Golden Rule to clear my desk every month and this has meant that only the very best programs received in any month have been published. Now I find myself without a single one! So I think that for the future I'll hang on to those 'second division' programs a little longer, just in case. In fact, a sort of queue.

So, all you budding genii, we still want those programs and letters. Long programs are good; so are rehashes of old games, but short programs and new applications are better!

Helping the blind

Talking of new applications, one lady approached me at the *PCW* Show with a request for help. She is a teacher of backward children who also suffer from sight defects — tunnel vision, partial blindness and so on — and she wanted to know how the microcomputer could help. Of course, I was able to tell her about speech synthesisers and the like, but it occurs to me that somewhere in the great Out There there'll be somebody with more ideas.

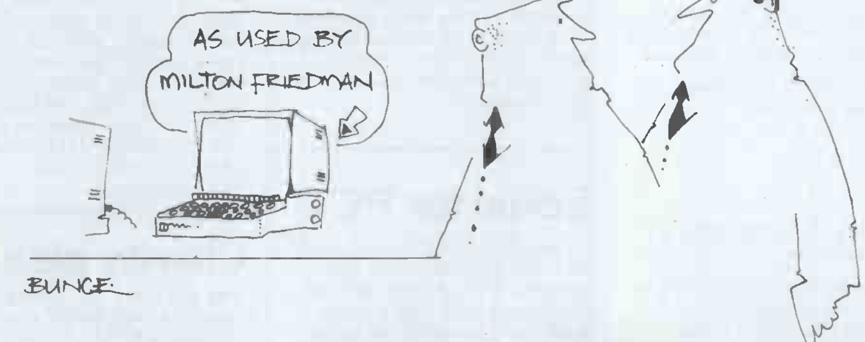
How about it? Get your thinking caps on and let us — and her — know about your bright notions. You'll be doing a lot of very unfortunate kids a lot of good. You may like to submit your suggestions to the 'Year of the Handicapped' competition — see elsewhere in this issue.

Arcade games

Another lady teacher raised a point that worries a lot of people. Is the arcade-type of computer game a 'good thing' or a 'bad thing'? She was definitely 'agin 'em,' as are (I think) most teachers. Me — I'm not so sure. I have a sneaky feeling that kids who get hooked on arcade-type games are very soon going to want to alter them and start writing their own — and then they're into programming.

The amusement arcade itself is another matter — very often unsavoury and unwashed characters hang about these places and the prices charged are, in my view, extortionate. But the game itself, on a home, club or school computer — why not? I would like your views on this matter. Do the arcade-type games do anything at all other than exercise manipulation skills?

It's a topic for a discussion that could get quite hot!



Quite honestly sir I think we'd sell more if we said, "As used by J.R."

COMPUTER ANSWERS

Send your queries to: Sheridan Williams, 35 St Julians Road, St Albans, Herts.

RML disks

I have a problem writing programs for the RML 380Z that are totally portable. How do I instruct CP/M that when I want to access disk drive C, I really mean drive C?
B Spinburg, Leominster.

I think I had better explain your question in more detai for those who are confused. CP/M accesses disk drives as A, B, C, D, etc, not 1, 2, 3, 4, etc. Research Machines chose to label its disks as follows: left drive/left side = A; left drive/right = C; right drive/left side = B; right drive drive/right = D.

The reason is to maintain compatability with all versions of its single and double-sided drives and those with either one or two drives. It could have been made more simple, in my view, by making the whole of drive one accessable as a single drive, in a similar manner to CP/M on the North Star Horizon.

I had the following answer given to me by RML who replied very promptly indeed:

'With the newer versions of our EPROM monitor, COS 3.4 and later, there is a relatively simple patch. A table at address 40 defines the characteristics of drives A to C. Thus to make all refer ences to drive B refer to drive C, you need merely make the contents of address 41 the same as address 42.

With earlier COS versions it is necessary to patch the basic I/O system (BIOS) of CP/M. CP/M should be read into memory from the system tracks of disk A using SYSGEN, then make the patch, and write out again using SYSGEN in the normal way. See patch that follows:

Patch to BIOS to change drives as follows:

Old	New
A	A
B	C
C	A
D	C

NB: RML 380Z CP/M 1.4 and 1.4B only.

1. Run SYSGEN, reading in CP/M from source drive A.
2. Enter the 380Z Front Panel with CTRL F and make the following changes. Note that "xx" will vary. Use old value from 1F9C at address 1F99.

Addr	Old	New
1E99	15	1C
1E9C	19	15
1EEA	19	15
1F95	0E	79
1F96	00	87
1F97	18	32
1F98	05	FA
1F99	79	xx
1F9A	32	C9
1F9B	FA	00
1F9C	xx	0E
1F9D	C9	00

3. Type K and carry on with SYSGEN.'

SW

Collecting garbage

Which computers besides the PET exhibit the garbage collection problem? I wish to sort 100 strings in less than one minute; is that reasonable and, if so, how? Can you recommend any single board computers?
Len Wood, Bourne End, Bucks.

The problem of garbage collection is not caused by the machine or by the language Basic but by the particular *version* of Basic. Normally garbage collection is meant to *aid* the programmer, not hinder him but the problem comes to a head when sorting. As far as I remember, all versions of Basic that I have used on different machines have this problem and your solution lies in one of the methods outlined in a previous 'Answer': compare the strings for order, but swap pointers, not the actual strings. A better solution is to buy one of the many machine code sorts available which will perform your sorting in seconds rather than minutes.

I cannot recommend any single board computers without some details of your requirements.
SW

Serial for PET

I have a PET 3032 and IEEE 488/RS232 interface for a printer. This works well at 300 baud with the printer. I wish now to work at faster baud rates, up to 9600. Can I write a machine code program using the 'user port' as an RS232 serial port? I need a program that will accept serial data at up to 9600 baud and place it somewhere in memory so that I can look at it in Basic.
Graham Smit, Warmond, The Netherlands

Although it is possible to write a routine which will make one of the data lines available on the user port act as a serial transmitter, it is not really practical for high baud rates; it is difficult to provide an accurate timing pulse because the PET has to service the keyboard, run programs, etc.

It would be better to adjust the interface to run at a higher speed. This can normally be done by changing a switch setting, or by twiddling a potentiometer inside. At high baud rates it is important that the computer knows whether the receiving device is capable of accepting data. This is normally done by providing another wire, which the terminal sets to a negative voltage when it is incapable of receiving data. If this is not provided, but the terminal is capable of sending data to the computer, then the same procedure can be carried out in software. Failing this, the data must be sent in packets which the terminal can handle. If the PET is receiving data, it will be necessary to write a machine code routine to accept the data and place it directly in memory, as Basic is not fast enough. It will be necessary to reset the Basic top of memory pointers to reserve a section of store as a character buffer. In this case the software method of handshaking would be the best.

The user port can more readily be used as a parallel port, as the timing is not so critical; in this case the eight I/O lines are used for data transfer and the two control lines are used to indicate data acknowledgement, and data available. A machine code routine to do this can allow data rates in excess of 9600 baud.
Mark Wratten

Charity plea

Let me start by saying that we are a registered charity, so money is tight. We provide industrial therapy for all Birmingham and much of the West Midlands. Our need is to provide regular surveys giving us and our clients better insight to the operation of the unit, to obtain a general view of our turnover and the success rate of our placings outside, along with current trends. We have no experience at all of computing, and no contacts whatsoever. We need a very elementary machine with the logic of a simpleton. Would the Sinclair ZX80 be of any use?
R M Heney, BITA, Birmingham

Mr Heney provided a fairly comprehensive description of the required data structure but only minimal description of what routines he requires. He is in obvious need of a systems analyst who can help them determine what he really wants. He obviously knows what he wants, but will have to be shown how to specify his requirements in detail.

All that I can say at this stage, Mr Heney, is that the ZX80 is *not* at all suitable for your purpose and that you do *not* require an elementary machine.

If anyone in the area is prepared to advise BITA, I will forward their letter. I would have thought that they should approach a local computer club as a first step, but am not convinced that they should try and get all the work done for free. Are all their requirements performed free by other trades? By asking for free program analysis they may find that they are lumbered with a very poor makeshift program which actually costs them more in extra work. Anyway, good luck to them in their search.
SW

Tuscan tips

I am looking for an inexpensive single-board computer with flexible expansion possibilities, which will permit data capture in the laboratory, as well as some analysis. Have you any views on the Transam Tuscan in this context?
A Sharp, Tayport, Fife

The Transam Tuscan is most unusual in being a single-board micro-computer designed to the new S100 standard. The important feature of S100 is that the computer is designed to take slot-in expansion card cards, all made to the same standard bus design, so that (in theory at least, and usually in practice) an S100 card from any manufacturer can be used in any S100 machine.

This obviously makes the Tuscan potentially attractive for your application — whatever I/O or processing facility you need, just plug in the right card! With so many suppliers, there's almost bound to be a source for what you need, whether it's A to D, D to A, a disk controller, extra memory, floating point arithmatic, etc. Of course, the cost can soon mount up with all those cards. . . although the Tuscan can only (!) take five extra cards at one time.

Another advantage of the Tuscan for your needs is that, being based on the Z80, it can be used with the CP/M disk operating system. This will then allow you to pick and choose your software from a wide range of sources. You can obtain a variety of different assemblers, and interpreters or compilers for many high-level languages . . . Basic, Pascal, APL, Fortran, even Micro-Cobol.

However, when comparing prices you should bear in mind that the advertised starting price of £195 is just for the basic board, and does not include such essentials as a keyboard, UHF modulator, etc. You may well prefer to attach a standard VDU with its own keyboard, rather than add these features separately.

The micro-computers which seem to have become the most used for your type of application are the PET, and the Hewlett-Packard HP85. While the PET would be not dissimilar in price to a Tuscan plus keyboard and screen, the HP85 at nearly £2000 is in another price bracket. It might also be worth looking at the type of system you could put together using Microtan 65 and Tanex, with associated racks and cards.
P L McIlmoyle

Cassette subs

Can you suggest a subroutine to provide cassette data file statements for the Nascom 2 similar to the INPUT # —1 and PRINT # —1 on the TRS-80? As well as this, a method of switching the cassette on and off under program control would be welcome bonus.
A Hetherington, Cleckheaton

Much as we would like to help, neither *PCW* nor I are philanthropic institutes, for this task is not so simple! To write, debug and validate machine code subroutines of this sort would almost certainly cost several hundred pounds at least!

Enough of the bad news. The good news is that it's already been done, in effect. As you may know, there are a number of Basic interpreters commercially available for the Nascoms. At least one of these (XTAL Basic from Crystal Electronics) has the ability to CSAVE and CLOAD data in arrays. Indeed, this same facility is available in Nascom's own 8k Basic, designed specifically for the Nascom 2. However, while this feature is available when running with the T-4 or NAS SYS monitors, it is not available with the ROM or EPROM versions of Nascom 8k Basic running with the T-2 Monitor.
P L McIlmoyle

Dates disgust

I was really disgusted at September's 'Computer Answers' in which some moron called Sheridan Williams has used *my* Gregorian to Julian algorithm without acknowledgement. It doesn't work; when implemented properly it does. It should be valid from 1/1/190 1/1/1900 to infinity not just to year 2400. You shouldn't use real arithmetic and neither should you use Basic which is not suitable for describing algorithms or any other purpose. As anyone who has used structured programming can tell you it is easy to understand several short routines than one long one. Using integer arithmetic is much faster also.
R J Baker, London

I want to answer this letter, as it gives me the opportunity to answer others who enquire whether they should go for Pascal or Basic. The above is just a precis of a very long letter from someone who felt that they had a grievance, and I have sent a detailed reply to him personally even though he didn't send an SAE and despite his abusive turn of phrase.

Each time you boil a kettle, do you credit the people who discovered how to boil it before you? The Gregorian to Julian problem is nearly as trivial, especially as I have seen 10-year-olds work out their own algorithms. The algorithm used was my own discovery. Why would anyone who wants such an algorithm require one that works outside the range 1901-2399 especially when used for business purposes? Also, why worry whether the answer takes 0.02s or 0.01s to run — it is being performed once only, therefore time and accumulation of errors are insignificant. Running cine films at 300 frames per second is quicker than 25 fps but for ordinary viewing is pointless.

I agree that Pascal is a better language but so is a Rolls-Royce compared with a Mini (or should I say Metro). The point is that you need a larger system to run Pascal than you do Basic. The magazine would not sell well if we ignored all those ZX80/Acorn Atom/PET/etc owners. ZX80 owners are usually very short of memory (sorry, their machines are!) and an algorithm such as mine is essential to reduce the amount of coding. If they were to use your program the they would have used a large chunk of their precious memory. I assume that you are the proud user of a disk-based system and perhaps have forgotten the more lowly users. I do agree that, generally, a well-structured program is easier to read, but remember that there are libraries of sub-routines that have been compiled and tested and which don't have to be decyphered before they can be used.

Finally there *is* an error in the routine, not mine but *PCW's*; the two sets of signs should read ∓ ± not ± ±.
SW

Small machines, big question

I would like to buy a computer for around £200 including VAT with the aim of eventually being able to do the following: 1, learn to program from the manual provided; 2, use floating point arithmetic and trigonometric functions; 3, play games with fast-moving graphics; 4, play the computer at chess; 5, write teaching programs, including text, for my children; 6, program in machine code; 7, use a computer-driven speaker; 8, not have to change my initial machine for a more powerful one later.

Could you comment on this list in relation to the Sinclair ZX80, the UK101, the Ohio Superboard, the Acorn Atom and any others that could be considered?

Could you also comment on the differences between the Superboard and the UK101, the difference between a single board, and a computer proper, and whether programs in Basic taken from a book of programs could be used in any machine with Basic.
I R Walker, Ilkeston

Taking your points in the same order:
1. Excellent as some manuals may be, (and leaving much to be desired, as others do), it's hard to beat a good book if you want to learn to program. Personally, I like *Illustrating Basic* by D Alcock. Ideally, go on a course, get a friend to teach you, or join the local computer club, where you'll get 'hands-on' experience;
2. The original version of ZX80 Basic provides neither floating point nor trig functions. These will be available in the future for the ZX80 and are available for all the other three machines;
3. I haven't come across chess programs for any of the machines you mention, but that's not to say that they may not be around, or become so later. I wouldn't suggest writing your own, unless you are expert in both chess and computers!
5. Yes, all four machines will let you write teaching programs, using text. You might well find yourself wanting to add extra memory if you go in for a lot of text;
6. Machine code programming is possible on all of these computers, although the ZX80 is limited to PEEK and POKE;
7. The Acorn Atom is the only one of the machines you list which has an in-built loudspeaker; interfacing the others would need some skill in electronics, at the least;
8. If you want to avoid having to change you computer by expanding it to take more memory, disks, a printer, etc, then the Acorn Atom is designed for just that. An expansion system for the Ohio Superboard and the UK101 has just been announced by Zen Computers while such facilities for the Sinclair ZX80 are still in the future;

The Superboard and the UK101 are very similar, the most obvious differences are the number of characters per line on the screen (25 for the 'standard' Superboard, 48 for the UK101), and the price. The Superboard is only available made up, and in this form is cheaper than the UK101. However, the UK101 in kit form is cheaper.

Single board computers are indeed 'computers proper'. it's just that they are rather small computers! By definition all the components are located on a single printed circuit board, and this is usually sold without a case, though cases are becoming available for many of them.

If you take programs in Basic from books or magazines, you will very often have to alter them to suit the particular 'dialect' of Basic used by your machine. This is especially true of input/output and file statements. If the programs use PEEK or POKE statements you will have to alter the addresses to match your machine's memory map.
P L McIlmoyle

POKER

David Levy peeks at poker.

For some reason which I fail to understand, poker is one of the most widely misrepresented games ever invented. Most people who do not know how to play poker consider it a game of luck, in which the person who gets dealt the best cards wins. I have even heard highly intelligent people refer to poker as a 'base, gambling game'. And there are those who associate poker with the card sharps of the 19th century Mississippi steamboats and assume that every poker player is some sort of low life. These opinions could not be further from the truth and, in my opinion, there is no less skill in poker than in chess or bridge.

The game of poker that became famous during the days of the Wild West is now known as five-card draw and is still popular. But there is another family of poker games which require even greater skill and which are much more interesting to play: these go under the generic name of stud poker. This month, I shall describe in some detail how a stud poker program might be written and next month I shall write about the older form of the game — draw poker.

Five-card stud

Briefly, each player is dealt one card face down and one card face up, and may look at his own down card. A round of betting takes place, and all those who put in the necessary amount of money on this round will stay in the game and receive a second face up card (the others drop out of the hand). After receiving the second up card, the players indulge in another round of betting and, once again, those who put in the necessary remain for a further round, while the others drop out. The third up card is followed by another round of betting, and then comes the fourth and final card up and the fourth and final round of betting. When the last round of betting is over, those remaining in the hand turn over their one down card, and the player with the best five cards wins the money. In order to determine whose cards are the best, the following ranking applies to the hands:

Straight flush: This is the best type of hand to have, and most regular poker players will only have such a hand a few times in their life. A straight flush is five cards of the same suit which are in an unbroken sequence, for example the 6 7 8 9 and 10 of hearts.

Four of a kind: As its name suggests, this type of hand has four cards of the same denomination.

Full house: Three cards of one denomination and two of another, for example three 6s and two aces.

Flush: All five cards of the same suit but not in an unbroken sequence.

Straight: All five cards in an unbroken sequence, though not all of the same suit.

Three of a kind: Three of the cards are of one denomination, the other two are not of the same denomination as each other.

Two pairs: For example two aces and two 7s — the fifth card is of no importance unless two players have the same two pairs, in which case the fifth card breaks the tie.

One pair: Aces is the highest pair, then kings, queens, and so on down to 2s.

High card: If a player has none of the above hands, then his holding is valued in accordance with the highest denomination card in his hand (ace is high) and then if two players have the same high card their second highest cards are compared and so on.

So much for the procedure and the ranking of the hands. Various betting options exist in most forms of poker, the most common ones being:

Bet: At the start of a round of betting, one player is first to speak. There are various methods for deciding who is first to speak and in stud poker it is usually the player with the highest face up cards. He has two options, he may bet or he may 'check'. If he wishes to add to the money in the pot, the player bets, by putting into the pot any amount of money that is in accordance with the house rules. We shall assume that we are playing 'pot limit', which means that the size of the bet may be anything from one unit up to the total amount of money already in the pot. So if the pot stands at £10 and we are playing in £1 units the first person to speak may, if he wishes to bet, put in any amount from £1 to £10.

Check: If the person whose turn it is to speak does not wish to bet and no-one else has put money in on that round of betting, he may say 'check', which means that he does not wish to put money in at this stage but he may decide to do so when it is next his turn. If, at any time in a round of betting, all the players check in succession, then the round of betting is over.

Call: Once someone has put some money into the pot during a round of betting, the next player must put in at least the same amount if he wishes to remain in the game. Putting in the same amount as the others is known as calling. When all the players have put money into a particular betting round, that round may only end when all of the players bar one have called — at that point everyone has put in the same amount.

Raise: Is it possible to put in more that the previous bettor and this is known as raising. If the first player puts in £1 and the second player wants to put in an extra £1, he will say something like 'your £1 raise £1', and put £2 into the pot. Once there has been a raise it is necessary for all the players after the last raiser to call the bet before the round is at an end, so that everyone will have contributed the same amount to the pot. The maximum that can be raised is the amount in the pot before the raise takes place. So if the pot stands at £1, and the player bets £1, making the pot £2, the second player can put in the £1 to meet the bet and then raise £3 (the current size of the pot).

Pass: Sometimes known as 'fold'. This is what happens when a player decides that he no longer wishes to take part in this particular hand — he turns his cards face down and relinquishes all claim to the money. Beginners often think that passing is cowardly but in fact more hands are passed by good players than by bad ones.

Some basic principles

Two essential principles should be followed in a game of stud poker. On card two and card three (ie when you have a total of two or three cards, including the down card), you should *never* put money into the pot unless your cards so far, including the down card, can beat every hand that you can see on the table. The reason for this is obvious enough — if your up cards are a 6 and an 8 of different suits, and your down card is a 2, and if your opponent is showing a 5 and a 9 of different suits, you should not be putting money into the pot because you are beaten 'on the table' and your opponent has a hidden card which may well go nicely with the others. Many beginners make the mistake of assuming, in a situation such as this one, that they have just as much chance of 'hitting a pair' (ie getting another 2, 6 or 8 on the fourth of fifth card) as their opponent and so it is almost an even money shot if they stay in the pot. But this is false accounting. Firstly, your opponent may already have a pair — his down card might be another 5 or a 9. In this case he will

INNOVATIVE

TRS-80 SOFTWARE

FROM THE PROFESSIONALS

Animate is a machine language program representing an entirely new breakthrough in the use of graphics on the TRS-80 or Video Genie microcomputers. As Walt Disney and others found to their profit some years ago, if you draw a number of separate pictures slightly different to each other, and then display them consecutively sufficiently fast, a moving picture is produced. This is precisely what Animate does. Pictures are built up as a sequence of frames, each one being as small or as large as you wish and composed using an easily used graphics cursor. The entire graphics content of a frame can be shifted in any direction so as to move objects without the need to redraw them in each new position. As each new frame is completed it is automatically stored in memory and given a number, so that it may be recalled and edited at will. The timing of the projection of each frame is definable up to a maximum of 100 seconds. When the picture is completed it may be viewed and edited as you wish. When the final picture is complete it may be stored on cassette as a SYSTEM program. Thereafter it may be loaded and accessed either by Animate or by any Basic program. Thus the same picture may be used in any number of different Basic programs, if you wish. Animate is available at present only on cassette for Level II or Genie machines of 16K and up. A disk version will be available shortly. A comprehensive manual is included.

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certainly beat you if you do not draw a pair; he may beat you even if you do draw a pair because his pair of 9s or 5s may be higher than your eventual pair; and if he does not yet have a pair and you both draw a pair, he has better chances than you because his cards at the moment are higher than yours, so it will be odds on that his pair will be higher than yours. The only way that you can win is if he does not make a pair and you do, but then your pair may be 'open' (ie both cards face up) in which case he will not put any money into the pot on card five. If you don't believe me, try it for yourself.

The second golden rule is that when betting on card four, don't put money into the pot unless you have 'equity', that is to say, unless the ratio of the money already in the pot to the money you are now putting in is no less than the odds against you having a winning hand when the last card is dealt.

A simple example will explain this principle. Suppose that you hold the 2, 3, 4 and 8 of hearts (the 2 is the down card) and that your opponent is showing the 5 of clubs, the 5 of diamonds and the 10 of spades. The pot stands at £10 and your opponent bets £10. What should you do? In order to win the hand, and to be sure that you are winning the hand, you need to hit a fifth heart to make a flush. Then, unless your opponent already has three of a kind or two pairs, and makes a full house on the last card, you must hold the winning hand. And if he does have a chance of making a full house you will see it from his fifth card, so there will be no danger of your betting too heavily on the fifth round.

Since you need to hit a heart to win and you have already seen four hearts (the ones in your hand), you know that of the 45 unseen cards remaining (the 44 in the deck and the one down card in your opponent's hand) there are nine hearts. The odds against your hitting a heart are therefore (44-9):9, or 35:9 (almost 4 to 1). But your equity, or investment odds, are only 2:1, because there is £20 currently in the pot and you must put in £10 to stay in. In making this calculation it is important to remember that the money in the pot does not belong to you in any way, even though you put some of it in there — the money belongs to the pot until someone wins it. It is also important to remember that you cannot usually count on winning any more money on the fifth round of betting, because your opponent will not be obliged to put in any more money, but there will be some occasions when it *is* reasonable to assume that your opponent will put money in the pot after the fifth card.

It is precisely because of this concept of equity that it is vital to make a good-sized bet when you are in the lead, because otherwise you are making it cheap or free for your opponent to stay in the pot, and then he may hit better cards than you do later on in which case he will 'steal' the pot. In the above situation, for example, if your opponent bets only £1 instead of £10, he is playing like a sucker. You call his £1 bet and now you have 11:1 money odds while the odds against hitting a winning card are only about 4:1. If your opponent plays like that often enough, in the hope of 'sucking you in' to the pot when you really should be out of it, he will be sorry to see his financial empire crumbling as you get better cards than him one hand out of five.

These two golden rules provide the basis for solid play in a game of five-card stud. Of course like most rules of thumb, there will be occasions when they should be broken, but it takes a good player to recognise these situations and, until you or your program is a regular winner, you should play it safe. There is one exception, and that is concerned with bluffing, about which I have written a little in the past. To play good poker it is essential to bluff occasionally, but the good player will judge when to bluff by taking careful note of his opponents' styles of play and their mannerisms. I shall write more on the subject of bluffing next month, when we will be looking at draw poker, so for our stud poker program let us assume, for the time being, that there will be no bluffing. I shall give an algorithm for programming stud poker but its parameters are subject to variation at the reader's discretion. In order to illustrate the algorithm, I shall describe one hand of stud poker in some detail and for the sake of simplicity I shall assume that the program is playing against only one opponent — you may extend the principles of the algorithm to a higher number of players and I would recommend five or six as being the right number for a personal computer program.

The algorithm in action

Our stud poker algorithm is based on a system for estimating the probability that our opponent's down card is of a certain denomination. These probabilities are adjusted in the light of information obtained from his play, or more precisely, from the way that he bets during the hand. Other factors, such as bluffing and poor play by the opponent, could also be included in such an algorithm but for the purpose of this example I shall keep things as simple as possible. The reader ought to have little difficulty in generalising from this example, to produce a routine that implements the algorithm successfully.

Let us suppose that when the cards are dealt the program receives the Ace of clubs as the down card, and the 9 of hearts as the up card. The opponent has the 8 of diamonds as his up card.
PROGRAM: (A C) 9 H
OPPONENT: (??) 8 D

Before the betting begins, we can already make certain probability estimates about our opponent's down card. We have seen one ace, one 8 and one 9, and there are 49 unseen cards at this stage in the proceedings. Of these 49 cards three are aces, three are 8s and three are 9s and there are four of every other denomination. So without any more information to go on, we can estimate the probabilities of the opponent's down card being an ace as 3/49, of its being a king as 4/49, a queen 4/49, and so on, giving us Table 1.

The program has the highest face up holding (9 is higher than 8), so it opens the betting. There is an 'ante' of £1 in the pot, so the program bets £1 and the opponent decides to call, putting in £1 to make the total amount of money in the pot £3. From the fact that our opponent called, it is reasonable to make two deductions: (a) he almost certainly has a down card which can beat a 9, otherwise he was very foolish to call the bet; (b) he may have another 8, giving him a pair of 8s but if he did have a pair of 8s he might well have raised the bet, so he is probably less likely to have another 8 than to have a 10, J, Q, K or A. (This deduction can be made into a learning mechanism, so that after playing a long session against the same opponent, the program could estimate the number of hands in which the opponent had not raised with a pair on card two.)

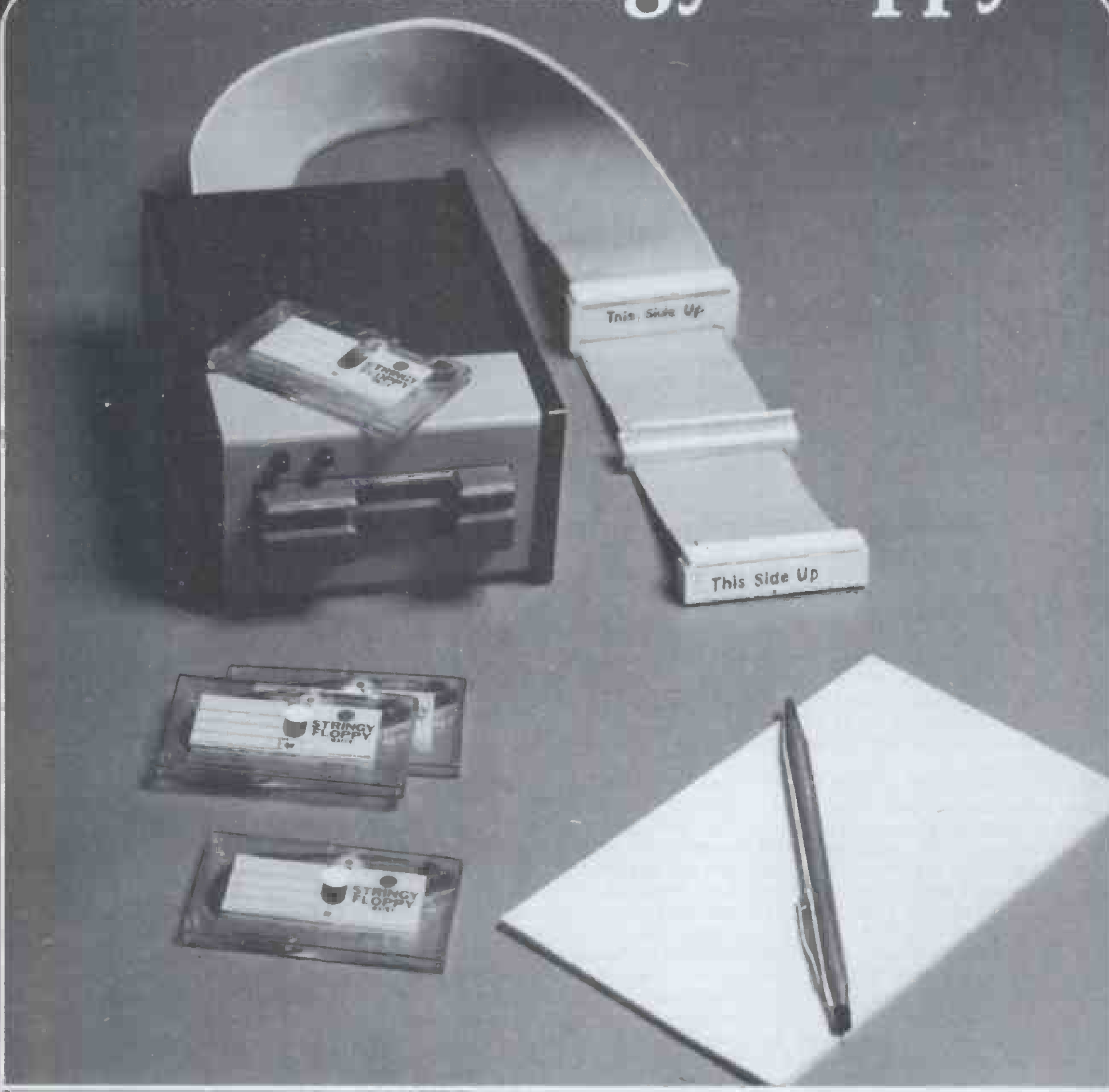
DENOMINATION	PROBABILITY
Ace	0.061
King	0.082
Queen	0.082
Jack	0.082
10	0.082
9	0.061
8	0.061
7	0.082
6	0.082
5	0.082
4	0.082
3	0.082
2	0.082

Table 1 Probabilities for opponent's down card before first round of betting (correct to three decimal places)

We must now apply some formula to adjust the old probabilities in the light of the new information received. This must be done in some way that weighs the importance of the old information relative to the new. Since the information that we had prior to the first round of betting was all *a priori* information, whereas we now have some *a postori* information, I would give the new information something like four times as much weight as the older information. Furthermore, I would suggest that we assume it to be twice as likely that the opponent's hole card was an A, K, Q, J or 10 than another 8. So from the assumptions made on the basis of the one called bet we can estimate the probabilities of the various denominations being the opponent's down card as in Table 2.

These fractions come from the fact that we wish to estimate the probability that he holds an Ace, King, Queen, Jack or 10 as being twice as much as the probability of his holding an 8, and we must have all the probabilities adding up to 1. We estimate the probabilities of his holding a 9, 7, 6, 5, 4, 3 or 2 as being zero, on the assumption that he is not playing badly, though as I mentioned before, this presumption can be varied by the program itself.

We must now combine the old and new probabilities in accordance with their weightings (new:old = 4:1), and so the new measure for the opponent holding an Ace as his down card is given by:
$(0.061 \times 1) + (0.182 \times 4) = 0.789$
The measure for the King is given by:
$(0.082 \times 1) + (0.182 \times 4) = 0.810$
The Queen, Jack and 10 have the same old estimates and the same new estimates as the King, so their revised measures are all given by:
$(0.082 \times 1) + (0.182 \times 4) = 0.810$
The measure for the 9 is given by:
$(0.061 \times 1) + (0 \times 4) = 0.061$


This Side Up
This Side Up
STRINGY FLOPPY
STRINGY FLOPPY

Ace	King	Queen	Jack	10	9	8	7	6	5	4	3	2
2/11	2/11	2/11	2/11	2/11	0	1/11	0	0	0	0	0	0

(2/11 = 0.182; 1/11 = 0.091)

Table 2

The measure for the 8 is given by:
(0.061 x 1) + (0.091 x 4) = 0.425
And the measures for the 7, 6, 5, 4, 3 and 2 are all given by:
(0.082 x 1) + (0 x 4) = 0.082

Finally, to arrive at the new probability estimates for all the denominations, we need to normalise these figures so that the total probability adds up to 1. So we sum the above measures:
0.789 + (4 x 0.810) + 0.061 + 0.425 + (6 x 0.082) = 5.007
and divide each of them by 5.007 to arrive at the new probability estimates (Table 3).

DENOMINATION	PROBABILITY
Ace	0.789/5.007 = 0.158
King	0.810/5.007 = 0.162
Queen	0.162
Jack	0.162
10	0.162
9	0.061/5.007 = 0.012
8	0.425/5.007 = 0.085
7	0.082/5.007 = 0.016
6	0.016
5	0.016
4	0.016
3	0.016
2	0.016

Table 3 Probabilities for opponent's down card after the first round of betting.

The first round of betting is now over, and the dealer gives each of the players one more card. The program receives the 7 of spades while its opponent gets the 10 of clubs, so the situation on the table now looks like this:
PROGRAM: (A C) 9 H, 7 S
OPPONENT: (??) 8 D, 10 C
and there is £3 in the pot. The opponent is now 'high', ie he has the highest cards showing on the table, since 10, 8 is better than 9, 7, and so it is the opponent to open the betting on this round. He may check, or he may bet anything from £1 to £3. Let us assume that he bets the maximum of £3.

The first thing that the program must do is to determine whether or not, on the basis of the probability estimates that it had before this £3 bet, the opponent is likely to have the winning hand and if so, by what margin of probability. In order to be winning at this stage, the opponent must hold, as his down card, an Ace, an 8 or a 10. An ace would give him A, 10, 8 against A, 9, 7, while a 10 or an 8 as the down card would give him a pair. From Table 3 the program can determine that the probability of its opponent's down card being an A, 8 or 10 is:
0.158 + 0.085 + 0.162 = 0.405
So the probability that he does not hold the winning hand is 1 — 0.405 = 0.595, and the odds against the program having the winning hand are 0.405:0.595, or 1:1.47. If the program calls the £3 bet, since the pot now stands at £6 the program will be getting 2:1 money odds, so the program definitely has enough equity to call the bet because 2:1 is better than 0.68:1. From this calculation the program may determine that it is safe to call the bet. The algorithm ought to have some randomly-based adjustment in its calculations to determine when to raise rather than call — possibly this might be a probability function whose input parameters are the actual odds against the opponent having the better hand, and some measure of how the opponent sees the situation. It is clearly better for the program, when raising the pot, to have its strength hidden in the down card if it wants the opponent to stay in the hand, while it is better to have all its strength on the table (with the 'threat' of more strength in the down card) if it is trying to bluff its opponent out of the pot.

Having made the above calculations, the program has determined that it is safe to call the £3 bet but since the odds against the opponent having the best hand at this stage are only 1.47:1, it would be a little imprudent to raise at this stage. What the odds should be is not an easy question to answer but I would recommend not raising unless the odds are at least 2:1. (In fact I would recommend an over-riding heuristic, under which the program would never raise when the opponent could have a cast iron cinch, as here, if he has another 10, the opponent knows for sure that he is winning.)

The program therefore calls the £3, making the total in the pot £9 and the dealer gives out another card to each player; this time the program gets the 6 of diamonds and its opponent the Jack of spades, so the situation on the table is now this:
PROGRAM: (A C) 9 H, 7 S, 6 D
OPPONENT: (??) 8 D, 10 C, J S
and there is £9 in the pot. The opponent is still high, since J, 10, 8 is a better holding than 9, 7, 6, but the program's hidden Ace is still an important card, because unless the opponent already has a pair or an Ace, the program is still winning. The situation has now been made even more complicated because the latest cards to be dealt give each player, in theory at least, the chance for a straight if the fifth card is exactly right. For example, if the opponent's hole card is a 9, 7 or Q, he can make a straight on card five by hitting a 7 or Q (if he holds a 9), or a 9 (if he already holds a 7 or Q).

The opponent's betting situation has improved somewhat since his highest face up card is better than the program's highest face up card, the opponent's second highest up card is better than the program's, and so is his third highest up card. So the opponent happily tosses in £9 with a smile on his face that the poor microcomputer cannot see. What should the program do now? Answer: stay calm and calculate the odds. In order to be winning at this stage, the program's opponent must hold an Ace, 8, 10 or J as his hole card. The probability of this, from Table 3, is:
0.158 + 0.085 + 0.162 + 0.162 = 0.567
This means that the program probably doesn't hold the winning hand at the moment, but the odds against it holding the winning hand are only 0.567:0.433, or 1.31:1, whereas if it calls the £9 bet it is getting 2:1 money odds, since the £9 bet has made the pot up to a total of £18. Therefore, the program should still call this bet, even though the odds indicate that at this stage it is probably not holding the best cards. So the program calls the bet, the pot stands at £27, and the fifth and final card is dealt. The program gets an Ace while its opponent gets another Jack, so the players have the following cards showing:
PROGRAM: (A C) 9 H, 7 S, 6 D, A D
OPPONENT: (??) 8 D, 10 C, J S, J H
and there is £27 in the pot. The human opponent now feels very smug, with a pair of Jacks showing, and says, 'I suppose I ought to bet something — here is £20.'

The principles apply here, just as they did on the previous rounds of betting, except for the fact that this is the final round, after which whoever has the best cards will take the money. The program calculates that to beat it the opponent must have a Jack (for three Jacks) or a 10 or 8 in the hole (for two pairs). The probability estimates indicate that the total probability of the opponent having the winning hand is:
0.162 + 0.162 + 0.085 = 0.409
therefore the odds against the program are 0.409: (1—0.409) = 0.692:1, well below the money odds, so there is every reason to call the final bet.

Refinements to the algorithm

There are various ways in which the reader might care to modify this algorithm. To begin with, there is the fact that when, for example, the opponent hit a 10 at card three, the program knew that its original, *a priori* estimate of the probabilities wasn't accurate because the 10 of clubs was actually still in the deck. At that point it could have recalculated the original *a priori* probabilities in the light of the news that the 10 of clubs and 7 of spades were still in the deck after card two and this would have the effect of making the calculations of the probability estimates more accurate from card three onwards.

Another useful idea is to modify the probabilities all the way through the hand on the basis of the opponent's betting. If the opponent shows strength (ie raises when he could call, or bets when he could check) the program could assume that it was more likely that he held a good card, and adjust the probabilities for the good cards upwards by (say) 10 percent, normalising the others as necessary. If the opponent showed weakness by checking when he might have been expected to bet, then the probabilities for the good cards could be adjusted downwards by 10 per cent.

Bluffing plays an extremely important part in poker, so it would be as well to assume that on a certain percentage of occasions the opponent will bluff, and then adjust this percentage over a

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FINITE STATE AUTOMATA

David Hebditch discusses a method of designing man-machine interactions.

A 'finite state automaton' may be formally defined as '. . . a machine that
1. recognises its current state from a narrowly-defined set of states;
2 scans input, character by character, and classifies it according to a narrowly defined set of classes;
3 takes an action and alters its state, based upon the current state and the class of the current input character, (see reference).

Finite state automata (FSA) are extremely useful devices for the formal specification of free-format input messages and to date, they have mostly been employed in language processors. A simple and consistent extension can be employed to convert the specification into a computer program. Where free-format input is not being used, FSAs can be employed to specify the checking to be carried out on 'complex' input fields such as dates, self-checking numbers, structured codes and so on.

A particular benefit of the technique is the ease with which programs may be subsequently modified to incorporate changes in the input format. Furthermore, the technique imposes a standard structure on such programs which further aids their maintainability.

FSAs are defined using circles for *states* and arrows for the *transitions* between them. An example is shown in Figure 1.

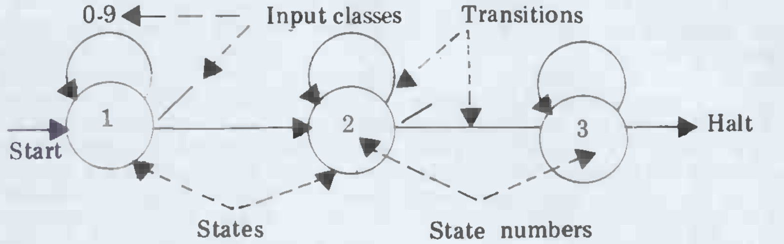

Fig 1

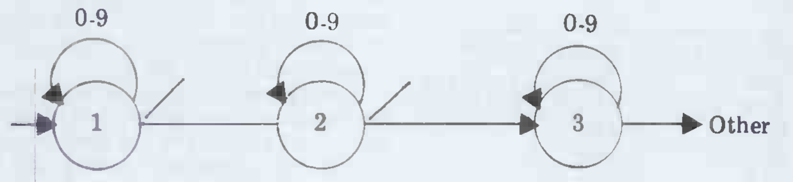

Fig 2

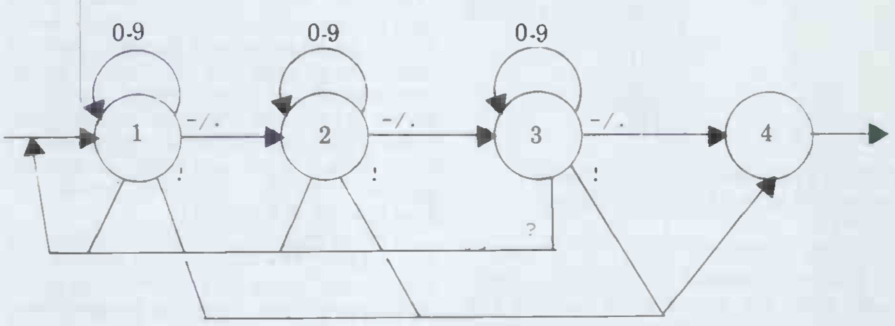

Fig 3

Figure 2 shows a simplified state diagram for the input of a date in the format DD/MM/YY (eg 16/6/80).

States are usually numbered sequentially and in Figure 2, State 1 is concerned with 'days' and scans the input, character-by-character, accumulating a numeric item. Slash (/) causes the FSA to move to State 2, which scans the 'month' and the FSA stays in this state while it continues to receive characters 0 through 9. Slash (/) causes a transition to State 3, which accepts numeric characters for the 'year' until any other character causes the FSA to terminate.

Any state diagram may be rewritten in the form of a matrix. This is done by showing the *states* as columns, *input classes* as rows and the *transitions* as 'next state' entries in the matrix itself. There are three states (1, 2 and 3) and '0' can be used to indicate an exit from the automaton. The three input classes are 0-9, '/' and 'other'. So the state matrix for our simple date routine is as below:

Input classes \ States	1	2	3
0-9	1	2	3
/	2	3	0
other	0	0	0

Interpretation is simple; if the FSA is in State 1 and a '3' is entered then the automaton remains in State 2. If a '/' is entered while in State 2, a transition takes place to State 3.

Of course, this routine is over-simplified. The state diagram shown in Figure 3 is more comprehensive. Try to interpret it before reading further.

A number of 'improvements' have been made. These are:
1 Hyphen (-) and point (.) are now acceptable alternatives to slash (/) as delimiters.
2 If at any time the user presses '?' the input so far is cancelled and he can start the date again.
3 Similarly, if the user presses '!' the FSA goes to the 'end' routine. This enables the program to complete the date from the contents of the last date entered. For example, if the user types the date 16-6-80 and subsequently enters 18! the program will transform this to 18-6-80.

Using '!' alone will 'Dupe' the whole date.

Translating Figure 3 into a state matrix produces:

Input classes \ States	1	2	3
0-9	1	2	3
-/.	2	3	4
? (or other)	0	0	0
!	4	4	4

The matrix shows how the entry of any other character causes the date to reset. If this is not the desired approach 'other' characters could be included in a different class (eg 0-9).

The *state matrix* merely indicates the logical flow of the Finite State Automaton. No actual processing is taking place. To define the checking and manipulations of the input we make use of an *action matrix*.

Note: Actions always take place before *transitions*. The actions which may be required in our date example will include:
— concatenating one numeric digit with the previous one;
— storing a complete input number as a 'day';
— storing an input number as a 'month';
— storing an input number as a 'year';
— checking the complete date.

The action matrix for the date example is shown below, along with a list of the actions to be taken. (It is assumed that initialisation has taken place).

Input classes \ States	1	2	3
0-9	A	A	A
-/.	B	C	D
? (other)	E	E	E
!	F	F	F

Actions:

A Concatenate digit
eg N = N * 10+ digit
B Store number as 'day'
eg D = N : N = O
C Store number as 'month'
eg M = N : N = O
D Store number as 'year'
eg Y = N : N = O
E Reset all items
eg N = O : D = O : M = O : Y = O
F Duplicate as necessary
eg IF D = O THEN D = OD
IF M = O THEN M = OM
IF Y = O THEN Y = OY
Check for errors (see below).
If no errors save date eg OD = D: OM = M : OY = Y
Exit date routine.

For the time being, the error checking has been omitted.

Clearly, it is not practical to continue to treat the logical structure of the FSA and the associated processing separately. Combining the state-flow and action together makes the processing of the FSA much clearer. Given that the action must always take place before the state-transition makes the merging of the matrices simple. A combined matrix for the date routine is shown below:

Input classes \ States	1		2		3	
	A	NS	A	NS	A	NS
0-9	A	1	A	2	A	3
-/.	B	2	C	3	D	4
? (other)	E	0	E	0	E	0
!	F	4	F	4	F	4

A = Action
NS = Next State

Error handling

The same matrix concept may be employed to specify the occurrence of error conditions in an FSA. The type of error which may occur includes:
— day number not in the range 1 through 31;
— day number too large for month eg > 28, > 29 or > 30;
— month number not in the range 1 through 12.

Some conditions (eg input character not in an acceptable class) may be handled in the state matrix (eg by returning to the beginning of the input sequence).

A possible error matrix for our date routine may be as below:

Input classes \ States	1	2	3
0-9	0	0	0
-/.	1	2-3	4
? (other)	0	0	0
!	5	5	5

Errors:
0 No error message but Action
1 Day < 1 or > 31
2 Month < or > 12
3 Day > 28, > 29 or > 30 for certain months:
eg
D> 28 and M = 2
AND Y MOD 4 ≠ 0
D > 29 and M = 2
AND Y MOD 4 = 0
D > 30 and
(M = 4 or M = 6 or M = 9 or M = 11)
4 LEN (Y) > 2 AND NOT END-OF-STRING
5 NO PREVIOUS DATE ENTERED (ie OD = 0 or OM = 0 OR OY = 0) but Action F exits date routine.

The error handling can be further incorporated with the earlier combined matrix as follows:

Input classes \ States	1			2			3		
	A	NS	E	A	NS	E	A	NS	E
0-9	A	1	0	A	2	0	A	3	0
-/.	B	2	1	C	3	2-3	D	4	4
? (other)	E	0	0	E	0	0	E	0	0
! (end)	F	4	5	F	4	5	F	4	5

The number of states, input classes, actions, conditions and errors will obviously vary according to the complexity of the item being processed.

The programming of finite state automata is relatively easy and can be performed in high level languages so long as they support the following functions:
— two-dimensional matrices and
— ON . . . GO TO . . . or
ON . . . GOSUB . . . or
PERFORM . . . DEPENDING ON . . . functions.

The following example shows how the date processing routine can be programmed in MBASIC.

This material is based on a paper presented by T A Dimock of Cornell University at a conference 'Pragmatic Programming and Sensible Software' held in London in 1978.

```
1000 REM    *** DATE CHECKING SUBROUTINE ***
1010 REM        (C)1980 DAVID BROUTCH.
1020 REM
1030 REM ***************************************
1040 REM
1050 REM DEMONSTRATES THE USE OF...
1060 REM ...FINITE STATE AUTOMATA
1070 REM    ---- ------------- -- IN THE CHECKING
1080 REM OF FREE-FORMAT ITEMS OR MESSAGES FROM
1090 REM INTERACTIVE DIALOGUES.
1100 REM
1110 REM ***************************************
1120 REM
1130 REM   USE OF VARIABLES AND VARIABLE-NAMES.
1140 REM   ----------------------------------
1150 REM
1160 REM DT$:    Contains the input date.
1170 REM RT:     Contains the return code.
1180 REM         RT=0 - No error.
1190 REM         RT=1 - Error found (message in E$).
1200 REM E$:     Contains the error message.
1210 REM D$:     Contains the day.
1220 REM M$:     Contains the month.
1230 REM Y$:     Contains the year.
1240 REM MA:     Contains the master array
1250 REM          - four states by
1260 REM          - four input classes by
1270 REM          - action / next state entry.
1290 REM PD$:    Contains previous day.
1300 REM PM$:    Contains previous month.
1310 REM PY$:    Contains previous year.
1320 REM N$:     Contains current number (as string).
1330 REM N:      Contains current number (as value).
1340 REM C$:     Contains current character.
1350 REM
1352   IF NW=1 THEN 2000 : REM ROUTINE ALREADY SET UP
1354 NW=1                 : REM NO SET UP NEXT TIME
1356 REM
1360 REM ***************************************
1370 REM
1380 REM  DIMENSION ARRAY AND SET UP VARIABLES
1390 REM  ----------------------------------
1400 REM
1410 RT=0    :REM Return code for no error
1420 PD$="XX" :REM Previous day.
1430 PM$="XX" :REM Previous month.
1440 PY$="XX" :REM Previous year.
1450 REM
1460 OPTION BASE 1:REM Set first array element number to one.
1470 REM
1480 DIM MA(4,4,2) : REM master array; format is
1485 REM
1490 REM                   MA(STATE,CLASS,ACTION-NEXT)
1500 REM                   --------------------------
1510 REM
1520 REM  The next routine sets up the master array.
1530 REM
1540 FOR STATE=1 TO 3
1550   FOR CLASS=1 TO 4
1560     FOR ACTION.NEXT=1 TO 2
1570       READ MA(STATE,CLASS,ACTION.NEXT)
1580     NEXT ACTION.NEXT
1590   NEXT CLASS
1600 NEXT STATE
1610 REM
1620 GOTO 1690   :' GO PAST THE DATA STATEMENTS.
1630 REM
1640 REM DATA STATEMENTS FOR THE MASTER ARRAY
1650 DATA 1,1,2,2,5,0,6,4 :REM STATE 1, CLASSES 1-4
1660 DATA 1,2,3,3,5,0,6,4 :REM STATE 2, CLASSES 1-4
1670 DATA 1,3,4,4,5,0,6,4 :REM STATE 3, CLASSES 1-4
1680 REM
1690 REM SET UP INPUT CLASS STRINGS.
1700 REM
1710 DIM INCLASS$(4)
1720 REM
1730 INCLASS$(1)="0123456789"   :REM INPUT CLASS 1
1740 INCLASS$(2)="-/."          :REM INPUT CLASS 2
1750 INCLASS$(3)="?"            :REM INPUT CLASS 3 (+OTHER)
1760 INCLASS$(4)="!"            :REM INPUT CLASS 4 (+END)
1770 REM
1780 GOTO 2000 : REM GOTO START ROUTINE
2000 REM ***************************************
2010 REM
2020 REM MAIN ROUTINE TO PROCESS DATE USING FSA.
2030 REM ----------------------------------
2040 REM
2050 STATE=1    :REM Start with STATE ONE.
```

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PRINTERFACING

Peter Faff continues his series on low-cost printers and how to connect them to your micro.

This month I will continue by looking at examples of matrix printers that are readily available. Each month I will try to give examples of printers that use all three technologies to give you as much choice as possible. Each article will contain a description of the mechanical operation of the printer, details of the printer timing signals and ways in which the printer could be interfaced to a control circuit or micro.

These articles are intended to be used as design guidelines by persons with a reasonable amount of knowledge of, and experience with, digital circuitry. Beginners will find that full constructional projects for working matrix printer units have been published in the well-known electronic hobby magazines over the last few years.

TI Thermal printers

Texas Instruments manufactures two types of thermal printer mecahnism — the EPN 9112 12-character printer and the EPN 9120 20-character printer. Both are available from Marshalls and cost approximately £38.00 and £52.00 respectively. The mechanical construction of both units is similar and very simple. The paper feed is carried out by a large-diameter rubber roller which is driven via a gear chain by a stepping motor. The ceramic print head is clipped into a holder and is held against the roller by spring pressure. The print head itself consists of a parallel array of heating elements which are multiplexed into groups of five — see Figure 1, which also shows the electrical connections to the printers. The print heads are fabricated on a ceramic substrate using beam-lead technology. Each element has a diode connected in series to eliminate problems when the elements are multiplexed. The elements should run from a supply of about 14 V and they require a pulse width of about 10 ms; the peak current drawn by a cold element is about 200-300 mA, falling to 50-100 mA as it warms up. Figure 2 shows a suggested drive circuit that can be used with both units. The five-element connections should be taken to 14 V to heat an element, and at the same time a digit connection should be grounded to enable a particular digit. To use the minimum amount of power, the elements should be enabled one at a time while the digits are strobed sequentially, although if a faster print rate is required then a number of digits could be grounded while a particular element is energised; this way several dots can be printed at the same time, at the cost of increased power consumption. The connection to the EPN 9112 is by a flexible 18-way printed circuit connector while the EPN 9120 uses a 25-way wire connector (see Figure 3). In both cases, the motor requires a supply of approx 17 V; the two windings should be energised in turn to rotate the motor by one step and a circuit to achieve this is given in Figure 4.

The Texas Instruments thermal printers are reasonably simple to use. For an interface and control circuit, the basic units required are as follows: (i) a RAM array to hold one line of character data, ie, 12 or 20 6-bit words; (ii) a character generator ROM that outputs data in 5-bit rows. This ROM should allow the data for one character to be output row by row; (iii) element drive, digit select and drive and motor control circuits, and, finally; (iv) hard-wired control logic or a suitable program to control all the above units. Figure 5 is a block diagram of a suggested system.

Figure 5 shows a 5 x 7 character cell; a typical ROM will contain 64 such character cells which can be selected by a 6-bit address bus while a further 3-bit address line allows the user to select one of seven rows of five bits. The line of data to be printed is stored in the RAM array. When printing starts, the control logic uses a 3-4 bit address line to select the digit to be printed, the RAM outputs the 6-bit digit data to the character generator ROM and at the same time the control logic selects the first row to be printed. When the row has been printed, the control logic selects the next digit and the data for the next character is fed to the ROM. This is repeated for 12 or 20 digits. After a full line of 5-bit rows has been printed, the control logic selects the next row stored in the character generator and again steps through the 12/20 digits. After seven rows have been printed the cycle is completed and a new line of data can be entered into the RAM. After each full row of dots has been printed, the motor should be incremented by one step; in this way a line of characters is printed sequentially in groups of five dots. If you do not like the idea of building a circuit to do all this then you can, of course, write a suitable program but you will still require a character generator ROM and the interface circuits to drive the printer.

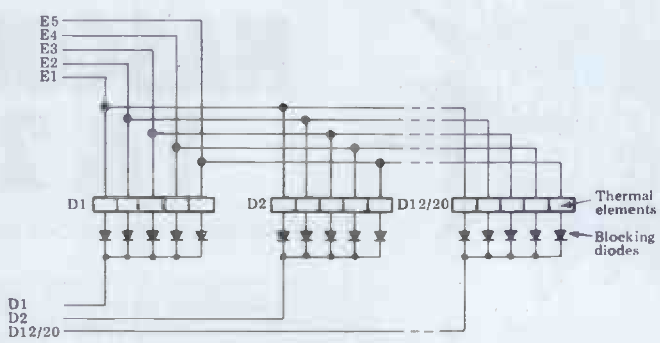

Fig 1 Electrical configuration of EPN 9112 and EPN 9120 print heads.

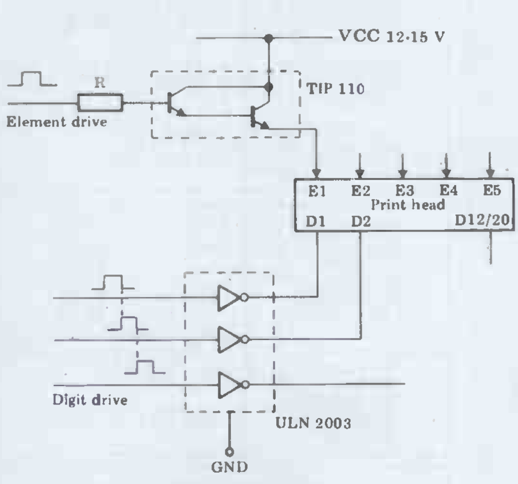

Fig 2 Suggested drive circuit.

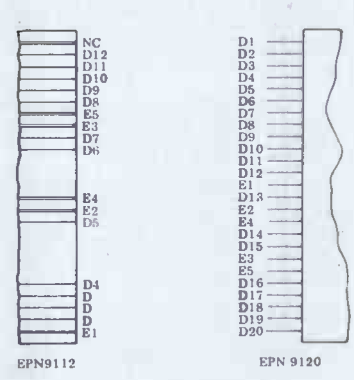

Fig 3 Connections to EPN printers.

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Olivetti series-parallel thermal printers

This is probably the most common thermal printer in existence. It can be found in various guises in the majority of thermal printing calculators, and is also available as a new unit, type PE 1800, from Datac Ltd for approx £38. To save wear and tear on my typing finger I will refer to the Olivetti series — parallel printer as the OSPP from now on.

The OSPP is a compact 20-column matrix printer that is mechanically very simple and reliable. The character field is divided up into 20 columns of five dots each by an internal timing disc and so the unit is not suitable for continuous graphics. The print head comprises ten thermal elements and each element prints two characters — see Figure 7.

As you can see from Figure 7, each element covers two characters and during each print cycle a total of 100 dots can be printed by each element. A print cycle starts and finishes with the print head at the extreme right of its travel. This point is indicated by the timing signal STLN. When the motor is operated, a cam causes the print head to oscillate across the paper. The print head begins to move from right to left and the strobe disc generates dot timing signals DT1 and DT2 which can be simply connected together. After ten DT signals have been produced, the mechanism causes the paper to space up by one dot line and the print head reverses direction to move from left to right generating a further ten DT signals. After these ten DT signals, the print head is back in the start position and another STLN signal is generated. The cycle can be continued as above to cover another two dot lines until the next STLN signal. After five STLN signals, a complete field of 100 dots will have been covered and the print cycle should be stopped by turning off the motor.

The timing signals are generated by a rotating disc and wiping contact arrangement within the printer and Figure 8 gives the full relationship between the DT1, DT2 and STLN signals and the dots that go to form a character. When the motor is running at the correct voltage the pulse widths should be approximately as shown.

From Figure 8 it can be seen that the two dot signal lines DT1 and DT2 carry alternate pulses. These pulses indicate when the print element is in the correct position to print a dot. In practice, the DT1 and DT2 signals should be connected together to give a pulse train that consists of discrete groups of five pulses. This pulse train should be debounced by a monostable with a pulse-width of approx 1.5 ms; the resultant signal can then be fed to the control logic to determine the sequence that dots should be printed to build up a character. It can also be used to enable the high current drivers for the individual heating elements.

The signal STLN occurs after every 20 DT signals and indicates that the print head is in the home position. STLN should be debounced by a 2 ms monostable and the resulant signal is used by the control logic to stop the printer at the correct point in the print cycle. From Figure 8 you will see that it takes 100 ms to print two dot lines and it will thus take approx half a second to print an entire line of characters and line space ready for the next line of print.

The printer comes with a 17-way flexible PCB connector. Figure 9 shows how this is wired. The OSPP comes in several versions, with or without a paper release lever. The mounting arrangements (feet) can differ and there are several motor voltages but this should cause little trouble since the important characteristics are all the same.

The supply rail for the elements is approx 20 V and to heat an element it must be connected to ground; a current limiting resistor of approx 47 ohms should be used in series with each element and the drive signal should be gated by the DT1 + DT2 signal to give a current pulse of about 1.5 ms. To get a good print it may be necessary to alter the values of the current limiting resistors. The drivers could be darlingtons or VMOS FETs — the choice is left to you.

The motor will operate from a supply of about 6 V and the motor control circuit should contain an electronic braking circuit to ensure that the printer inertia does not cause the motor to coast on past its home position. The easiest way to brake the motor is to short the two terminals together when the supply is removed; this allows the motor's back emf to bring the motor to a swift halt. Again the finer details of the circuit are left

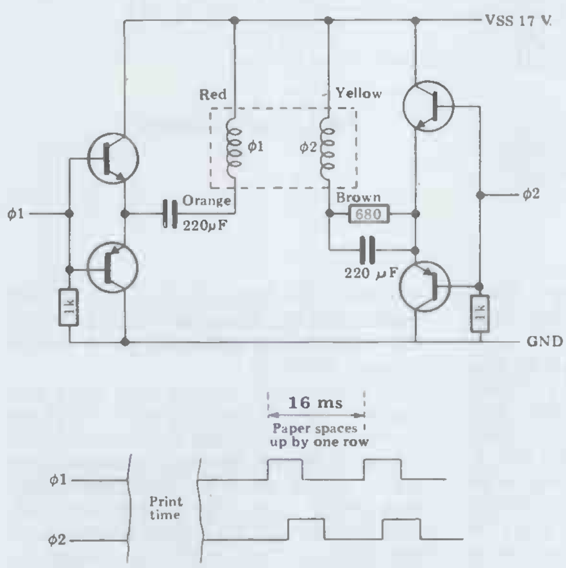


Fig 4 Suggested drive circuit and timing for stepping motor.

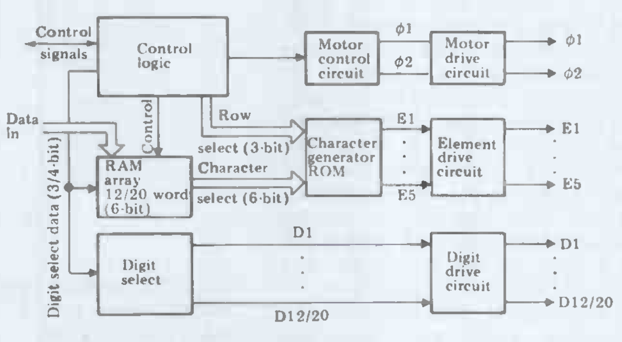
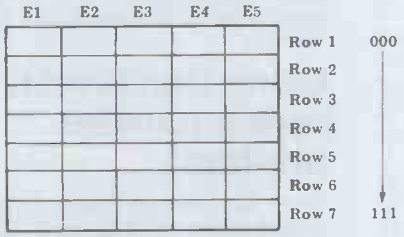
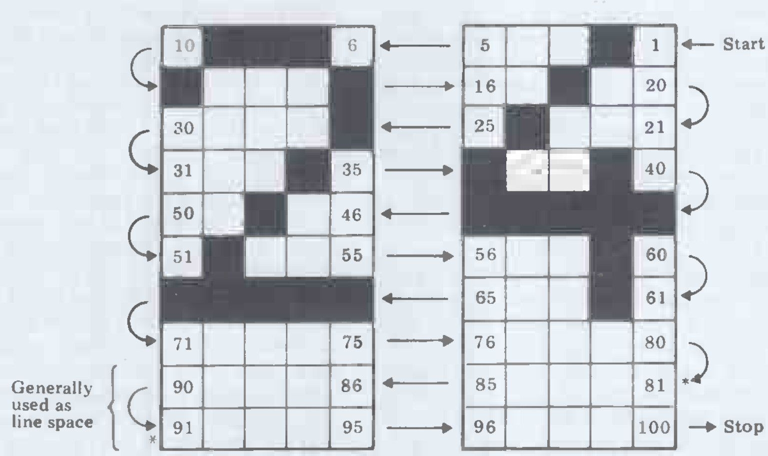


Fig 5 Block diagram of suggested control circuit for TI thermal printer units.



Character block 000000 → 111111

Fig 6



* Paper feed at these points

Fig 7 Print area covered by each print element.

to the constructor.

The element drivers and the motor control circuits are quite straightforward but the difficult bit is the rest of the control logic that decides when to print a dot to build up each character. To keep the control logic simple you should let your micro do most of the hard work of selecting which dot to print. To print a line of characters it is necessary to turn on or off each of the ten element drivers in sequence. Referring to Figure 7, you can see that one element prints two characters. The characters are printed line by line alternately and the direction of motion reverses after each line; somehow you must generate a serial bit stream corresponding to the numbered dots in Figure 3. Since there are ten elements, the process must be repeated ten times during an interval of approx 3 ms between DT signals. The element drivers should be controlled by a 10-bit latch. The control logic must set or reset each bit in turn, depending on whether or not a dot is to be printed. The outputs of the latch are enabled by the DT1+DT2 signal to print the dots at the same time.

This impact printer mechanism is very similar to the Olivetti thermal printer mentioned earlier. It is a compact 20-column matrix printer and again it is available new (as type PU 1100) from Datac Ltd for approx £59 or it can probably be found living in an Olivetti printing calculator (Logus series). Mechanically, the unit bears little resemblance to its thermal brother but the print is built up in the same way and the timing signals are similar. Since this is an impact printer it generates a certain amount of noise but this is only a minor problem. With two-ply carbonless paper this printer can produce one copy, and ribbons for the printer are available from many shops. The printer mechanism is quite complex but provided it is treated with respect it should give years of trouble-free service. It is a good idea to blow paper dust out of the printer after using a few rolls of paper and putting a drop or two of oil on the rotating parts will not do any harm.

The printing is achieved by ten metal needles which rest in guides under a removable cover. Each needle is coupled to an anchor that moves backwards and forwards, and is held against spring pressure to a magnetised metal bobbin; when the coil wound on a bobbin is energised, the magnetic attraction is neutralised and the spring causes the anchor to move forwards. This motion is transmitted to the print needle which also moves forward and hits the ribbon and paper, thus producing a dot. Later in the cycle, a rotating eccentric shaft pushes the anchor back onto the bobbin where it is again held by the magnetic attraction. The needles are moved across the paper by a perforated guide which sits in a cam. The paper feed and line spacing is also determined by this cam and cannot be altered and the timing signals are again generated by a rotating disc and spring wiping contact. The needles build up characters in a similar way to the thermal printer; Figure 10 shows the dots within two character cells that each needle covers.

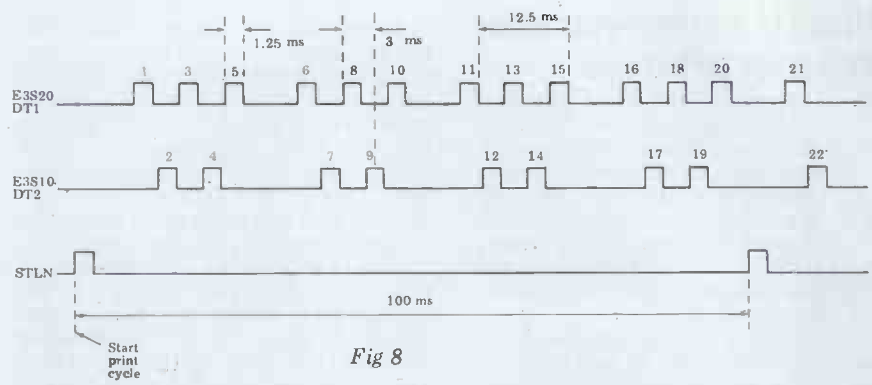


Fig 8

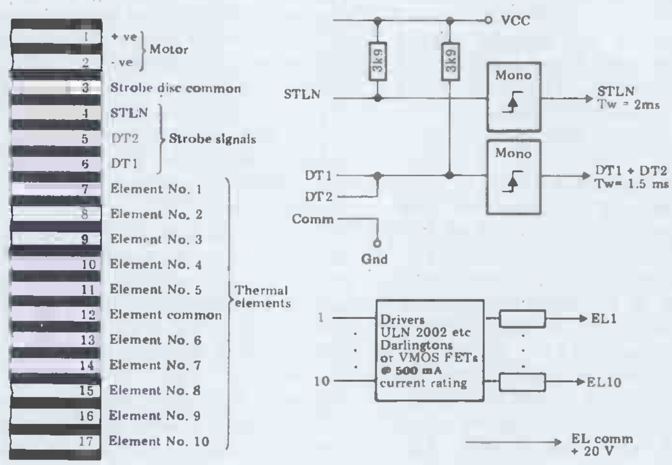


Fig 9

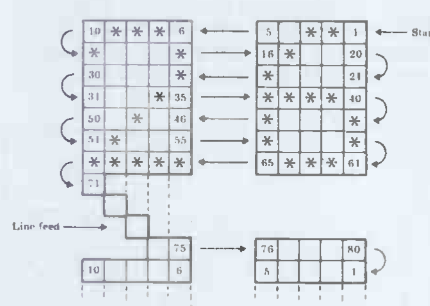


Fig 10

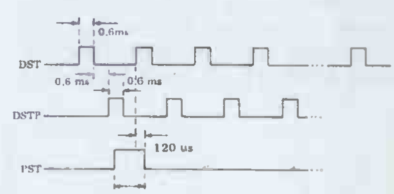


Fig 11 Timing signals

With this printer you must use a 5 x 7 matrix since this is defined by the main control cam.

The timing signals generated by this printer are shown in Figure 11. There are three timing signals: DST and DSTP are generated 20 times for each rotation of the control cam and PST is generated once every four cam rotations. DST indicates to the control logic that it can energise the coils to print a dot, and DSTP that follows is the signal to turn off the current through the coils. When the signal PST overlaps with signal DST then the printer is in the correct position to begin printing. The print cycle should be stopped after 80 DSTP signals have been received and an electronic brake in the motor control circuit is required to prevent the motor from coasting on past the stop position. The coils require a supply of approximately 38 V and suitable drivers would be VLN 2003/2 darlington arrays. The motor supply is nominally 18 V but this may need to be adjusted to obtain a printing speed of 1.7 lines per second.

Figure 12 shows how the two sockets attached to the printer are connected up; these are on a standard 0.1in pitch and matching plugs should be easy to find.

The circuitry required to work this printer would be similar to that required for the thermal version. A 10-bit latch would be used to control the state of the ten coils, the signals DST and DSTP turn the coils on and off, and the signal DSTP must also be used by the control logic to determine which particular dot out of two 5 x 7 arrays is to be printed. This processing must be carried out for each of the ten print needles and will need to be carried out in the space of a few milliseconds.

Using the Olivetti series parallel printers

Since the two Olivetti printers mentioned earlier are both very similar you will find that the same circuitry can be used with only a little modification to operate both units. Before you start

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work it is a good idea to experiment with the printer so that you become familiar with its operation. Try to design a simple circuit that will make the printer print a solid five by seven array and then stop. This circuit can later be incorporated in the control logic.

As mentioned previously, each printer has ten printing elements which must be energised in parallel. The best way to achieve this is to use a 10-bit latch so that you can load the state of each element into the latch as it is determined by the control logic. When all ten bits have been loaded, a separate input can be used to enable all the outputs when the next dot-print signal is received.

Since each print element covers two character fields you will need to determine which character the element is over at any one time. You will also need to keep track of which row is being printed and also which particular dot in that row is being printed. All this can be done with an arrangement of counters and logic or a suitable program by using the timing signals that are generated. After a dot signal has been received you should be able to determine which particular dot in the character field is to be printed.

At the start of the print cycle all the counters should be reset. To find the row number you should use a counter that is incremented after every ten dot signals. An up/down programmable counter that counts from one to five will give you the dot number with the aid of a bit of extra logic to control the resetting and the count direction of the counter. From START, the count sequence will be: START -5-4-3-2-1-5-4-3-2-1-1-2-3-4-5-1-2-3-4-5- (repeat from START). To determine which character (left or right) is being printed is a little more difficult but again a counter and some simple logic should suffice.

A 20-character memory is required to store the line to be printed and a 6- or 7-bit RAM should do for this. The micro will load the line to be printed into this RAM and the control logic will read this data out as the print cycle progresses. The next major stage is the character generator; this will probably be a ROM and it must output data in groups of five bits that correspond to the slices down a 5 x 7 character cell.

A six-bit address from the line storage RAM is used to select the particular character 'page' in the ROM and a 3-bit address from the row counter will select the correct row out of the seven in each 'page'; a further circuit, controlled by the dot counter will then select the correct bit out of the five that appear at the ROM outputs. Finally this bit must be loaded into the 10-bit latch in the correct position for the digit to be printed.

Before anything can be printed, a digit counter must cycle through ten

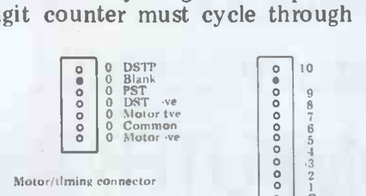

Fig 12.

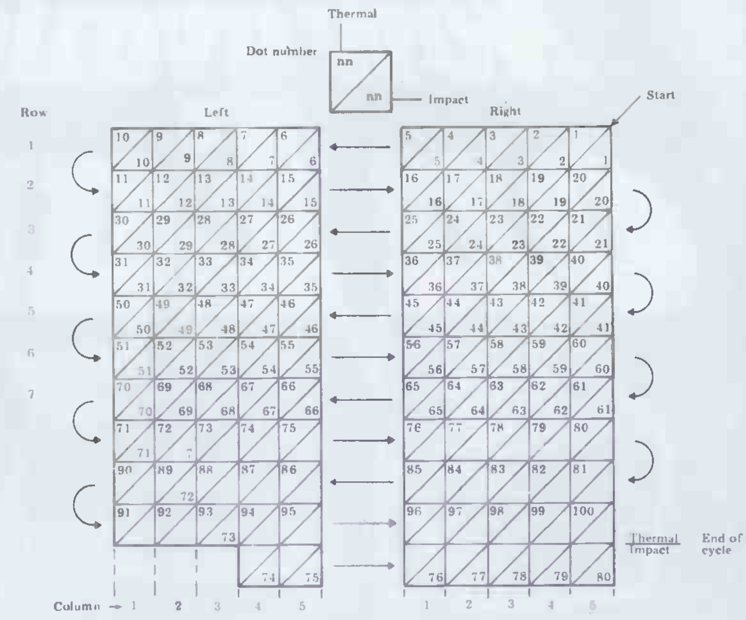

Fig 13 Character cells covered by print element.

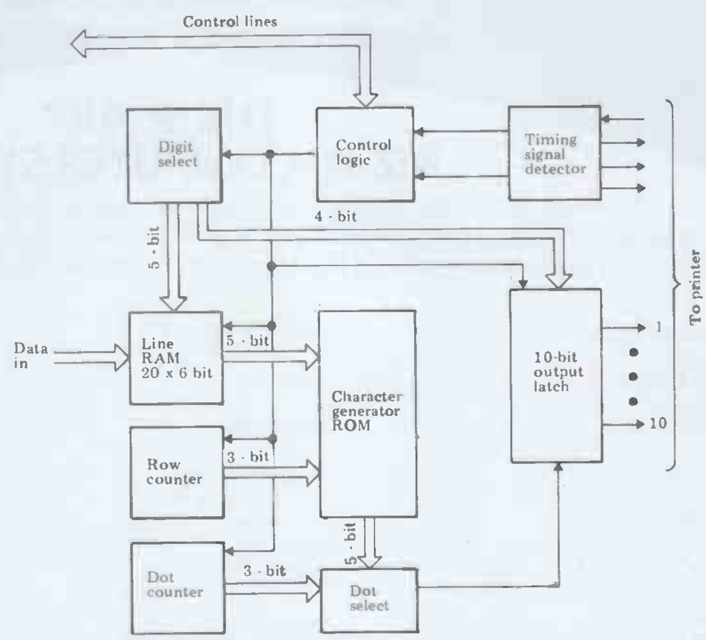

Fig 14 Block diagram of suggested control system.

of the 20 digits stored in the line RAM. Every alternate character should be read out to the character generator and a single bit will be loaded into the 10-bit latch as outlined above. This is repeated until each bit in the latch has been filled and a line of dots can be printed.

It is now only necessary to design a suitable control circuit that ensures that the operations explained above are carried out in the correct sequence to produce a coherent line of print. Figure 13 shows how the individual dots in the character field are numbered for both printers. It also shows the row and column numbers and the direction of movement of the print element. Figure 14 shows a block diagram of the system outlined above but please bear in mind that this is given only as a guide and you will have to take your brain out of neutral while you design this system. Depending on how ambitious you feel, you might end up with a system that is self-contained and only needs to be loaded with 20 characters and told to print, or you could reduce the hardware down to the basic interface circuits needed and concentrate your attentions on developing a program that will carry out all the processing. This latter approach is probably cheaper but since I am a hardware freak I will leave the software approach alone.

Olympia NMP 20 printer mechanism

The Olympia is a low cost 20-column printer that uses metallised paper. The unit is very compact and comes with a hinged lid that also serves as a paper roll holder. You might be able to get hold of a secondhand Olympia CPM12 or CPM12/1 calculator within which you should find an NMP20 mechanism lurking. If you use a calculator unit you will have to remove the interface board and add the missing components to be able to use the full 20-column width; this should be fairly

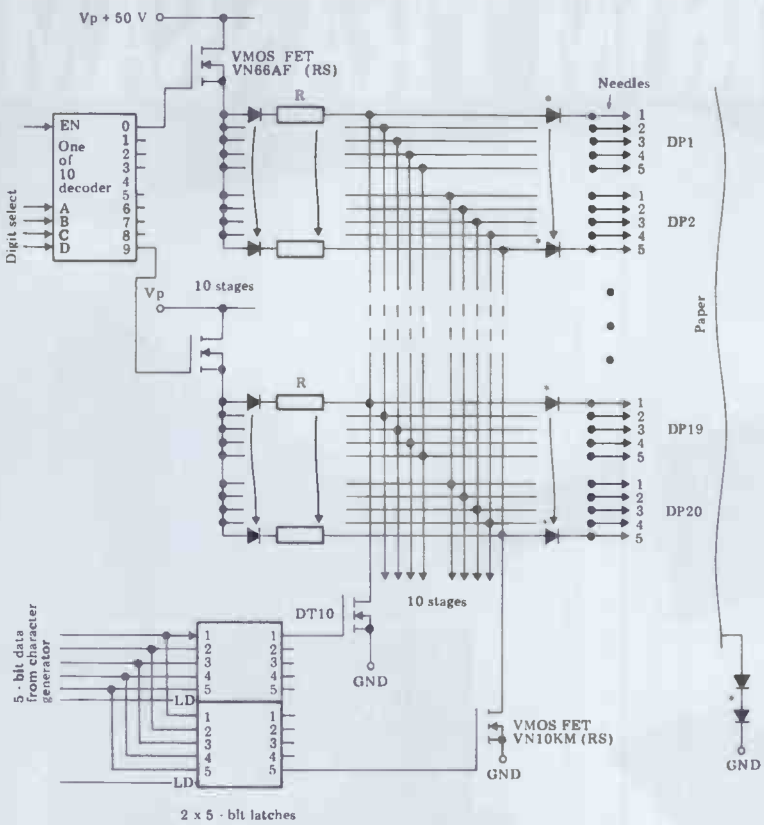

Fig 15 Suggested circuit of multiplexed interface board for NMP 20.

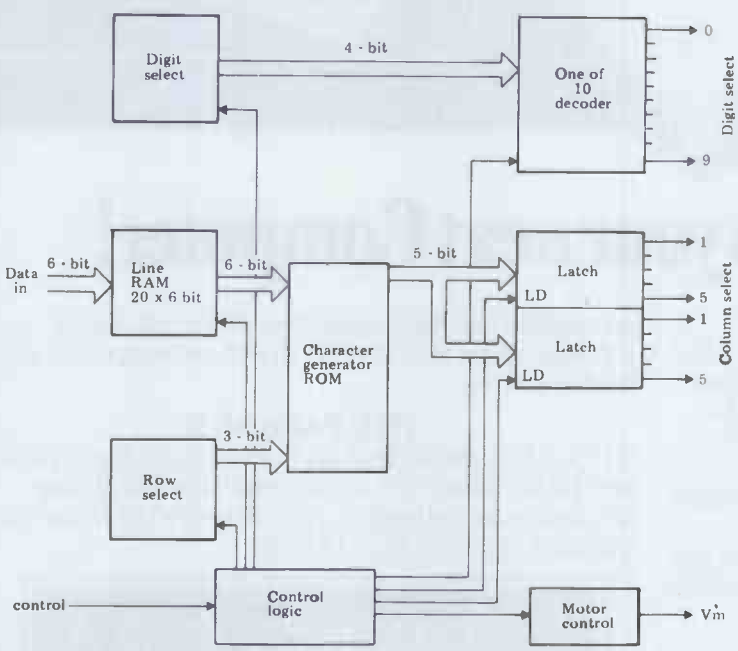

Fig 16 Block diagram of suggested control system for NMP20

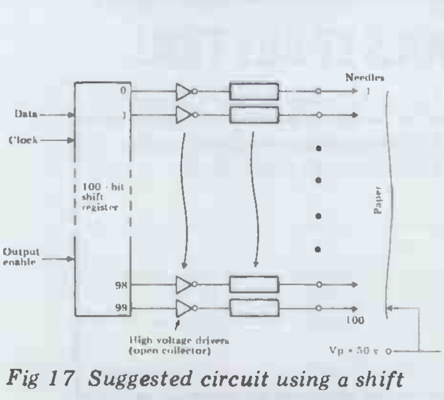

Fig 17 Suggested circuit using a shift register for parallel operation.

straightforward if you copy the existing circuitry. Alternatively you can buy the unit new, in which case you should contact Dataplus Ltd. The printer comes in two versions. The cheaper of the two at approx £35 comprises the basic mechanism without the interface board. This interface board reduces the number of connections required from over 100 to 23; the circuit is quite complex and expensive to construct, so the printer with interface board will set you back about £90.

The printer mechanism itself is very simple and robust and the only moving part apart from the hinged lid is a small DC motor that drives the paper feed roller. In operation, the printer generates no timing signals and the size of the print can be varied over a wide range by simply adjusting the speed of the paper feed.

The printing is carried out by a parallel array of 100 sprung metal fingers or needles. These are moulded into a small unit that screws onto the frame and plugs into the interface board underneath. The needles are arranged as 20 groups of five needles each. There are several ways that this unit could be used. Firstly, you could buy the unit with the interface board or you could design your own interface board to save money. The idea of the interface board is to reduce the number of connections going to the printer and this is done by connecting the needles into ten groups of ten needles which can be multiplexed in the normal fashion. The alternative is to dispense with the interface board altogether and operate each needle individually. This method will enable you to achieve a very high printing speed but it does mean a lot of wires need to be used for interconnections; also, the power consumption could be quite high.

Figure 15 shows a suggested circuit for an interface and multiplexing board. This is similar in concept to the board that comes fitted to the NMP20 but it uses VMOS FETs instead of bipolar devices and as such should be more reliable, I have not yet tried this circuit but it should work. (If not than a little experimentation is in order — let me know if you try it.) Basically this circuit divides the needles into ten groups of ten; the needles are commoned together and connected to the FETs DT1 to DT10. These FETs are switched by the two 5-bit latches which store the parallel data output from the character generator ROM. The individual groups of ten needles are connected in series with a blocking diode and a current limiting resistor and can be sequentially connected to Vp by high current FETs. These are controlled by the one of ten decoder. The paper is connected to ground by a roller in the paper feed. The diodes in the return line raise the potential of the paper roll slightly above ground.

In use, the character generator would load two sets of row data into the 5-bit latches, the one of ten decoder would select a digit group and the outputs would be activated. This would allow current to flow to one group of ten needles. The PD between the needles and the roll is approx 50 V and so the resultant arc would cause a dot to appear on the metal surface. To prevent a needle from printing a dot, the relevant common line must be grounded via DT1-DT10, which are controlled by the latch. When a common line is grounded, it presents a preferential path to the current and so no arcing occurs at the needle tip. The one of ten decoder and the five-bit latches should be CMOS devices operating at 15 V to provide sufficient drive voltage for the VMOS FET switches.

Figure 16 shows a suggested block diagram for the remainder of the circuit. This is fairly straightforward

GOTO page 134

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GET WELL SOON

A TAPE RECOVERY SYSTEM

Ever pressed 'record' by mistake and started to overwrite your only copy of a much-loved program? Alan Shelley explains how to cure this and other tape-related ills.

The program to end all programs is complete. You worked well into the small hours to finish it, could hardly sleep for thinking about it and finally when you did, strings of graphics characters switched themselves on and off in splendid arrays, and that neat new maths function that really clinched things munched its way through byte after byte in a multi-coloured field of data statements. Next morning you've come down bleary-eyed, intent on reliving the glory of this thing you've created. You switch on, check the cassette is rewound, slip it into place, type LOAD and start the cassette player. The message 'SEARCHING FOR ULTPROG' displays itself and you wait happily...

That's funny, it's never taken this long to find it before; you check the tape is going round, then — horror! The record button is down and there is no second copy... Who hasn't pressed 'record' by mistake and realised too late when hours of work have been lost? Well all is not lost, there *are* ways to rescue what's left. This article explains how to do it on the Commodore PET and it may well be possible to develop similar methods for other micros.

First, let's consider how a Basic program is held in memory. Each program line consists of a line number, followed by the statement(s) comprising the line itself, then a zero byte which marks the end of the line. In front of each line number are two 'link bytes' which contain the address of the first of two bytes in front of the next line number. At the end of the program, instead of an address, two more zero bytes are found. This pair of zero bytes with the zero at the end of the last line form a group of three zero bytes at the end of the program. The link byte before the first line of the program is preceded by a zero byte; this is at memory location 1024 (hex 0400). See diagram 1.

By means of the link bytes, the operating system can skip through the program examining line numbers without having to go through every statement; this is used in executing GOSUB and GOTO statements, for example.

When a program is saved on tape, the PET operating system gets the start address of the program (this is usually 1025 [hex 0401] and is held in two bytes at locations 40 and 41 [0028 and 0029 hex][122 and 123 for old ROMs hex 007A and 007C]) and the end address, which obviously varies according to the length of the program. These two addresses plus the program name form the header which is preceded by a timing tone. The program itself follows, and is also preceded by a timing tone. Both the header details and the program are recorded twice and in each case the two copies are separated by a short 'bleep' of the timing tone. This is known as a 'redundant recording' method and is used in the interests of reliability.

When the program is loaded into memory from tape, the first thing encountered is the timing tone which enables the operating system to adjust itself to the tape speed. This is another reliability feature, by virtue of which the system tolerates a variation of running speed from machine to machine. The next thing encountered on the tape is the program name, followed by the start and end addresses. If the program name matches the one required, these addresses are stored in memory for reference. Starting at the location indicated by the first address — usually 1025 (hex 0401) — the program is loaded into memory (RAM) byte by byte. As each byte is loaded, a checksum bit is calculated and, if this does not agree with the checksum bit on tape, an error count is incremented and the location is noted. If errors have been noted after the first copy of the program has been read, the system starts at the beginning of the program in memory and compares the error locations with the second tape copy. Whenever a correct byte (tested by the checksum bit) occurs on the second copy, this is substituted for the faulty byte in memory and the error count is decremented. If uncorrected errors still exist at the end of the second pass, the message 'LOAD ERROR' is displayed on the screen. If no errors have occurred on the first pass, the program in memory is complete and the system simply scans to the end of the second copy.

Now, with a program tape which has lost its header and possibly part of the program, the first problem is that of giving the computer something to find, since it cannot switch straight into loading a program totally unprepared. It cannot manage without at least a small part of the timing tone and it needs the start and end addresses of the program. In order to recover a damaged program, a way has to be found to provide this information and the obvious way is to use the header of another program. First, wind the damaged recording to a position just before the start of the unerased portion (this can easily be found with the help of an audio cassette player or by pressing 'play' on the PET cassette deck and holding down the '<' key on the keyboard; if there is a recording present, the '<' sign will be printed repeatedly on the screen). Having positioned the damaged tape correctly in readiness, place another tape in the cassette deck, preferably with a program known to be longer than the corrupted one. (If a shorter one were used, part of the wanted program would be lost because, when the end address obtained from the program header is reached, the computer stops loading information. The way round this is to make up a 'dummy header' with addresses that will cover any length of program. This will be dealt with later.)

The method now is to enter 'LOAD' and start the cassette deck in the normal way. However, as soon as the message 'FOUND PROGNAME' appears, press the cassette stop button but *do not* touch the computer. Remove the dummy tape and substitute the corrupted tape, then start the cassette deck again and the computer will continue to read the tape, apparently blissfully unaware that anything untoward has taken place. At the end of the read one of four things will happen:

1. The message READY appears and the recovered program will list normally (success!!);
2. The message READY appears but the program will not list;
3. The message ?LOAD ERROR appears and the program will not list;
4. The system 'hangs' — either of the

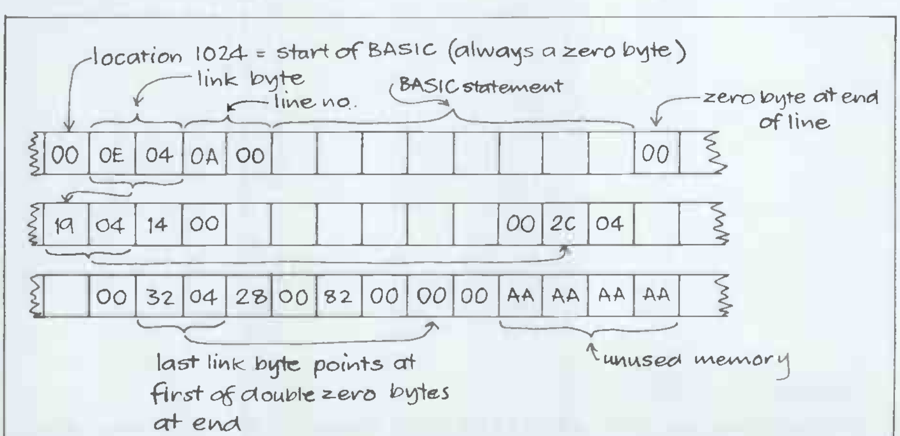


Diagram 1 Sketch of program in memory

above messages may be displayed but the cursor does not reappear.

If the program is complete, ie, it has lost no more than part of the header, then No 1 will probably happen and the program should also run. It is possible, however, for No 1 to occur with an incomplete program so it is worth checking this before running it, although nothing worse than an undefined statement error is likely to occur. If the first program copy has been corrupted, there is about a 10% chance of 1, 2 or 3 happening and a 90% chance of No 4. If the system hangs, unless you know how to 'uncrash', you have no alternative but to switch off and start again. Since uncrashing is such a useful procedure, especially when working with machine code, a separate paragraph will be devoted to it later.

Now if either of alternatives 2 or 3 have occurred, it is necessary to do some machine code adjustments which can be time-consuming, and to have either the tape Monitor or new ROMs with the resident Monitor, or to devise a routine using PEEKs and POKEs. The object is to discover whether or not anything has been loaded and, if so, whether it is the required program or just garbage. In order to be able to determine this, it is a good idea to familiarise oneself with the appearance of a program in memory before attempting the rescue operation. This may be achieved as follows: first load or key in a short program — say about ten lines or so — written for the purpose if necessary. What it does is unimportant, since we only want to look at it in code. Having keyed in the program, enter the command SYS 1024. This will cause the contents of the various registers to be displayed, which will look like the first two lines of diagram 2, although the actual values may vary.

The contents of memory can be displayed by typing 'M', followed by the start and end addresses (in hex) of the section of memory required to be examined. Thus M 0400 0480 (the spaces are necessary), followed by return, will display the first 128 bytes of memory where the program resides and will include the whole of your program if it is short enough. Compare this with diagram 2 and you will be able to identify the various parts of the program. Note that the link bytes preceding each line of the program actually point to the start of the next line. A method using PEEKs is described later and this avoids the need to enter the Monitor.

Now, to get back to what may have been loaded from the corrupted tape. Enter SYS 1024 then display the first 128 bytes of memory as described above and examine them to see if they conform to the pattern of a program. If not, then the whole recovery procedure will have to be repeated, but if they do then the link bytes should be examined. Since the program would not list, the link bytes must point to the wrong addresses and the reason for this is that the program has been loaded into the wrong place in memory. This can be remedied in one of two ways: either by changing the link bytes to point to the correct addresses, or by moving the program up or down in memory into the correct position. Both are laborious procedures to carry out manually, but there is no need to do this because entering SYS 50242 (50234 for old ROMs) calls the subroutine which puts in the correct link bytes throughout the program. Any garbage there might be at the beginning of the program is left and when the program is saved again, this will be saved along with it, unless it is deleted first. This is possible to do because it will always have a spurious line number associated with it, which happens because the operating system takes whatever happens to be in locations 1027 and 1028, where it expects to find a line number, and interprets it as such.

When using this SYS 50242 (50234 old ROMs), the system will hang if, for any reason, the three zero bytes at the end of the program are missing and, if this happens, the only thing to be done is to insert them at the end of the saved material by the use of the Monitor (or PEEKs and POKEs), after uncrashing the system of course. (Uncrashing does not cause the contents of memory to be lost.)

This process of program recovery is usually a lengthy business because the failure rate is so high. So, when repeatedly doing this exercise it is worth clearing the whole of memory each time by switching the computer off and on again, so that anything that is subsequently loaded is easily distinguishable from the AAs which fill virgin memory. Actually, it is better to use SYS 64721 (64824 old ROMs) which will clear the whole of RAM from 1024 upwards and will reset the pointers without the need to switch off. This will leave a machine code program in the second cassette buffer intact.

One word of caution here. It is wise, having rescued a program from a partially-erased tape, to save it before doing anything else because if it happens to be incomplete in some aspect, or has picked up some incorrect bytes, it is quite possible to hang the system merely by trying to edit it. In fact, even the SAVE could be tricky, so first enter the command CLR which will reset any pointers which have been disturbed.

The use of a dummy header was mentioned earlier; since the purpose of this is to prevent the object program being truncated by having the end address too low, it is necessary to put a fairly high address into the pointer to the start of variables. This is done by POKEing into the pointer an address

Enter machine code monitor

You enter these shown in boxes

Program Counter, Interrupt Vector, Status Register, Accumulator, X Register, Y Register, Stack Pointer

```
READY.
SYS1024

B*
    PC   IRQ   SR  AC  XR  YR  SP
.;  0401 E62E  32  04  5E  00  F8
M 0400 0440
.:  0400  00  0E  04  0A  00  85  22  4E
.:  0408  4F  2E  22  3B  41  00  19  04
.:  0410  14  00  81  49  B2  31  A4  41
.:  0418  00  2C  04  1E  00  99  49  2C
.:  0420  49  AA  41  2C  49  AC  41  2C
.:  0428  49  AD  41  00  32  04  28  00
.:  0430  82  00  00  00  AA  AA  AA  AA
.:  0438  AA  AA  AA  AA  AA  AA  AA  AA
.:  0440  AA  AA  AA  AA  AA  AA  AA  AA
M 0028 0030
.:  0028  01  04  34  04  34  04  34  04
.:  0030  00  80  00  80  00  80  28  FF
X
READY.
```

Display section of memory

line no.

zero byte at end of line

address of first byte in machine code line

link bytes each point to next link byte

← virgin RAM

Display section of memory

Pointers :- start of BASIC program; start of storage area for variables; start of array storage; end of arrays; top of RAM

Exit from monitor

A four-line program in memory

```
CLR:FOR I = 1024 TO 1087 : PRINT PEEK(I),: NEXT
0        14       4        10
0        133      34       78
79       46       34       59
65       0        25       4
20       0        129      73
178      49       164      65
0        44       4        30
0        153      73       44
73       170      65       44
73       172      65       44
73       173      65       0
50       4        40       0
130      0        0        0
170      170      170      170
170      170      170      170
170      170      170      170
READY.
```

Diagram 2

The same program displayed by PEEKing by means of a direct command as in the top line. Values are in decimal.

which is near the top of the memory. The pointer is held at addresses 42 and 43 in the new ROMs, so the command POKE 43, PEEK(53)–4 (old ROMs A=PEEK(134) : POKE 124, A–4) will set the end of Basic 1024 bytes below the top of memory, since location 53 is the high byte of the top of memory address. Then enter SAVE "DUMMY HEADER" and press play and record on the cassette player. Let it run for about 20 seconds then press RUN/STOP and switch off the cassette. As we only want the header, there is no point in leaving it to record the whole of memory.

After using the dummy header in a rescue operation it is necessary to set the end of Basic pointer to the end of the rescued program otherwise it will not SAVE properly. There is no need to do this if No 1 occurred, since it will have been done automatically by the operating system. The method is somewhat laborious as it involves searching through memory for the three zero bytes at the end of the program as follows: enter SYS 1024 followed by M 0400 8000. This will cause the contents of the whole of RAM to be displayed on the screen. It will, of course, scroll up at a rate of knots but slowing it by pressing the RVS key should enable you to pick out the three zero bytes as they go by. If memory was cleared by switching off before making the recovery, the program will be followed by clear memory which will be displayed as a large block of AA bytes and will be easily recognisable. If necessary, displaying 128 bytes at a time will make the job easier but obviously longer. Having found those three zero bytes, determine the address of the first byte following them — a simple matter, since the address of the first byte of each line is displayed at the beginning of the line. Let's assume the one in question is 0434, as in diagram 2. Now, still in the monitor, enter M 0028 0030 and two lines of memory will be displayed which contain the pointers vital to the operating system. Cursor up to the third byte on line 0028, change it to 34 (or whatever is applicable) and the next one to 04 (or otherwise as applicable), and then press return. The rescued program can now be saved again before doing anything else, apart from checking the three zero bytes at the end.

To examine the contents of memory by means of PEEKs instead of entering the machine code Monitor, the following routine should be entered as direct commands:

CLR : POKE 43, PEEK (53)–1 :
  POKE 42,0 (RETURN)
FOR 1 = 1024 TO 32768 : PRINT 1 ;
  PEEK (1), : WAIT 59410, 4, 4 :
  NEXT (RETURN)

(For old ROMs the first line should be amended to:

CLR : A=PEEK(134):POKE 124,A–1 :
  POKE 123, 0 (RETURN))

This will display the contents of RAM from the start of Basic upwards and it will consist of each address followed by its contents. The WAIT has been included to make it more convenient in use since the routine will only run while the space bar is depressed. To stop the program, press the space bar and the RUN/STOP key simultaneously. The WAIT may not work on old ROMs so, if this is the case, it should be omitted and you will be able to slow the operation down by using the RVS key. The POKE at the beginning is necessary to set the variable storage area high up the memory, in order to prevent the routine from corrupting any of the rescued program data. When running the routine, the thing to watch for is the three consecutive zeros or, if these are not present, a succession of 170s which correspond to the AAs of virgin memory. If the three zeros are absent, they should be POKEd in place of the first three 170s. Having found or entered the three zeros, the address of the location following them should be determined as above and the following additional direct command should be entered:

1 = (here put the required address) :
  POKE 43, 1/256: POKE 42, 1–
  INT(1/256)

(For old ROMs change 43 to 124 and 42 to 123 as before)

Following this, SYS 50242 (50234 old ROMs) can be entered as above and the program can be listed and saved.

The foregoing method is the only hope of recovering what remains if the 'middle marker' has been lost, but is little more than academic if this is still intact.

A reliable method of recovering a damaged program, provided erasure has not gone beyond the middle marker, is to use the PET's own operating system to load it by calling the relevant subroutines. This has to be done in machine code and a Basic loader for an appropriate program on new ROMs only is given. The machine code program resides in the second cassette buffer and is run by our old friend SYS 826 which produces the normal message PRESS PLAY ON TAPE 1.

Before pressing play it is necessary to position the object tape as already described. When play is pressed a quickly-changing series of characters in the top right corner of the screen indicates that there is something on the tape and a tell-tale single character in the top left corner indicates what has been found, as follows:

A — there is a signal present on the tape
@ — the timing tone is present
♪ — loading is taking place

Loading is complete either when the quickly-changing series stops and becomes a single stationary character (which could be anything), or when the cassette stops and the screen displays READY. In the former case, you should press the RUN/STOP key and enter SYS 883; in both cases switch off the cassette player and enter CLR. If the CLR is not done, strange results will occur when running programs, since zero page locations are altered by the routines.

If the ♪ doesn't appear, loading has not taken place and this is almost certainly because the program has been erased beyond the middle-marker. The only possibility for recovery is the direct method described earlier.

The reason for two possible results after loading has occurred successfully is that one of two conditions exists. First, the program has been erased

GOTO page 133

```
1 REM  BASIC LOADER FOR RECOVER
2 REM  M.D.SHELLEY, OCTOBER 1980
3 FOR I = 826 TO 969
4 READ A
5 POKE I,A
6 NEXT
7 DATA 160,0,132,201,132,157
8 DATA 132,206,132,203,132,171
9 DATA 132,192,132,193,132,178
10 DATA 132,194,200,132,44,132
11 DATA 212,132,199,132,251,160
12 DATA 4, 132,200,132,252,160
13 DATA 128,132,202,32,18,248
14 DATA 120,238,17,232,169,132
15 DATA 133,144,169,3,133,145
16 DATA 32,158,248,32,66,196
17 DATA 24,165,31,105,2,133
18 DATA 42,165,32,105,0,133
19 DATA 43,96,174,73,232,160
20 DATA 255,152,237,72,232,236
21 DATA 73,232,208,242,134,204
22 DATA 170,165,191,141,39,128
23 DATA 165,44,141,0,128,48
24 DATA 18,240,19,165,171,240
25 DATA 2,198,44,169,8,133
26 DATA 183,165,191,16,2,132
27 DATA 191,76,66,249,165,178
28 DATA 240,13,165,208,208,9
29 DATA 56,165,221,9,128,133
30 DATA 221,198,44,76,66,249
```

PET QUARTET

Don Finlay explains how to start a 'barber shop' harmony group. Apart from yourself, all you need is a PET and MTU's four-voice music board.

Monophonic music is one of the simple capabilities of most microprocessor systems, enabling the user to play tunes with a square-wave derived from one line of an output port. More interesting waveforms can be obtained by adding hardware in the form of a digital-to-analogue converter. Generating polyphony is more difficult, and the usual home computer is unsuitable for the task; the calculations take considerable time, limiting the sampling rate and, therefore, the range of frequencies that can be produced. However, good software can make it possible to play out a limited number of parts simultaneously.

In September 1977, the magazine *Byte* carried an article by Hal Chamberlin, entitled 'A Sampling of Techniques for Computer Performance of Music'. In addition to providing an excellent introduction for anyone taking up the subject, this gave the listings for a 6502 machine-code program which enabled the processor to get samples from each of four waveform tables, add them, and output them to a digital-to-analogue converter so as to give an audio output with four-part harmony. The article has been reprinted in *The Byte Book of Computer Music*, so is easily available

to anyone who reads the advertisements in *PCW* carefully.

It isn't necessary to read this article, however, nor to understand machine code, in order to use the board and software produced by Micro Technology Unlimited, of Manchester, New Hampshire, and available in Great Britain from IJJ Design Ltd, 37 London Road, Marlborough, Wilts, SN8 2AA. Hal Chamberlin's software has been extended and adapted for easy use in the PET, and the hardware has been modified so as to run on the single 5 volt supply (instead of the original 12 volt) and output port available on the back of the machine. The complete package, costing £57, comprises a cassette carrying the 'Music Monitor Interpreter' program, with two sample four-part songs; the hardware board, which plugs into two sockets at the rear of the PET a booklet describing the hardware, with some notes on troubleshooting and a circuit diagram; and a software booklet which describes how to use the system, although it doesn't give any listings of monitor or demonstration programs.

Songwriting

With a little study, the user can start writing his own 'song' programs very quickly. I should say straightaway, however, that programming a four-part song into the PET is not easy, as every piece of data has to be turned into a hex-coded byte, using tables printed in the software booklet.

First, the length of each musical 'event', during which nothing changes, is decided upon and coded according to a table which codifies 15 note lengths in the American notation of whole notes (semibreve) down to thirty-seconds (demisemiquaver). I found it helpful to mark in the English note names against this table. The absolute length of the event is partly determined by this code, and partly by another code which is used to set the tempo and which has to be loaded into another block of instruction data, so fine adjustments can be made afterwards — or coarse ones for amusing or way-out effects. Secondly, each note of the song has to be turned into a 1-byte code, using a table of six octaves. (This is used as an address to locate a 2-byte code for the 'skip' calculations required for any precise frequency.) So the coding for the song table, which corresponds to a musical score, consists of a set of events, each of which starts with a duration and is followed by one to four bytes representing the one to four voices to be played.

If you produce and then run a song table for a hymn tune, or Anglican chant, which might be the simplest thing to try first, it may sound fine or it may sound much too smooth, because there is no break between notes, especially repeated notes. The reason for this is that the note generation routine has no attack and decay program, ie, each note comes up at full volume immediately and cuts off immediately, so a repeated note is identical with a double length note. This is where the programmer's musicianship is tested; he will have to decide what breaks are needed for repeated notes or phrasing, and program these as separate events, with a corresponding shortening of the event describing the previous set of notes. (A break in a voice is programmed as a zero in the note code for that event.)

Illustrations by Gillian Lockhart

Real-time waveform table calculations for attack and decay could, in principle, be carried out, but the program is already stretching the 6502 to the limit in achieving a rate of 8770 output samples per second. This limits the maximum audio frequency which can be generated to less than half of 8770 Hz. Since the sample rate is within the audio band, it also requires a filter to eliminate the whistle which would otherwise be heard. A filter on the board has a sharp cutoff at 3.5 kHz, which ensures that any spurious frequencies above this value, which may be generated by switching transients in the converter, are also removed. Although this is a long way from hi-fi standards, it sounds surprisingly good, and the sudden onset and decay of notes does not give clicks, as one might expect. There is a certain amount of background noise — inevitable in an 8-bit system, which is not unduly prominent.

The song table is entered from location 1000H onwards, and is divided into playing sections by single-byte separators of 00 in the 'duration' position, used as terminators. The first example supplied on cassette is for '76 Trombones', and occupies memory from 1000H to 1844H. It gives almost exactly three minutes of music, in an amusing and elaborate arrangement. Secondly, there is 'The Entertainer', occupying 1000H to 179FH and running for 3½ minutes. The user can study the codings for both, by examining the PET memory in machine code mode.

Sequencing

In addition to the song table, a set of instructions must also be provided which specifies tempo, waveforms and sequences of song table to be followed. This starts at location 0F00H, and can again be studied on the screen.

There are in all eight different instructions, all starting with FF.

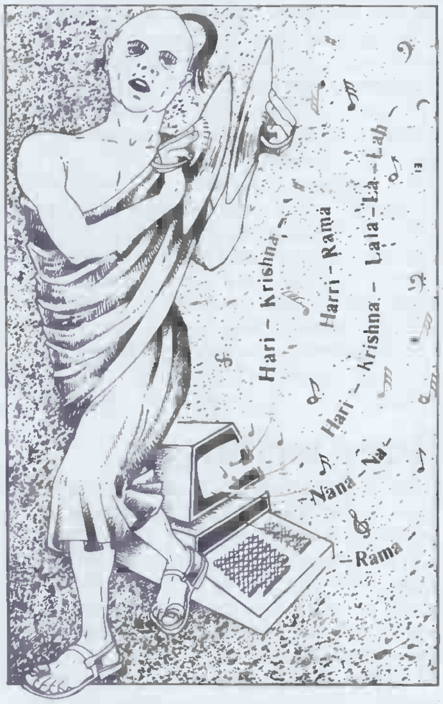
FF 00 NN sets the number of voices to be used, where NN is a code for each number 1 to 4. This instruction enables the song table to be interpreted as sets of two bytes, for a solo voice, up to five bytes for four parts.

FF 01 0B 0C 0D 0E is the usual instruction to use the four waveform tables stored in pages 0B, 0C, 0D and 0E. If fewer than four voices have been selected by the FF 00 instruction, it is still necessary to specify four here because the PLAY routine is unaltered and steps through four waveform sample additions regardless, maintaining its timing loop. So any unused voices are directed to a 'silent' page which has preferably all zeros but can be just an unused page of memory full of 24s or AAs. I found, however, that if I set up only one active voice and had three pages all with AAs for the silent ones, something went terribly wrong with the waveform; examination on a CRO showed a very large pulse superimposed on it. Clearly, something had caused an overflow in the waveform calculations. It didn't occur with only two pages of AAs. The advice to use zeros, given in the software booklet, is good.

FF 02 NN sets the tempo, according to a table of values which in execution are multiplied by the duration values in the song table, in two count-down loops controlling the length of an event. A whole piece, or any sections of it, can be speeded or slowed by this instruction, without altering the pitch.

FF 03 PP is followed by sets of three bytes defining harmonics in amplitude and phase, which set up a chosen waveform in page PP. No limit is quoted for these, but the memory allocated indicates a maximum of 18 harmonics — far more than in drawbar organs, for instance, and more than will be heard for notes above about 200 Hz since the filter will eliminate them. A word of warning is necessary: a waveform must not contain any harmonic which exceeds the frequency of half the sample rate (ie, harmonics are limited to frequencies below 4385 Hz). If it does, then 'aliasing' or 'foldover' will be heard; this is the generation of a sort of mirror image frequency, which is lower than 4385 Hz by the amount by which it was intended to be higher. The resulting note sounds random, as it is not harmonically related to the fundamental. For example, if we take a 440 Hz as a fundamental, we can use up to nine harmonics but the tenth will alias. The filter cannot prevent this, as the waveform is already distorted before reaching it. As the software book says, it may be necessary to use a different waveform table for higher notes.

The software book doesn't give any guidance on good waveforms to choose and, although the monitor and sample programs supplied on cassette sound quite good, there is no indication how these were calculated. Looking up the sequencer for the sample tunes, by displaying the block of memory starting at 0F00H, doesn't help because the FF 03 instruction is not used in either of them; the tables were evidently pre-calculated. I soon found a few pleasant sounding ones, though, with some trial and error.



FF 04 PP DD sets up a rectangular waveform in page PP, with duty cycle DD and maximum amplitude determined by a byte in address 00BFH, loaded by the FF 06 instruction. This is not a Fourier approximation, but a block of bytes at the maximum specified amplitude, followed by zeros, in the appropriate page. The recommended highest note to be used with this waveform is middle C, 'to avoid significant alias distortion'. I would dispute that this is the true reason. There are indeed unpleasant sounds with this waveform, but surely the real reason is that the waveform table is nearly always being scanned unevenly, to get the right frequency. If we outputted every sample in the table at absolutely regular intervals, we would have a perfect rectangular waveform with an infinite number of harmonics, and no aliasing.

FF 05 PP creates a silent waveform in page PP.

FF 06 AM sets the waveform amplitude by putting the byte AM into location 00BFH, for use in waveform calculations. Usually this is set to 3F, so that when four waveforms are added, the maximum amplitude cannot exceed FF. If you try using only a single voice, however, you find the quality is greatly improved by increasing this to FE; this is increasing the resolution of the waveform from six bits to about eight bits, improving the signal-to-noise ratio by 12 dB. For some reason the system won't accept FF as a maximum here; when I tried it the waveform came out with a maximum of only 7F. The instruction is normally used before the FF 03 waveform instruction, so is out of logical order.

FF 07 HH LL is an instruction to jump to a subroutine starting at HH,LL, which can return to the sequencer if terminated with RTS (6502 mnemonic for return from subroutine — object code 60). No suggestions are made for the use of this; you could, perhaps, print a message or text or words of a song on the VDU.

FF FF indicates the end of the sequence, causing the program to return to BASIC control.

Also in the sequencer section of instructions are sets of 2-byte addresses, each of which is the starting address of a section of song data. Any of these pairs which doesn't start with FF is recognised as an address rather than an instruction. The program follows the sequencer instructions in order, so addresses may be repeated if sections are to be repeated.

A sequencer example in the software book uses the instructions FF 00 to FF 04, mixed in with some addresses. Care is needed in examining this, as there is an FF representing an amplitude within the FF 03 instruction sequence — FF doesn't always indicate an instruction. It would have been better if laid out as one instruction per line, as in an assembly listing, rather than in the tabulated block with eight bytes per line. The small section of song table coding printed as an example is shown in lines of five bytes, which is better. Further study can be made by looking at the memory blocks allocated to song table and sequencer, for the two demonstrations songs. If you are new to the PET, as I was, it also helps to make you familiar with manipulation of its machine code data. However, the sequence blocks in these two programs are even simpler than those in the booklet, although longer.

That tune again

My first attempt at writing a new program was to code my old tune 'Gaudeamus Igitur' (cries of 'Not

that again' resound in the lab when I demonstrate it to another victim — must code another one soon) into a four-part arrangement for male voice quartet, as I happened to have a good version by Leslie Woodgate. The first effort was too smooth, as I hadn't allowed for breaks between repeated notes. Second one was very pleasing, and reminiscent of barber-shop singing, although with organ-like tones. I used the demonstration cassette's waveforms before experimenting with my own, and these were evidently well chosen for my limited range of notes.

Experimenting with your own waveforms rapidly leads to trouble. Because it is possible to use so many harmonics in the Fourier synthesis program, you naturally try looking up a table of harmonics from (eg) *Computer Music Journal* and synthesising a flute, oboe, trumpet or violin from this. It is very good mental exercise, as the quoted harmonic levels are in dB, whereas the amplitudes needed for this program are linear and in hex. You have to remember that each 6 dB reduction is a ration of 2:1, so that for instance a seventh harmonic which is 12 dB down from the fundamental is one quarter the amplitude Not only this, but you must remember that the sum of all the harmonic amplitudes must not exceed 255 decimal, or the table overflows. But you want the sum to be near 255 for good resolution. If you overlook this, the synthesis does not work, or produces a faulty wavetable. I would have preferred to have an error message displayed here, as it is very easy to slip up. Eventually I devised a sequence of operations necessary:

1. Decide the fundamental frequency of the highest note to be played. It is useful to mark frequencies against notes in the table in the software booklet, an aid which the authors should have included.
2. Divide this frequency into 4385. The integer result gives the highest harmonic permissible.
3. Convert harmonic amplitudes for the required instrument from dB into ratios relative to the lowest amplitude. At this stage, use decimal; let the lowest amplitude be 8 for four harmonics; 4 for eight harmonics; or 2 if 16 harmonics are to be used.
4. Add all these relative amplitudes. If the sum exceeds 255, reduce them all by the same ratio until they do not.
5. Convert relative amplitudes into hex.
6. Enter into the FF 03 instruction.

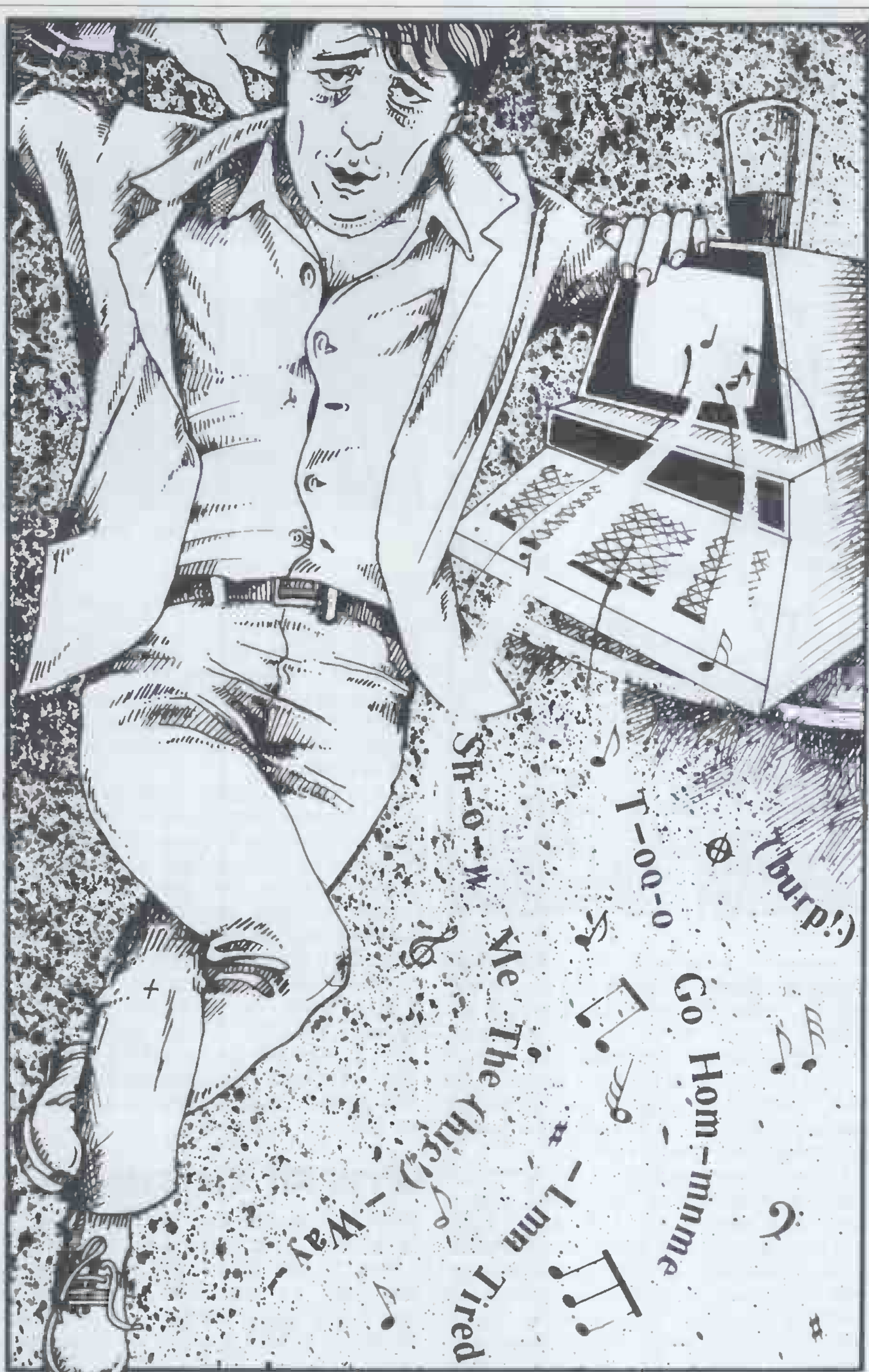
I followed this procedure in translating a 'Cornopean' sound for notes up to a 440 Hz. Only nine harmonics are possible, and the amplitudes I arrived at were, in hex, 3A 35 20 1D 1A OF OE 07 04. The waveform was entered into page OB and I wrote a program to play out a complete scale covering the six octaves allowed for in the software. The results were better than expected in that several notes above 440 Hz sounded reasonable — possibly because the aliasing frequencies were high enough to be trapped by the filter. The sound was reedy to some extent, but the brightness was limited by the 3.5 kHz upper limit, of course.

Up but not down

Transposition is something all musicians require from time to time. I wondered how my male voice quartet would sound if I transposed all voices up an octave. This ought to be easy; rather than re-write all the note codes, I could re-voice the four parts with new waveform tables containing no fundamental pitch and only even harmonics (since all the harmonics of a note which is transposed up an octave must be doubled in order). As far as the waveform table is concerned, the page would now contain two complete cycles of the new waveform.

I put in second, fourth and sixth harmonics and found this worked quite successfully, turning my barber-shop into a close harmony 'female' voice sound. It would also be possible, of course, to transpose only some of the voices this way.

Transposition by only a semi-tone or two is not possible, however, with the monitor supplied. One would have to re-write the song table, in the absence of a program to offset the note codes. And I can't see how to transpose down an octave — you can't make a double-length wavetable.



Hardware

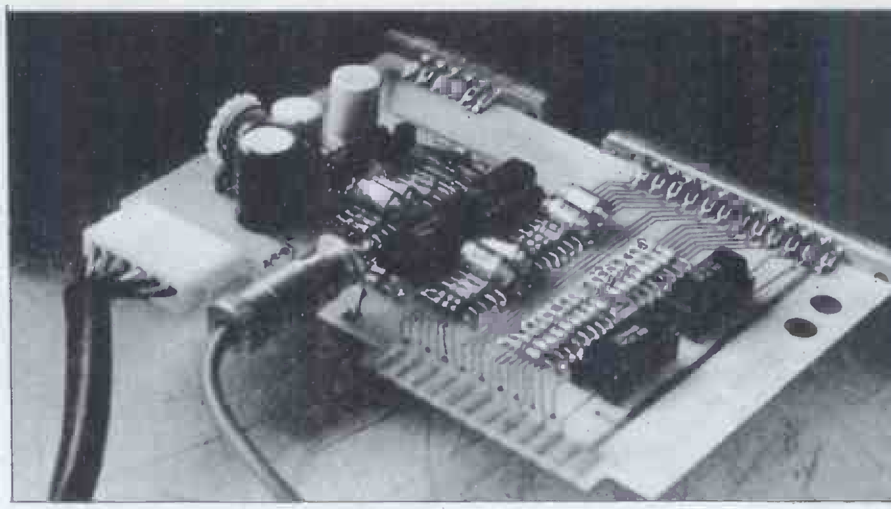
In principle, this is very simple, but some unusual and clever techniques have been adopted to enable the 8-bit binary output signal to drive a loudspeaker using only the 5 volt rail. It consists of three sections: a digital-to-analogue converter (DAC); a sharp cutoff lowpass filter; and a power amplifier. The cassette connection is brought through the board, so the cassette deck is plugged onto the back of the board which is in turn plugged into the back of the PET, employing the two ports designated 'user' and 'second cassette'. A phono socket can drive a loudspeaker, delivering 300 mW into 8 ohms or 500 mW into 4 ohms (not MW as in the brochure — why are some technical people so careless over units?) and the current drain is less than 50 mA quiescent, or 300 mA at full power, squarewave drive.

The DAC does not take the easy way

of a special purpose chip, because all those available need split power supplies, either for themselves or for the current converter. Instead, CD4050 buffers are used as switches in a binary-weighted type, using a fairly lavish arrangement of parallel and series buffers and resistors to improve

conversion accuracy by statistical averaging. Twelve gates, in two hex chips, and 17 resistors (fewer than would be needed in the more common ladder network) convert the eight bits into a current which is fed into a three-stage filter, each stage having two poles in 'resonant lowpass', ie the response peaks somewhat, just below cutoff.

Offset binary coding in the software makes it possible for the filters to run from one supply of 5 V also, with direct coupling, and again using CMOS chips. These are CD4069 inverters, and there are three in each stage, giving an inverting amplifier, leaky integrator and ideal integrator with overall feedback through a resistor. The passband ripple is quoted as less than 0.5 dB, and the cutoff slope gives 30 dB attenuation at 1.35 times the cutoff frequency of 3.5 kHz.



The MTU four-voice music board.

Output from the filter goes to the power amplifier; most of the gain here is obtained in three parallel-connected CD4069's which also buffer the filter output to power amp input connection. They drive a Darlington-connected output stage of four transistors, working in Class AB.

A circuit wasn't initially supplied with my hardware booklet, but IJJ soon sent me one on request. It is evidently intended to be supplied; without it you couldn't follow the descriptions or the troubleshooting notes, which are well detailed and should enable easy repair if needed. My board worked first time.

Some PET programs generate a sound signal on a single line which appears on the 'CB2' signal output. This is allowed for by taking it through the board and mixing it at the input to the power stage, so the board needn't be removed to use this.

Overall impression

The MTU software, described as the 'K-1002-3C', and the hardware board, which is the 'K-1002-2', may not be too easy to use, but they offer an impressive demonstration of what can be achieved by patient work in machine code, in an 8-bit system. Sounds produced cannot compete with electronic music produced by large computers or even by analogue synthesisers, but have value in demonstration or teaching work, or possibly in composition. Defects of digital synthesis are shown up, in the form of noise generated by limited resolution, and the limitation of waveform synthesis at constant amplitude, regardless of frequency, shows up in weak sounds coming from the loudspeaker at low note frequencies. There is also the limitation to 3.5 kHz maximum in the output. However, if songs are coded with each voice given an appropriate amplitude for a limited range of notes, a good balance can be achieved. For the price, the system is good value to any teacher or experimenter interested in music.

Things to come

It is possible to get away from the organ-like sounds that I have been describing by making much more use of large memories. MTU has now produced an 'Instrument Synthesis Software Package' which does just this, enabling you to get harpsichord, wah-wah, chiming and a whole range of more interesting sounds, still using up to four-part harmony. I will be reporting on this shortly.

Acknowledgements: To The City University Microprocessor Laboratory, for use of a PET 3032; and to Ted Willett, University Photographer, for the picture.

MICROCHESS

By our chess expert, Kevin O'Connell

The 11th ACM (Association for Computing Machinery) tournament, held in Nashville, Tennessee (October 26–28), was a triumph for Ken Thompson and Joe Condon of Bell Telephone Labs. Their program, running on a PDP 11/70 with some special chess hardware, made a clean score to win this event just one month after Belle took the world title in Linz.

This achievement establishes a new record. In 1977, Chess 4.6 won the world title but could only share first place in the ACM tournament.

Since 1970 the ACM has been won by Chess 2.0, Chess 3.5, Chess 3.6, Chess 4.0, Ribbit, Chess 4.4, Chess 4.5, Chess 4.6 and Duchess (tie), Belle, Chess 4.9 (with Belle equal second).

This year was certainly the year of the micro, with Bebe (special chess hardware), Challenger (stand alone unit) and Mychess (Cromemco) all doing respectably, as you can see from the table of results.

The following game was described by David Levy, controller of the ACM tournament, as 'one of the most exciting games in the history of this event.' Played in the last round, it decided the tournament.

Results

	R1	R2	R3	R4	Total	Place in World Ch.
1 BELLE	W6	W5	W2	W4	4	1
2 CHAOS	W8	W9	L1	W5	3	2
3 BEBE	D4	W6	L5	W9	2½	6=
4 CHESS CHALLENGER	D3	W8	W9	L1	2½	18
5 CRAY BLITZ	W7	L1	W3	L2	2	—
6 MYCHESS	L1	L3	W7	W10	2	12=
7 CUBE 2.0	L5	W10	L6	D8	1½	—
8 OSTRICH	L2	14	W10	D7	1½	12=
9 AWIT	W10	L2	L4	L3	1	6=
10 CLASH	L9	L7	L8	L6	0	—

White: CHESS CHALLENGER
Black: BELLE

1 e2–e4 e7–e5
2 Ng1–f3 Nb8–c6
3 Bf1–b5 a7–a6
4 Bb5–a4 Ng8–f6
5 0–0 (Ke1–g1) Nf6xe4

It just so happens that I am the author of the only book in English about this lively opening variation.

6 d2–d4 b7–b5
7 Ba4–b3 d7–d5
8 d4xe5 Bc8–e6
9 c2–c3 Bf8–c5

So far according to the book.

10 Bc1–e3?

This move is not given house room in my book. It allows Black to saddle its opponent with doubled, isolated pawns, 10 Nb1–d2 or 10 Bb3–c2 would be normal and good.

10 . . . Bc5xe3
11 f2xe3 Ra8–b8
12 Nb1–d2 Ne4–c5

Threatening a knight fork of the pawns on e5 and b2.

13 Qd1–e1 Nc5–d3
14 Qe1–g3 0–0 (Ke8–g8)
15 Ra1–b1?!

A strong human would have played 15 Bb3–c2, when Black would almost certainly have played 15. . .Nd3xb2, allowing the combination 16 Bc2xh7+ Kg8–h8 (16. . .Kg8xh7 17 Nf3–g5+ Kh7–g8 18 Qg3–h4 Rf8–e8 19 Qh4–h7+ Kg8–f8 20 Ng5xf7 Be6xf7 — take my word for it that White also wins after the even more complicated Qd8–d7 — 21 Rf1xf7+ Kf8xf7 22 Ra1–f1+ Qd8–f6 — or 22. . .Kf7–e6 23 Qh7–f5+ Ke6–e7 24 Qf5–f7 mate — 23 e5xf6 and White wins) 17 Nf3–g5 (threatening Qg3–h4) 17. . .g7–g6 18 Ng5xe6 f7xe6 19 Bh7xg6 and White is a pawn up with a very strong attack. Though it would be expecting rather a lot from any program to see all that.

15 . . . Qd8–e7?

Better 15. . .b5–b4

16 Bb3–c2 Qe7–c5

White cannot now capture on d3 because of Qc5xe3+ (that is what BELLE was planning on), but White has something better.

17 Nf3–g5! Nc6xe5
18 Ng5xh7! Rf8–d8

If 18. . .Kg8xh7?? 19 Qg3xe5 and the knight on d3 is lost.

19 Nh7–f6+ Kg8–f8

White should now be aiming for Nd2–b3, gaining time, by attacking the black queen, to put his knight on the excellent square d4.

20 Bc2xd3 Ne5xd3
21 Nf6–h5 g7–g6
22 Nh5–f6 Be6–f5?

This move soon lands Black in trouble. 22. . .b5–b4 was a good alternative.

23 Qg3–g5 b5–b4
24 Nf6–h7+ Kf8–e8
25 Nh7–f6+ Ke8–f8
26 Nd2–b3

At last.

26 . . . Qc5–c4
27 Nf6–h7+

But now White really should have followed up with 27 Nb3–d4! (or 28 Nb3–d4! or even 29 Nb3–d4). If then 27. . .Qc4xa2, 28 Nd4–c6 wins: Black has to play Kf8–g7 (otherwise Qg5–h6 is mate) then 29 Nc6xd8 and if 29. . .Rb8xd8 30 Nf6–h5+ followed by Qg5xd8. If Black does not take the a-pawn then he must deal with the threat of 28 Rf1xf5 (28. . .g6xf5 29 Nd4xf5 and mate follows).

27 . . . Kf8–e8
28 c3xb4 Rb8xb4
29 Nh7–f6+ Ke8–f8
30 Nf6–g4?

It would have been better to try for the draw with a series of knight checks. Guess what other move is also available!

30 . . . Rd8–d6
31 Ng4–h6 Qc4–e4!

An important move — centralising the most powerful piece, helping to defend the king-side and pressurising g2.

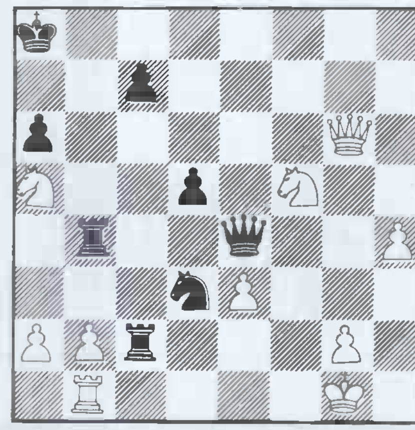
32 Rf1xf5?!

An interesting exchange sacrifice that just fails. White should have played 32 Nh6xf5 g6xf5 33 Qg5xf5 Qe4xe3+ 34 Kg1–h1 with the result that his only weakness (the e-pawn) would have disappeared.

32 . . . g6xf5
33 Qg5–g8+ Kf8–e7
34 Qg8xf7+ Ke7–d8
35 Nh6xf5 Rd6–c6
36 h2–h4

36 Nb3–d4 (that move again) was very much stronger and would have considerably improved White's otherwise slim attacking chances.

36 . . . Rc6–c2!
37 Qf7–f8+ Kd8–d7
38 Qf8–f7+ Kd7–c8
39 Qf7–g6 Kc8–b7
40 Nb3–a5+ Kb7–a8!!



A very deep move. Black gives up a pawn (with check) to get some time (time can sometimes be at least as important as material, but programs are rarely able to follow such subtle changes in values). White will find its queen on the wrong side of the board and the time it takes to get it back to the king-side is enough to transfer the initiative to Black and enable the latter to launch the decisive phase of the attack.

41 Qg6xa6+ Ka8–b8
42 Qa6–g6 Nd3–e5!

Mate on g2 was prevented but this is a real blow, threatening the queen as well as Rc2xg2+ (discovering an attack from the black queen against the rook on b1).

43 Qg6–g8+ Kb8–a7
44 Rb1–f1 Rb4xb2

Threatening mate in two.

45 Kg1–h1 Rc2xg2

White's next few moves would be called 'spite checks' in a game between humans here they are 'horizon checks'. checks".

46 Na5–c6+ Ne5xc6
47 Qg8–a8+ Ka7xa8
48 a2–a4 Ka8–b8?

What is this nonsense? Fortunately for BELLE the bug scuttles back into the woodwork after a few moves.

49 a4–a5 Kb8–a8?
50 a5–a6 Ka8–a7?
51 h4–h5 Ka7–b6?
52 a6–a7 Rg2–g1+
53 Kh1xg1 Qe4–g2 mate

And with that, our resident expert O'Connell was whisked to the local intensive care unit in a severe state of nervous excitement. Massive doses of librium are reportedly taking effect.

MULTI-USER SYSTEMS

Sue Eisenbach and Dr Adrian Stokes begin their new series devoted to multi-user microsystems with an historical summary of the subject.

Until quite recently, multi-user systems had been very much a mainframe phenomenon. Now, however, a number of micro systems are appearing with these capabilities, a trend which should rapidly increase with the recent announcement of CP/Net.

As many *PCW* readers may be unfamiliar with the way in which multi-user systems originated, developed and currently operate, we'll begin this series with a look at their history. Next month we will talk about the various implementation approaches and then, in the rest of the series, we'll examine different systems in the marketplace.

The past

All early mainframes were single user; only one person could run a program at one time and, in fact, only one program could be run at one time. This was a quite acceptable state of affairs since cycle times were very slow and operator interventions took only a low percentage of the total time. The user had control over the computer and could interact with and oversee his program while it was executing, although not in today's interactive sense (unless one regards the system waiting for the user to feed more data cards in as 'interactive').

The next few years brought the substantial reduction of cycle times and a new mode of operation was necessary if computers were not to remain idle waiting for human action. Batch processing was introduced to solve this problem. Several jobs were grouped together to form a single batch. A monitor program, sitting in memory, to which control was returned at the completion of a program run, processed the batch. Operator actions were not required during the processing of individual programs.

Unfortunately, as processors became faster, this type of batch processing could not keep the processor busy and the mechanical I/O devices of the time could not be speeded up enough. The next development was to use magnetic tape for I/O. Input could be transferred from cards to tape and output from tape to cards, under the control of a slow, cheap processor. With this kind of arrangement the (expensive) CPU was only idle during data transfer to and from magnetic tape — a much more efficient use of its time.

In a batch processing system the user cannot control his program while it is in the machine and so the monitor had to be capable of coping with any program errors that might occur. For instance, a program might go into an infinite loop (or worse, an infinite loop while outputting to magnetic tape). Although looping might be detected by a conscientious operator watching the console lights, it was better to get the monitor to handle it automatically.

The clock interrupt was developed to force regular entry into the monitor and time limits were imposed on user programs. The Interrupt mechanism generates a call to the monitor in response to some external event in such a way that the original program can be resumed as if nothing happened. Interrupts have many other uses besides time limitation and their development was a significant step in computer design.

Another problem area concerned the accidental destruction of the monitor program or work areas by errors in a user's program. (This fault is frequently not catered for in today's micros.) If this happened, an operator had to restart the machine to continue processing the batch. The program interrupt solves this problem, too. Extra hardware was included in the processor to check the legality of each attempt to write into a memory location and a violation interrupt is generated when an illegal access is attempted.

The program interrupt mechanism also allowed peripheral devices to be used more efficiently. A program can pass a line of output to the monitor which can be transferred, one character at a time, to magnetic tape (or later to disk) using a program interrupt for each character. While data is being transferred, the user program can be processed. The converse would apply to data input. This overlapping of computation with I/O (generally not available on micros) allowed the return to a single machine architecture since computation and I/O could be handled simultaneously by a single processor. Disks allowed more efficient systems to be produced as there's no tape winding time and disks can buffer I/O from several devices at one time.

The next software development was the common file store using magnetic disks. The user or the system software could deposit files on the disks to be kept for safe keeping by the operating system, as the now rather large monitor program came to be known.

The availability of interrupts allowed multi-programming operating systems to be produced. A number of programs could share the system resources, particularly the CPU. These almost always worked such that a program ran until it had to wait for something, usually data to be read or output, then the next ran and so forth, possibly with some priority system to allow more important programs to obtain a larger share of system resources. One of the most complex multi-programming systems is IBM's OS/MVT (Operating System/Multiprogramming with a Variable number of Tasks) which, unlike many of its predecessors, didn't allocate fixed memory regions but allowed memory to be re-allocated dynamically. Needless to say, a fairly high proportion of CPU time is concerned with such resource allocation and other functions of the operating system.

Finally, the development of a public file system led to multi-access systems where the user (and there can be as many as 300 users on some systems) sits at an interactive terminal and is able to control his program. To be more specific, this means that the user may interact with his running program, either to input data in response to prompts or to interrupt its execution. This is achieved using a technique known as 'time sharing' whereby each user is allocated a period of time, often the same for each user but sometimes altered to implement a priority system. The users are allocated the CPU on some pre-determined basis (often 'round robin') and run during their time slice or until an interrupt occurs (usually input or output). Most multi-access systems are also multi-programmed.

So, on mainframes a vast amount of development was required before the user finally regained control over the processor while executing his program. However, in contrast to the first computers, a relatively low proportion of CPU time is spent actually processing users' programs. Rather, the processor spends a fair proportion of its time executing the operating system (for example, dealing with resource allocation).

Micro systems

Nearly all microcomputer systems are single-user interactive systems for several reasons. The first is that such systems are relatively simple to implement. Secondly, micros have limited resources in terms of memory, CPU power and I/O ports. A typical system might have Z80 CPU, 16k RAM and two I/O ports, a configuration which is scarcely sufficient to support multiple users.

By expanding the system configuration to, say, 64k (usually the maximum possible) and adding extra I/O ports, it is possible to obtain a system which will support a few users but is heavily restricted by CPU power. Of course, it is necessary to modify (enlarge) the operating system to cope with more than one user. Such systems are available on the market but are only satisfactory for a limited number of applications. In order to implement a multi-user system with wider appeal, other techniques must be adopted.

Looking at the components of a micro system, it's clear that the part which runs out of steam first is, luckily, one of the cheapest — the CPU. This points the way to a real multi-user system: give each user his own CPU and a bit of memory and share the expensive components, such as disks (the approach used by CP/Net in fact). In fact, as the number of users increases, larger disks (eg 8in hard disks) become attractive since they are very

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Compiled by Dick Pountain

CASIO I/O ROUTINES

The Casio fx501/502p was the first programmable calculator to provide tape rather than magnetic cards as its bulk storage medium, although now, of course, it has been joined by the Sharp PC1211 and its Tandy clone.

The Sharp possesses two features which make data and program saving far more flexible than on the Casio. Firstly, the recorder may be stopped and started under program control via the Remote socket and secondly, since the Sharp uses Basic, it is possible to save and load selected data memories without overwriting (ie, obliterating) the contents of other registers. This is performed by the PRINT# and INPUT# commands with a named data memory, eg INPUT# DATA 1 : A(3) loads tape file DATA 1 into memory register A(3). In addition the Sharp can load and run consecutive program files under program control using the CHAIN command.

On the Casio, the data SAVE dumps the contents of all M registers to tape and data LOAD loads *all* M registers, overwriting their previous contents. The contents of the X, Y and L registers are not dumped and are overwritten on loading and so lost.

Reader Vernon Mantle has produced routines using the non-standard INV EXE instruction which allow saving and loading of the X register without loss of M register data and also independent saving and loading of the F register.

INV EXE is not mentioned in the Casio manual but it can be programmed and has the op code FF-E6. Files saved under program control with INV EXE always have the file number 00. Vernon has also submitted two short programs which write a succession of data and read the same, under program control, without the loss of M register data. These demonstration routines could easily be modified to perform arithmetical operations on an unlimited chain of data, the practical limit being time, since the saving and loading is rather slow.

Vernon's modified I/O routines are as follows:

SAVE X (writes the contents of the X register to tape under program control).
Coding: INV SAVE INV EXE

This routine will write a block of data onto tape. The block label will be F 000. The block will contain the contents of the X register at the time of execution. All other registers will be unaffected.

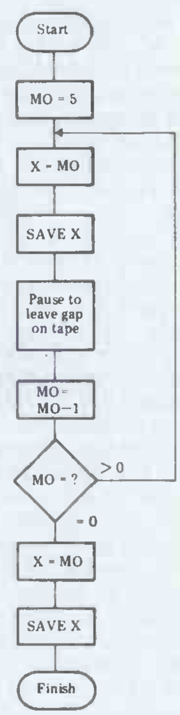
SAVE M (writes the contents of all current M registers to tape under program control).
Coding: INV SAVE EXE

This routine will write the M registers' contents to tape, setting the X, Y and L registers to zero but leaving the M registers unaltered. The block label will be F000.

LOAD X (loads data from tape into the X register under program control).
Coding: INV LOAD INV EXE INV PAUSE

This will read the next block of data on the tape regardless of the block label. If the block was created by SAVE X, the saved X register will be loaded back into the calculator's X register. If the block was created by SAVE M, the saved F register will be loaded into the X register. Executing this routine will not affect the Y, L or M registers.

LOAD M (loads data from tape into the M registers under program control).

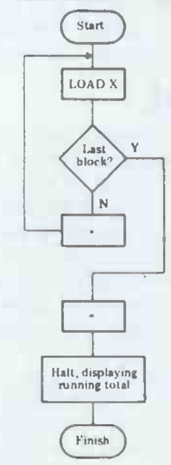


Operation
1 Enter program statements
2 Connect calculator to cassette recorder
3 Set recorder to record, start tape running.
4 Press PO to write data blocks to tape.

Coding
PO
  5 MIN 0

LBL 0
  MR 0
  INV SAVE INV EXE (SAVE X)
  INV PAUSE INV PAUSE
  INV DSZ GOTO 0
  MR 0
  INV SAVE INV EXE (SAVE X)

Fig 1 Program to write six blocks of data to tape using SAVE X.



Operation
1 Enter program statements
2 Connect calc to cassette recorder
3 Play tape recorded by previous program.
4 Press P1 to read tape and accumulate running total.

Coding
P1
LBLO
  INV LOAD INV EXE INV PAUSE (LOAD X)
  INV X = 0 GOTO 1
  + GOTO 0
  LBL 1
  =

Fig 2 Program to read six blocks of data saved by program in Figure 1, keep running total and display it when last block read in, using only X and Y registers.

Coding: INV LOAD EXE INV PAUSE

This will read the next data block on tape, regardless of block label. If the block was created by SAVE X, it contains only one saved register and this will be loaded into the calculator's F register, leaving the other M registers unaltered. If the block was created by SAVE M, all the calculator's M registers will be overwritten with data from the tape. Executing LOAD M will always set the X, Y and L registers to zero.

I suspect that this is not the end of this subject. I shall certainly be experimenting with Casio I/O routines; one valuable objective would be to find a way of saving/loading selected M registers (if possible) and also selected program memories. I shall also try to produce and report to you a useful calculating routine using SAVE X to write to tape in order to store more than 20 results. Any results of other readers' researches will be gratefully received.

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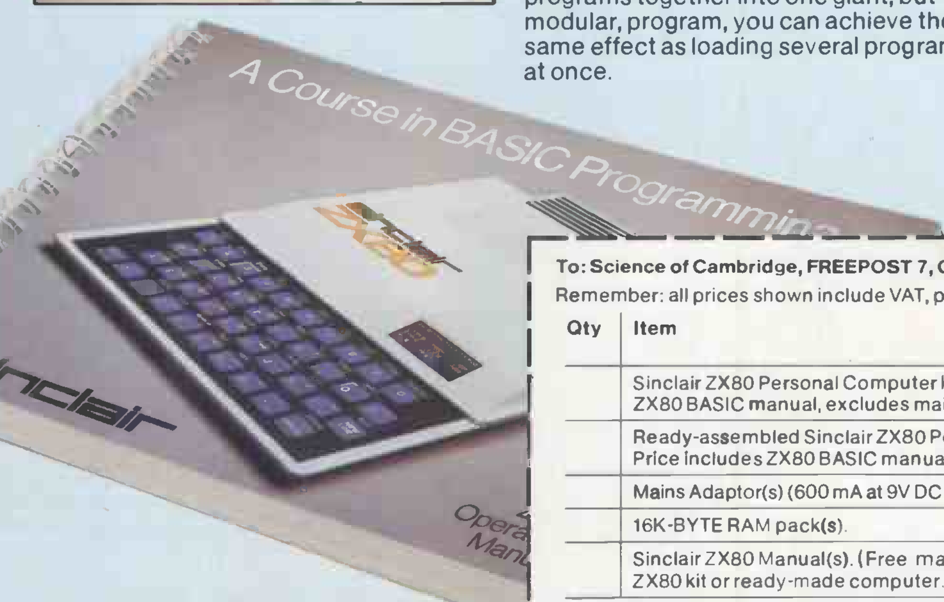

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PCW SUB SET

Continuing PCW's unique series aimed at the serious programmer working in assembler language, Alan Tootill brings more examples of work sent in by readers.

We seem to be addicted to relative calling. October's datasheet RLTV, to implement a relative call, has drawn the best response we have had from readers to date.

Mark Restorick, from Oldham, put his finger on a flaw in RLTV. The fourth instruction, ADD HL,SP, could change the state of the flags register, which has not been saved. He gave the solution to move the PUSH AF from 14th to third instruction and make the instruction which now follows, LD HL,+6, instead of +4. Mark also proposed a version of the routine one byte shorter but taking eight more T-states to execute.

Paul Jenner of Southampton sent the code in Figure 1, which we will call RLTVB. It shortens October's RLTV from 27 bytes and 199 T-states to 24 bytes and 188 T-states.

```
PUSH HL         ; save
PUSH DE         ; registers.
PUSH AF
LD HL,+6        ; point to return
ADD HL,SP       ; address on stack.
LD E,(HL)       ; get original
INC HL          ; return address
LD D,(HL)       ; in DE.
LD A,(DE)       ; displacement in A.
INC DE          ; increment
LD (HL),D       ; return address
DEC HL          ; and return it
LD (HL),E       ; to the stack.
LD, L,A         ; put displacement
RLA             ; in HL
SBC A,A         ; properly
LD H,A          ; signed.
ADD HL,DE       ; add to return.
POP AF          ; restore
POP DE          ; registers.
EX (SP),HL      ; put new return on
RET             ; stack & jump to it.
```

Figure 1

RLTV transformed

If this series wasn't about showing that routines made public will inevitably be improved, I would kick myself for not having seen this better way of ordering things. Take note all you who keep your software secret and tatty.

In fact, Paul doesn't use this code. He has written interruptable RCAL (relative call) and SCAL (indexed subroutine call) routines for his Nascom, using the 10H and 18H restart locations and a common subroutine, GETPRM, to get the parameter in A and the return address in DE. His SCAL routine needs a table of routine addresses and the address of this table is given at locations STAB and STAB+1, as in the Nascom monitor.

For those of you who still like this system, particularly if you have restart locations still uncommitted, this is how

Datasheet

```
;= SFIFO, WFIFO, RFIFO — first-in-first-out buffer suite
;/ CLASS: 2
;/ TIME CRITICAL? : No
;/ DESCRIPTION:  SFIFO sets up an empty buffer at (IX).
;/               WFIFO writes a byte to the buffer.
;/               RFIFO reads a byte from the buffer.
;/ ACTION: sets up a buffer of given length in memory with buffer
;/         variables stored below (IX) to (IX—8);
;/         writes a byte to the next place in the recirculating
;/         buffer, which puts its first byte after initialisation
;/         at (IX+1) and in subsequent cycles from (IX);
;/         reads the first byte to have been written and not yet
;/         read from the buffer.
;/ SUBr DEPENDENCE: local within the Datasheet.
;/ INPUT: IX holds the base address of the buffer for all entries.
;/        DE holds the maximum size of the buffer for entry to SFIFO.
;/        C holds the byte to be written for entry to WFIFO.
;/ OUTPUT: from all entries:
;/        (IX—1) holds the most significant byte of the displacement
;/        of the last byte read.
;/        (IX—2) holds the least significant byte of the displacement
;/        of the last byte read.
;/        (IX—3) holds the most significant byte of the displacement
;/        of the last byte written.
;/        (IX—4) holds the least significant byte of the displacement
;/        of the last byte written.
;/        (IX—5) holds the most significant byte of the count
;/        of bytes written but not yet read.
;/        (IX—6) holds the least significant byte of the count
;/        of bytes written but not yet read.
;/        (IX—7) holds the most significant byte of the maximum
;/        buffer length.
;/        (IX—8) holds the least significant byte of the maximum
;/        buffer length.
;/        from WFIFO:
;/        the byte from C has been placed in the buffer unless full.
;/        if the buffer is full, the carry is set.
;/        from RFIFO:
;/        if the buffer is empty, the carry is set and A = 00H,
;/        otherwise the byte read is in A.
;/ REGs USED:     by SFIFO: AF, DE, IX.
;/                by WFIFO: AF, C, IX.
;/                by RFIFO: AF, IX.
;/ STACK USE: 8
;/ LENGTH: 121
;/ PROCESSOR: Z80
LSTRH   EQU   —1
LSTRL   EQU   —2
LSTWH   EQU   —3
LSTWL   EQU   —4
BCNTH   EQU   —5
BCNTL   EQU   —6
MAXBH   EQU   —7
MAXBL   EQU   —8
SFIFO:  PUSH HL        ; SAVE HL           E5
        LD A,+6        ;                   3E  06
        PUSH IX        ; get buffer base   DD  E5
        POP HL         ; pointer in HL.    E1
FZ1:    DEC HL         ;                   2B
        LD (HL),+0     ; zeroise           36  00
        DEC A          ; displacements     3D
        JR NZ,FZ1      ; & byte count.     20  FA
```

THE LOWDOWN ON PET!

My name is Julian Allason and I publish a magazine called **PRINTOUT**. It is exclusively about the CBM/PET.

I first saw the PET in America three years ago. It was made of wood then. I was so impressed that I came right back and opened a software house publishing PET programs.*

Then a little over a year ago I started **PRINTOUT**. There was a need for an independent magazine that could conduct really thorough evaluations of the flood of new hardware and software products, and report the latest PET developments in detail. Since then **PRINTOUT** has tested scores of programs and peripherals, and broken the major PET news stories.

Volume 2 Issue 1

READ/WRITE Your letters and questions: our replies
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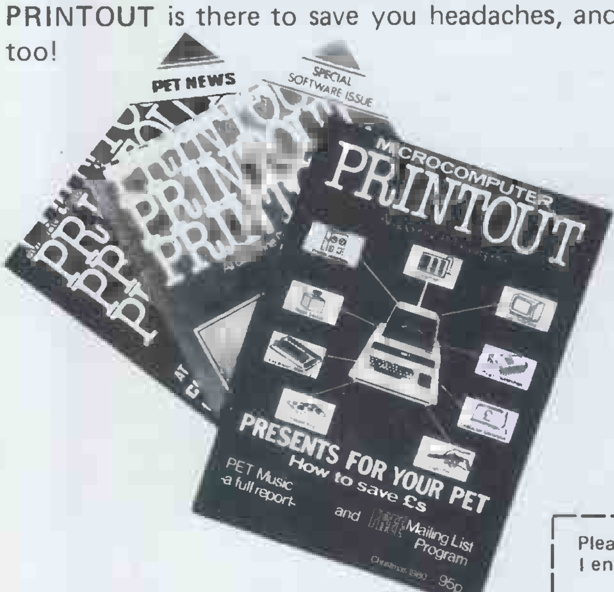
We recruited the world's top PET experts to explain the intricacies of the system, to answer your questions and give advice. These days **PRINTOUT** probably publishes more useful PET information than the other magazines put together. Take a look at the contents of the last issue and you will see what I mean.

There are a whole bundle of changes around the corner that are going to affect every single CBM/PET owner. An example. The complexities of Commodore's new BASIC 4.0 and DOS chips are already causing mind bending problems. Add in the increasing number of plug-in ROM chips and the situation's really complicated. **PRINTOUT** is there to save you headaches, and money too!



We didn't set out to be an encyclopaedia, but there's no doubt that is what **PRINTOUT** is on the way to becoming — a single reliable source of unbiased information about the PET system. And fun to boot!

I don't think you can afford to be without **PRINTOUT**. So try a copy for yourself. Or better still, subscribe now!

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it goes:

```
RCAL:    PUSH HL
         PUSH AF
         PUSH DE
         CALL GETPRM
         JR RCAL2
SCAL:    PUSH HL
         PUSH AF
         PUSH DE
         CALL GETPRM
         JR SCAL2
         .
         .
         .
RCAL2:   LD L,A
         RLA
         SBC A,A
         LD H,A
         ADD HL, DE
RCAL3:   POP DE
         POP AF
         EX (SP),HL
         RET
         .
         .
         .
SCAL2:   LD E,A
         LD D,00H
         LD HL,(STAB)
         ADD HL, DE
         ADD HL, DE
         LD E,(HL)
         INC HL
         LD D,(HL)
         EX DE,HL
         JR RCAL3
GETPRM:  LD HL,+8
         ADD HL,SP
         LD E,(HL)
         INC HL
         LD D,(HL)
         LD A,(DE)
         INC DE
         LD (HL),D
         DEC HL
         LD (HL),E
         RET
```

```
         DEC HL               ;                        2B
         LD (HL),D            ; set                    72
         DEC HL               ; maximum                2B
         LD (HL),E            ; buffer length          73
         POP HL               ; restore HL.            E1
         RET                  ; return.                C9
WFIFO:   PUSH DE              ; save                   D5
         PUSH HL              ; registers.             E5
         LD E,(IX+BCNTL)      ; get byte               DD 5E FA
         LD D,(IX+BCNTH)      ; count in DE.           DD 56 FB
         INC DE               ; update count.          13
         CALL CPMAX           ; if buffer full         CD YY YY
         JR C,INFL            ; jump out else          38 17
         LD (IX+BCNTL),E      ; restore new            DD 73 FA
         LD (IX+BCNTH),D      ; byte count.            DD 72 FB
         LD E,(IX+LSTWL)      ; get disp of            DD 5E FC
         LD D,(IX+LSTWH)      ; last byte written.     DD 56 FD
         CALL RCIRC           ; get next disp &        CD YY YY
                              ; put abs addr to HL.
         LD(IX+LSTWL),E       ; restore                DD 73 FC
         LD(IX+LSTWH),D       ; new displacement.      DD 72 FD
         OR A                 ; unset carry.           B7
         LD (HL),C            ; write byte.            71
INF1:    POP HL               ; restore                E1
         POP DE               ; registers.             D1
         RET                  ;                        C9
RFIFO:   PUSH DE              ; save DE.               D5
         LD E,(IX+BCNTL)      ; get byte               DD 5E FA
         LD D,(IX+BCNTH)      ; count in DE.           DD 56 FB
         LD A,D               ; set carry              7A
         OR E                 ; and jump               B3
         SCF                  ; out if                 37
         JR Z,OUF1            ; count zero.            28 1A
         PUSH HL              ; save HL.               E5
         DEC DE               ; reduce count.          1B
         LD (IX+BCNTL),E      ; restore                DD 73 FA
         LD (IX+BCNTH),D      ; new count.             DD 72 FB
         LD E,(IX+LSTRL)      ; get disp of            DD 5E FE
         LD D,(IX+LSTRH)      ; last byte read.        DD 56 FF
         CALL RCIRC           ; get next disp &        CD YY YY
                              ; put abs addr to HL.
         LD (IX+LSTRL),E      ; restore                DD 73 FE
         LD (IX+LSTRH),D      ; new displacement.      DD 72 FF
         LD A,(HL)            ; get byte.              7E
         OR A                 ; clear carry.           B7
         POP HL               ;                        E1
OUF1:    POP DE               ;                        D1
         RET                  ;                        C9
RCIRC:   INC DE               ; next displacement.     13
         CALL CPMAX           ; check buffer.          CD YY YY
         JR NZ,RC1            ; jump if not limit.     20 01
         EX DE,HL             ; else recircle.         EB
RC1:     PUSH IX              ; get buffer base        DD E5
         POP HL               ; pointer in HL.         E1
         ADD HL,DE            ; add displacement.      19
         RET                  ;                        C9
CPMAX:   LD L,(IX+MAXBL)      ; get maximum            DD 6E F8
         LD H,(IX+MAXBH)      ; length to HL.          DD 66 F9
         OR A                 ; clear carry.           B7
         SBC HL,DE            ; subtract disp.         ED 52
         RET                  ;                        C9
```

RLTV run riot

Geoff Barker, who lives near Oxford, asks, 'Why limit calls to the plus 7FH-minus 80H displacement of the relative jumps? Surely an opportunity now exists to go anywhere!' It does indeed, if you don't mind a two instead of a one-byte parameter in the main code, every time the routine is used.

Geoff also thinks that the displacement ought to be from the first byte of the CALL RLTV, to make it similar in operation to the relative jump. That depends on what you are used to. If you write in machine code, you will be used to giving displacements from the first byte of the instruction following the relative jump and will want a routine that handles such displacements for relative calls. If you supply displacements, rather than labels, to an assembler, you will probably be used to giving displacements from the first byte of the relative jump instruction and will be more at home with a relative call routine that handles displacements of this kind. Geoff's code, which we will call RLTVW, is for two-byte displacements taken from the first byte of the CALL RLTVW instruction — see Figure 2.

```
EX (SP),HL      ; update return
INC HL          ; address and
INC HL          ; return it
EX (SP),HL      ; to stack.
PUSH HL         ; save
PUSH DE         ; registers.
PUSH AF
LD HL,+6        ; point to updated
ADD HL,SP       ; return address on stack.
LD E,(HL)       ; get displacement
INC HL          ; address + 2
LD D,(HL)       ; in DE
EX DE,HL        ; and HL.
DEC HL          ; disp addr + 1.
LD D,(HL)       ; get
DEC HL          ; displacement
LD E,(HL)       ; in DE and
ADD HL,DE       ; add to ret addr.
DEC HL          ; correct to
DEC HL          ; first byte
DEC HL          ; of CALL.
POP AF          ; restore
POP DE          ; registers.
EX (SP),HL      ; put new return on
RET             ; stack & jump to it.
```

Figure 2

To alter RLTVW to handle displacements from the first byte of the instruction following the displacement,

GOTO page 133

Personal Computer World

COMPLETE FEATURE INDEX FOR 1980

NEWCOMERS-START HERE

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!

Welcome to the confusing world of the microcomputer. First of all, don't be fooled; there's nothing complicated about this business, it's just that we're surrounded by an immense amount of necessary jargon. Imagine if we had to continually say 'numbering 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, storing the results or sending them somewhere else. All this information is called *data* and it comprises numbers, letters and special symbols which can be read by humans. Although the data are (yes, it's plural) accepted and output by the computer in '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. Thus in most micros each character, number or symbol is represented by eight binary digits or *bits* as 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 00110101 — complicated for humans, but easy for the computer! This collection of eight bits is called a *byte* and computer freaks who spend a lot of time messing around with bits and bytes use a half-way human representation 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 ...... E=1110 and F=1111. Our example of 5 is therefore 35 in hex. This makes it easier for humans to handle complicated collections of 0s and 1s. The machine detects these 0s and 1s by recognising different voltage levels.

The computer processes data by reshuffling, performing arithmetic on, or by comparing them with other data. It's the latter function that gives a computer its apparent 'intelligence' — the ability to make decisions and to act upon them. It has 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 input 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 nearer the *programming language* is to English, the faster the programming time. On 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 feeds 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 *PEEK* 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 (POKE).

Moving on to *hardware*, this means the physical components of a computer system as 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 directly 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 are several smaller PCBs, each with a specific function — for instance, one card would hold the CPU and its support chips. The most widely-used bus system is called the *S100*.

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 put information into RAM. Two types of RAM exist — *static* and *dynamic;* all you really 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 often store interpreters and the 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 PROMs) which can be programmed using a special 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 converting data to a series of audio tones and recording them; later the computer can listen to these same tones and re-convert 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's 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 disk drive which rotates it and moves a *read/write head* across the disk's surface. 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 it can get to any item of data by moving the head to the appropriate track and then waiting for 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 floppy* — a miniature continuous loop tape cartridge, faster than a cassette but cheaper than a disk system. *Hard disk* systems are also available for microcomputers; they store 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 the visual display unit *(VDU)*, which looks like a TV screen with a typewriter-style *keyboard;* sometimes these are built into the system, sometimes they're separate. If you want a written record *(hard copy)* of the computer's output, you'll need a *printer*.

The computer can send out and receive information in two forms — *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, with a separate wire carrying each bit. Serial I/O involves sending data one bit at a time along a single piece of wire, with extra bits added to tell the receiving device when a byte is about to start and when it has finished. The speed that data is transmitted is referred to as the *baud rate* and, very roughly, the baud rate divided by ten equals the number of bytes being 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 two computers with modems to exchange information. A modem must be wired into the telephone system and you need British Telecom's permission; instead you could use an *acoustic coupler*, which has two obscene-looking rubber cups into which the handset fits, and which has no electrical connection with the phone system — British Telecom isn't so uppity about the use of these.

DIRECT ACCESS

PACKAGES

This package guide appears bimonthly alternating with our In Store hardware guide.

	ARDEN DATA PROCESSING 0533 22255		B+B COMPUTERS LTD 0204 26644		BEAM BUSINESS CENTRE 01-636 1392			BENCHMARK COMPUTER SYSTEMS 0726 61000
	PET	Apple	PET/CBM	Altos (CP/M MP /M)	PCC 2000 Simpelec Triton 3	PET	Apple	North Star Horizon
Stock Control/Recording	15	P.O.R.	300	300	350			450
Sales Ledger		300			350			250
Purchase Ledger		300			350			250
General Ledger/NL		300			350			250
Integrated Accts			300	300				950
Word Processing		75						
Mailing List		300	75	75				
Invoicing			25-50					100
Database Management/ Information Retrieval		150	75					250
Payroll		P.O.R.						350
Incomplete Records								
Personnel Records								
Estate Agent		850			350			
Time/Cost Recording			300		350			250
Job Costing								
Mail Shot					450			
Credit Control								
Cash Flow								
Production Analysis			300					
			Disk Operating System 150			Standard PET + Apple Packages		

	BENCHMARK COMPUTER SYSTEMS 0726 61000	BRISTOL SOFTWARE FACTORY 0272 23430	CAP-CPP MICRO PROD-UCTS LTD 01-404 0911	COMMODORE 01-388 5702		COMP-SOFT 0483 39665	COMPUTASTORE LTD 061-832 4761	
	Cromemco	PET		PET/CBM	8000 Series	PET	Vector	PET
Stock Control/Recording	450	300		150				
Sales Ledger	250	300	800	200	250		400	
Purchase Ledger	250	300	1000	200	250		400	
General Ledger/NL	250			200			400	
Integrated Accts	950			(50)	P.O.R.		1000	
Word Processing				75/150	250		400	325
Mailing List								
Invoicing	100		400					
Database Management/ Information Retrieval	250		P.O.R.	50/150	P.O.R.	170		
Payroll	350		P.O.R.	150	250			200/350
Incomplete Records								
Personnel Records								
Estate Agent								
Time/Cost Recording	250							
Job Costing								
Mail Shot								
Credit Control		650						
Cash Flow								
Production Analysis								
	Revolving Credit 400+; Hire Purchase 400+; Leasing 400+			Assembler Dev 50; LISP 75; Pascal 120				

PACKAGES

DIRECT ACCESS

	COMPUT-A-CROP 01-499 6987	COMPUTECH 01-794 0202		DATA BANK 0509 217671		
	CP/M	Apple II	ITT 2020	PET	ITT 2020	Apple II
Stock Control/Recording	500-1500			10	10	10
Sales Ledger	500	295	295			
Purchase Ledger	500	295	295			
General Ledger/NL	500	295	295			
Integrated Accts	1500					
Word Processing	150-260			40	40	40
Mailing List	50-150			50	50	50
Invoicing	150-350					
Database Management/ Information Retrieval	150-750					
Payroll	495	375	375	10	10	10
Incomplete Records						
Personnel Records	450					
Estate Agent	750					
Time/Cost Recording						
Job Costing	700					
Mail Shot	200-360					
Credit Control						
Cash Flow						
Production Analysis	700					
	Property Management 450-1000; Company Secretary 450; Legal Precedents 1100	Utilities 20	Utilities 20	Bank Account 10; Salesman 10; Cash Register 10	Bank Account 10; Salesman 10; Cash Register 10	Bank Account 10; Salesman 10; Cash Register 10

N.B. Discounts on multiple sales

	GRAFFCOM SYSTEMS LTD 01-734 8862	GRAMA (WINTER) LTD 01-636 8210	GREAT NORTHERN 0532 450667		A J HARDING 0424 220391	HARTFORD SOFTWARE 0606 76265
	CP/M	PET/CBM	8080/Z-80	Apple	TRS 80	PET
Stock Control/Recording	350	150	275	150	200	
Sales Ledger	450		275		225	
Purchase Ledger	450		275		225	
General Ledger/NL	400		275		225	
Integrated Accts	1100	650	995			
Word Processing	400	75/150			15	85/65/40/20
Mailing List	250				25/38/55	45
Invoicing					25	
Database Management/ Information Retrieval		150			32.50	
Payroll	500	150	275		200	
Incomplete Records					40	
Personnel Records						85
Estate Agent						
Time/Cost Recording	400					
Job Costing						
Mail Shot						
Credit Control						
Cash Flow						
Production Analysis						
	Equipment Lease/Rent/HP 400; Financial Modelling 400; Order entry/invoicing 350		Job Order Control 275; Prof Appts. groups 275; Prof Appts individ. 220; Prof Client. Billing 330	Video message 200; Statistics 150	VAT Register 15	Lotteries 45; Membership Accting 85; T.A.P. Business System 125

PACKAGES

	H.B COMPUTERS 0536 83922	HIPPOSOFT 0332 23127		INTEREUROPE SOFTWARE DESIGN 0734-786644	INTEX DATALOG LTD 0642 781193	T V JOHNSON 0276 62506
	CBM	PET	ACT 800	MCZ Zilog	PET	PET/CBM
Stock Control/Recording	35/25				195	150
Sales Ledger	350					P.O.R.
Purchase Ledger	350					P.O.R.
General Ledger/NL	200					
Integrated Accts						650
Word Processing	35	375	375	500+		75/150
Mailing List	35					
Invoicing						P.O.R.
Database Management/ Information Retrieval		225	225			150
Payroll	10				50/195	150
Incomplete Records						
Personnel Records				500+		
Estate Agent	30					
Time/Cost Recording						
Job Costing						
Mail Shot				200		
Credit Control						
Cash Flow						
Production Analysis						
	Utility set 78 VAT Master 25 Bureau de Change 8 Price Lister 12			Screen Generator 75+ Conference Organiser 500+ Budgeting Package 500+		Petsoft programs 160

	TV JOHNSON 0276 62506		KATANNA MANAGEMENT SERVICES 0245 76127	KATANNA (cont'd)	KEEN COMPUTERS 0602 583254	LIFEBOAT ASSOCIATES 01-836 4663	
	TRS 80	Apple II	TRS 80	CP/M	Apple	CP/M	8080/Z80
Stock Control/Recording	115		200	500	P.O.R.	325	325
Sales Ledger			225	500	300	425	425
Purchase Ledger			225	500	300	425	425
General Ledger/NL			325	500	300	375	375
Integrated Accts	75					950	950
Word Processing	45/95	75	70	500	75		
Mailing List					300		
Invoicing			75	500		325	325
Database Management/ Information Retrieval	150				150		
Payroll			218	500	P.O.R.	475	475
Incomplete Records					P.O.R.		
Personnel Records							
Estate Agent					850		
Time/Cost Recording							
Job Costing							
Mail Shot							
Credit Control							
Cash Flow							
Production Analysis							
			Individual designed programs 100 up			Order processing 550	

PACKAGES

	LIVEPORT (EXIDY SORCERER FIRMWARE) 0736 798157	LUDHOUSE (COMPUTING) LTD 01-679 4321	MICRO COMPUTER APPLICATIONS LTD 0734 470425		PADMEDE COMPUTER SERVICES 025671 2434	
	Sorcerer	**CP/M**	**Tandy Model I**	**Tandy Model II**	**Apple II**	**ITT 2020**
Stock Control/Recording			30-50	300	300	300
Sales Ledger		500	90	90	300	300
Purchase Ledger		500	90	90	300	300
General Ledger/NL		500	90	90		
Integrated Accts			350*	350*	450	450
Word Processing			50/75	175-240		
Mailing List			40	75		
Invoicing			90	90	300	300
Database Management/ Information Retrieval			25-80			
Payroll	250	450	249			
Incomplete Records			40			
Personnel Records						
Estate Agent						
Time/Cost Recording			P.O.R.	P.O.R.	300	300
Job Costing			P.O.R.	P.O.R.	300	300
Mail Shot				75		
Credit Control						
Cash Flow		250				
Production Analysis						
	+ range of Life-boat progs.	S/L, P/L + Stock control, 1000 Contract costing, 2000		CP/M & utilities 150 CBasic 70		

* includes invoicing

	PERSONAL COMPUTERS LTD 01-626 8121		ACT/PETSOFT 021-454 5348	ROCKLIFF 051-521 5830	SMG MICRO COMPUTERS 0474 55813
	Apple II	**MZ-80K**	**PET**	**PET/ Computhink**	**PET*/8032**
Stock Control/Recording	35/98	150	12/25/350	250	395
Sales Ledger	295		95/350		395
Purchase Ledger	295		95/120/350		395
General Ledger/NL	295				
Integrated Accts	340	150			
Word Processing	150-300		25/325		
Mailing List	40		15		75/150
Invoicing	125		350		in stock control
Database Management/ Information Retrieval	98		325		
Payroll	200		50/25/195		
Incomplete Records	125				
Personnel Records	98				
Estate Agent	175		25		
Time/Cost Recording	125				
Job Costing	125				
Mail Shot	225				
Credit Control	98				
Cash Flow	75		8		
Production Analysis	75				
	Pad to plotter system 250 Statistics 100-195 Programming Aids 40		VAT 17.50		Vet Package P.O.R. Solicitor's package 750 Planning/ maintenance 595 Warehousing P.O.R.

*Computhink Disks

PACKAGES

	THE SOFTWAREHOUSE 01-637 2108		STAGE ONE SOFTWARE 0202-23570	SYSTEMATICS INTER-NATIONAL 0268 284601	SUMLOCK BONDAIN 01-250 0505	TRIDATA MICROS LTD 021-622 1754	
	Apple	**TRS-80**	**Commodore/ Computhink**	**Apple II/ ITT 2020**	**Apple**	**TRS 80I**	**TRS 80II**
Stock Control/Recording	80	48	100/250	500	P.O.R.	200	375
Sales Ledger			P.O.R.	250P	300	225	375
Purchase Ledger			P.O.R.	250P	300	225	375
General Ledger/NL			P.O.R.	250P	300	225/325	425
Integrated Accts			P.O.R.				
Word Processing	60	30/60/90	120	180/95	75		
Mailing List	50-150	50-150	100	100	300		
Invoicing	295		P.O.R.			75	125
Database Management/ Information Retrieval	60-140	60	45-250	100	150		
Payroll	200			250P	P.O.R.	218	375
Incomplete Records	250		750				
Personnel Records							
Estate Agent			250	750	850		
Time/Cost Recording			P.O.R.				
Job Costing	450						
Mail Shot	14		125				
Credit Control							
Cash Flow							
Production Analysis							
	Solicitor's complete record accounting 3000; Postal Advertising Response Package 350	Statistics 45; Investment Portfolio 20	Petaid report generator 125; PR/Advertising Package 1000; Bonds/Pension Quotations 100; Printers Job Control 250; Bank Accounts 100; Appointment Planner 100	Text File Librarian 125; Financial Planning 250; Office Admin 100			

Key: POR Price on request
( ) Program used to link accounts packages.
P = program written in Pascal

	VLASAK ELECTRONICS LTD 062-84 74789
	Apple II
Stock Control/Recording	285
Sales Ledger	315
Purchase Ledger	315
General Ledger/NL	225
Integrated Accts	855
Word Processing	120
Mailing List	
Invoicing	140
Database Management/ Information Retrieval	
Payroll	375
Incomplete Records	
Personnel Records	
Estate Agent	
Time/Cost Recording	
Job Costing	
Mail Shot	
Credit Control	
Cash Flow	80
Production Analysis	
	Letter writer 80

Personal Computer World

PACKAGES

PCW's 'Packages' secion is produced bi-monthly, alternating with our 'In Store' hardware guide. As it is obviously impossible to include every package currently available for every machine, we have confined coverage to business 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 (formatted as printed in this section) to: Packages, *PCW*, 14 Rathbone Place, London W1P 1DE.

DIRECT ACCESS

TRANSACTION FILE

The classified service that's free to non-commercial readers. Advertisements (50 words max) to: PCW Transaction File, 14 Rathbone Place, London W1P 1DE.

For sale

Cromemco... Z2 with a 4 MHz Z80A, 4FDC disk controller, 64k RAM, 21-slot motherboard, twin 8" disks, only 6 months old. Unforeseen financial crisis forces sale with full doc, £2600. Tel 051-228 0144.

Chess Challenger 7... still in new cond, mains adaptor, £80 ono. A Samet, 8 Elm Park Ave, London N15 6AT. Tel 01-800 9257 after 7.

T158... prog calc, well used but in working order with charger, manuals etc, £25. Alastair Mutch, tel Aberdeen (0224) 573378 (6-9pm).

Computhink... 400k twin disk unit for PET, £750. PET 3022 printer with cable, £395. Both as new cond. Tel Rugeley (08894) 2052.

Olivetti TE300... printer terminal with 110 baud RS232 int, paper tape punch & reader (reader needs attn), with stand, cables, some 8½" paper & copy of manual. Will demo, asking £225. Tel Watford 34560 after 5 weekdays, anytime weekends.

Apple II Plus... 48k, one disk drive & controller, all extras inc modulator, many progs, 2 months old, £1050 (list £1400 for hardware only). Also Z80 softcard, £195. 3 months old Centronics 730, £450. Tel 01-450 5049.

TRS-80 Level II... 16k, VDU, cassette, covers, tapes, learning Basic, stats package & Basic books £450 ono. Tel Botley (Hants) 5714 after 5.

ZX80... assembled, inc PSU and all leads & manuals, £75. Tel 061-432 2247 eves.

TRS-80 Level I... 4k inc VDU, cass recorder, PSU, game progs, instruction tapes & manuals, 6 months old, offers around £300. Tel Blackpool (0253) 36646 eves or mornings (shift worker) or all weekend.

Nascom 1... with buffer board, mother board, PSU, NasSys, 8k RAM, new case, £150. Also Nascom 1 16k, two Basics (one tape, one EPROM), PSU, all Verocase with 12" monitor, printer & software, £450 ono, may split. Tel Chris Rose, Tiverton 57657 day, 57886 night.

Superboard... 8k RAM, PSU, modulator & case (not fitted), offers around £215. Tel Southend-on-Sea 204901 after 7.30.

TRS-80 Level II... 32k plus cassette, manual, video or TV adaptor, tapes, £450. Tel 01-828 7822 ext 463 day.

PET 32k... (expanded from 8k), large keyboard, green screen, toolkit, reset switch, cover, progs & doc inc PET Revealed, only 3 months old, £650 ono. Also monitor & 4k exp for UK101, £15 & £25 resp. Tel 01-543 1890 after 5.

Bits & PCs... Toolkit for Nascom £30; Sale due to floppy upgrade. Tel 01-550 8965.

ZX80... one month old with exp board for up to 3k & PSU. Checked by Science of Cambridge. Switchable video. Reason for sale — upgrading. Accept £80 ono. Tel Orpington 70601.

UK101... 8k, assembler, case, new & old monitor, extended monitor in ROM, disassembly of all monitors, £250 ono or swap for Nascom 1 why? Tel A Crofts, Warwick (0926) 53868 eve, 44111 day.

Used VDU... in good working order, £100. Tel Sue, 01-794 8419 after 8pm.

Acorn... System One, working with Acorn PSU & programs, £65 inc postage. A Johnson, 5 Johnsburn Rd, Balerno, Edinburgh EH14 7DN.

Sorcerer... 32k Cognivox voice synthesiser/speech recogniser/music & sound effects producer, full manuals (technical & software) & £80 worth of software on cassette (mainly games), £700. Write D Mok, 33 St Cross Rd, Winchester, Hants SO23 9JA.

PET 2001... 8k old ROMs, calc keyboard, new cassette head just fitted, £325 buyer collects. To view & test tel 01-582 7766.

Bargain... 2111-2 RAMs (unused) half price, £2 (32 chips); unused KB756 ASCII keyboard, £35; Superboard PIA int- £15; light pen, £8; must sell, sold Superboard. B Mistry, 75 St Margarets Rd, Bradford, W Yorks.

Apple Z80... card as new, never used, with CP/M, Microsoft Basic 5.0, £180. Tel 01-450 5049.

T159 & T158... both exc cond, boxed with all manuals, cards, & stats lib module. Offers, tel Dr D Boxer, 0382 23181 ext 583 or 0382 825090.

Casio FX502P... plus FAXI cass int, with instruction and application manuals & cassette, Masterpac application book, new cass, total val over £120, as new cond for £75, or exch 6502-based m/c code dev board — Kiml, Syml etc. Greenload, tel Skipton (0756) 60811.

Triton... L7.2 (2MHz), 8k ext Basic, motherboard, full on-board RAM, manuals, games tapes, cased, working, offers. 27 Beaumont Ave, Sudbury, Middx or tel Rob, 01-450 8911 ext 337/324 office hours.

UK101... 8k RAM, new monitor, 600/300 baud cassette, ½ MHz RS232 int, cased, all sckts fitted (video, TV, etc), £450. Tel Harlow (0279) 415335.

PET 2001... 8k, new keyboard & ROMs, green screen, Basic course on cass, beginner's manual, some games, plenty of magazines, quick sale, £400 ono. P Griffin, 6 Florence St, Chuckery, Walsall WS1 2LG.

Nascom 1... T4, NasSys, full doc, £100. Hewart 6800, full kb, 1k monitor, VDU & cass, ideal starter, £60. Tel Steve, 01-370 8458 day, Wokingham 785470 eves.

Used... working system, processor, keyboard, 35 cps printer (190 car wide, platten/sprocket feed), mag card handler, 50 cps paper tape reader/punch, manuals, mag cards, paper, complete, £450 ono. Tel Locks Heath (04895) 3818.

PET... 8k, old ROM, Expandamem, Toolkit, £500. Computhink disk drive, 400k, £600; extension keyboard, £50. Buy it all & you get 250 free progs. Tel 01-948 2847/01-894 7149.

Microtan 65... built by Tangerine, keypad, graphics, l/case, mini-motherboard, MPSI PSU, manual, some simple software, £125 ono — no split. Farnfill, 55 Meadowfield, Gosforth, Cumbria, tel Gosforth (09405) 345 after 6.

PET 32k... plus Computhink 400k, little used, immac cond, Petalect maintained, dust cover, disks, PET literature, £1000 ono. Tel 079-78 416.

Olivetti... TE300 printer with Bailey bi-dir int (for PET), paper tape read/write, full keyboard, instr manual, unused since recent service, offers around £300. Ken Hall, 4 St Paul's Court, Kettering, tel 0536 515136.

ZX80... as new, Sinc built, with leads & book, £70. Tel Ipswich 210028.

Merlin... electronic toy with Mastermind, Noughts & Crosses, Blackjack, Magic Square, Echo & Music Machine. Uses LED display with sound, in good cond, £20 ono. Tel Paul Myatt, Hitchin (0462) 4085 eves & w/ends.

UK101... assembled & cased, 8k RAM on board plus spare 6k RAM, extended monitor & games on tape, cassette, tapes, 5 Basic books, £225. Tel Porthcawl (065671) 6138.

PE VDU... board, assembled, £20; Protoboard 6 breadboard, unused, still boxed, £8. Geoff Kitt, tel 0204 694265.

T159... prog calc, PC100C printer, 37 spare prog cards, spare rolls paper, PPX59 club cat & newsletters, pristine cond, best offer. Andrew Taylor, 01-444 5104, or write 23 Park Hall Rd, London N2 9PT.

8k PET... brand new, large keyboard, new ROMs, fitted mu-metal screen eliminating 'wobble', £420, buyer collects. Tel Whitchurch (Hants) 2602 after 6 or anytime w/ends.

Nascom II... plus 16k RAM on 48k board, PSU in kit, unwanted gift, £330. Dr V Tam, 80 Streathbourne Rd, London SW17 tel 01-736 1212 ext 6338.

T158C... brand new, a T158 but with non-volatile memory, stores progs indefinitely, standard module & manuals, cost £90, accept £74, buyer collects. Tel Whitchurch (Hants) 2602 after 6.

Printer... Centronics 101 dot matrix, parallel/RS232 int, working, £100 ono; Nolton 1602A modems, 1800-19200 baud, synch with multidrop facility, built in word checker, V24, also line filter units, tech h/book, £150 ono for pair. Milgo 4400 modems, 4800 baud, with field kits, V24, £35 each, £60 pair. Tel Horsham (0403) 69835.

Apple II + 48k... with plenty of software. 12 Harold Ave, Blackpool, tel 692261/67091.

Sorcerer... word proc pac, £90; development pac, £60, as new with doc. Tel 01-979 4370.

Sharp MZ-80K... as new, 48k RAM, inc dis/assembler, debugger, monitor, Basic listing, programming & games books, software (games etc worth over £200), home used, only two months old, worth £1000, accept £750 ono. Tel 0604 37402 after 7 or w/ends.

IMP printer... recent purchase, need faster one so IMP must go for £260. 12 Harold Ave, Blackpool, tel 692261.

Nascom 16k... DRAM board type A, built, working on Nascom 1, full doc etc, £135. With 32k RAM, £170 ono. Also Stuart colour graphics board, built but unused, full doc, £35 ono. Tel Oxford (0865) 725495 after 6.30 eves & w/ends.

UK101... assembler tape, manual, hints on use, cost £17, sell £10; Space Invaders in UK101 m/c code, cost £5.75, sell £3. Tel Dave, 031-664 2144 eves.

PDP8/S... with std int & hi-speed reader int, cables, h/books, PSU, working, needs ASR/KSR, £150 ono. Reed SW keyboard, qwerty, ASCII, new, £35 ono. Part finished 'Champ' as PE, with articles, £60. Jack, tel 0705 596058.

Games computer... Signetics 2650 proc, UHF output to TV, 8 colour graphics, mult resolution to 227 x 252, sound via speaker & AY8910, cass int with named files, monitor in ROM, lots of software, manual, also full spec Teletext decoder, UHF output & remote keypad, sensible offers please, tel 0925 811191 eves & w/ends.

MK14... + I/O chip, cost £56 new 6 months ago, unused, needs slight attn, most chips scktd, offers around £45? Also alarm bell, siren, keyswitches, all unused, offers? Tel Leamington Spa (0926) 38678 after 6 weekdays.

ZX80... Sinc built, hardly used, manual, TV & tape leads, book of Basic comp games, £70 inc p&p. Tel Canvey Island 69902.

Printing terminal... Friden Flexowriter incorporating 11" max width printer, keyboard, 8-level punch & reader, 2nd unit for spares, 110 V AC supply, not ASCII hence only £50. Tel 0254 22341 eves & w/ends.

Casio FX502P... prog sci calc. Systema C3800 sci calc. Sell sep or together, tel Michael, 01-949 0120 after 6.

Data 100... S-1200 matrix printer, 120 cps, 192 char set, 136 col (15") width. Centronics par int, line buffer, etc. Hardly used (owner needs APL char set), £650 with manual. Tel Liverpool 051-924 2581 eves.

UK101... 8k Microsoft Basic, 8k RAM, cased + all leads, various cassettes inc ext monitor & disassembler, m/c code book, extra 2x8 bit par int using 6522 VIA, £250. Tel Colchester 61193.

32k PET... big keyboard, green screen, cass, software, little used, boxed, £350 ono. Tel Bob Marshall, 01-659 4748 eves.

Apple II + 48k... disk drive, software inc w/proc, Chess, etc, only 6 months old, as new, £950 ono. Tel (04203) 5273 eves.

77/68... Mon 2 PCB with TBug, £45; 3 off 77/68 4k RAM PCB, socketted, exc memories, £15 each; VDU board, £40; 5 V 30 amp Kingshill PSU, £30; Mon 1 PCB + sckts & bootstrap ROM only £12; 5 V Vero rack with 12 wire wrap edge connectors, £25; cass int, £10. Tel 099 386 698.

UK101... 8k RAM, built, cased, tested, bought mid-March '80, all leads supplied, no hidden snags, mags, games & utility progs, £275 ono. H Wynn, 89 Ossulton Way, E Finchley, London N2 0JS, tel 01-883 1983.

ZX80... + exp board & addn'l 1k RAM, PSU, manuals, cables, listings for graphics, music, misc games, cost new £120, sell at £70. Tel Leatherhead (03723) 76256 after 5 or anytime w/ends.

PET 2001-8... (8k with int cass & small keyboard), 30 progs inc Microchess, Space Invaders, Startrek, Wartex, etc, as new £395. 5 PET manuals & assorted pile PET mags, £17.50.

Space Invaders... & about 50 other PET games, bought in error, all work on 8k except 2, with case & card, cost over £20, accept £5 inc postage. Tel Graeme, Woodbridge (03943) 3267.

Apple II 48k... 2 disk drives & ctrllr, Applesoft in ROM, UHF o/put, games paddles, many games inc Space Invaders, £1100. Tel Norwich 810675.

Atari... video computer with 2 games carts, £75 in perfect working order. Tel 01-381 5312.

TRS-80 L2 32k... with VDU, exp int, cass, one disk drive, software (Sargon, Adventure, Assembler, TBUG) & manuals, retails for £1300, sell for £950 ono. TISR52 prog calc, £50 ono. Dave Goodwin, 1 Clopton Green, Clopton, Suffolk IP13 6QL.

Sharp MZ-80K... full 48k RAM, Xtal Basic, assembler, monitor, Basic listing, 9 months warranty, hardly used, inc games & cassettes, £625 for quick sale. Tel Oxford (0865) 880362.

ZX80... inc leads, mains adaptor & manual, £70 ono. Tel 031-663 5937.

TRS-80 L4 16k... + lots of software, 4 months old, would like PET (large keyboard, new ROMs). Tel Maidenhead 39393 eves.

DIRECT ACCESS

TRANSACTION FILE

HP19C. . . prog sci calc with printer, 98 step memory, 29 addressable storage registers, mains charger, h/books & spare printer paper, £85. Tel Rickmansworth 76067.

Acorn System 1. . . with extra RAM & I/O, two books, good cond with all doc, price £78 or offer. Tel Roger Shingler, 021-353 0753 after 6.

Telequipment. . .S61 scope, single beam, 5 MHz, large 10 cm screen, £100 (or trade-why?). Tel Peter, 01-637 8882, office hours.

TRS80. . . RS232C int, unused, with cable & manual, £65. TRS80 cassettes with d/precision routine & 7 games, £25. Whole lot for £83. Tel Bosco, 01-546 2044, Mo Mon-Thurs after 6.

PET. . . new 16k large keyboard with cassette plus extensive games s/ware, as new, £600 ono. Tel 0274 670114 eves.

Printer mechanism. . . 40 col LRC 7040 dot matrix with motor mains transformer & capacitor, £40. Tel Wolverhampton 763617 eves.

Acorn. . . System 1 with VDU card & modulator, doc, 2 books inc 6502 Applications Book, built & tested, cost £190, accept £110. Tel 0532 681588.

Nascom 2. . . 32k user RAM, graphics in video terminal toroidal txfmr, doc & tapes, first reasonable offer secures. Tel (0234) 43843 eves or w/ends.

Triton. . . L7.2 monitor & 8k Basic in EPROMs, 19k RAM, S100 disk interface, RS232, video or TV, fast VDU EPROM & cass rec, £500 ono. SA800 disk drive & manuals, £225. Tel Stoke-on-Trent (0782) 314053 eves.

ZX80. . . 2k RAM, PSU & leads, 5 good progs on C12 cassettes, book of progs, £110 ono. Tel Andrew, Peterborough (0733) 44342.

Acorn Atom. . . 8k Basic, 2k RAM, with case, prof built & tested, all leads & op manuals, ideal for beginner, fully expandable, ex cond, £155. Tel Leicester (0533) 730653 after 6.

Wanted

MK14. . . revised monitor, socketed, extra RAM, RAM I/O, working. Willing to pay £30-£35. Tel Martin, 01-393 1054 eves.

Tangerine. . . Microtan 65, ASCII keyboard preferred, Tanex exp considered. Tel George Rees, Swansea (0792) 61753.

16k Apple II+. . . with Applesoft in ROM, price subject to cond. Tel Chorleywood 3042.

Details. . . of software used successfully for RTTY & CW on a UK101. Ward, 44 Northgate, Barnsley, S Yorks.

PCW. . . Vol 1 no 5. Tel Peter Tootill, 051-220 9733 or 051-922 7260 ext 250.

Apple II+. . . or ITT2020, 16k, must be in good cond, for exch with 32k Sorcerer with voice synthesiser/recogniser, music production, lots of software & manuals. Write D Mok, 33 St Cross Rd, Winchester, Hants sO23 9JA.

PCW. . . vol 1 nos 4, 5, 6, 7, 9, 10, 11, 12, vol 2, nos 5, 6, 8 (in good cond). Contact Aron Felix Gurski, Kvernevikstemma 18, N-5084 Tertnes, Norway.

DIARY DATA

Birmingham, England	(Edgbaston Cricket Ground) Electronic Business Equip. Exbn — BIZTRONIC. Contact: Groundrule Ltd, 061-928 0406	27 — 29 Jan
Bahrain	Middle East Electronic Comms. Show & Conf — MECOM. Contact: Arabian Exbn. Management, 49-50 Calthorpe Rd., Edgbaston, Birmingham. 021-454 4416	2 — 5 Feb
Eindhoven, Holland	Int. Microelectronics Sub. Systems Trade Fair — Microelectronica. Contact: Golden Gate Exbns Inc, PO Box 428, Los Altos, CA94022, USA	4 — 6 Feb
Bilbao, Spain	Electrical & Electronic Equip Exbn — ELA Contact ECL Ltd, 01-486 1951.	2 — 8 Mar
London, England	(Wembley Conf C) Microsystems '81 Exbn. Contact: IPC Exbns Ltd, 01-837 3636	11 — 13 Mar
Glasgow, Scotland	(Albany Hotel) Computermarket. Contact: Couchmead Ltd., 42 Gt Windmill Street, London W1. 01-437 4187	17 — 19 Mar
Malmo, Sweden	Computer Exbn — DATAKRAFT. Contact: ECL Ltd, 01-486 1951	23 — 27 Mar
Manchester, England	(New Cent. Hotel) Computermarket. Contact: Couchmead Ltd., 01-437 4187	24 — 26 Mar

USER GROUPS INDEX

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 February issue.

NATIONAL

UCSD p-System User Society. Will hold its first AGM on 30-31 Jan at the Dragonara Hotel Bristol. Registration fee £10. Membership is £25 pa. Contact: Malcolm Harper, Programming Research Group, 45 Banbury Rd., Oxford OX2 6PE, tel 0865 58086

TRS-80 Level 1 User Group. For all users of Level 1. Quarterly newsletter containing software (which is also available on cassettes). Annual sub £3 (newsletter) or £7 (newsletter & cassette). Contact (with SAE): N Rushton, 123 Roughwood Drive, Northwood, Kirkby, Merseyside L33 9UG.

British Apple Systems User Group. For Apple II and ITT 2020 users. Meets first Tues eve and third Sun afternoons each month at The Old School, Branch Rd, Park Street, St Albans (on A5 about 2 miles south of city centre). Contact: John Sharp, Garston (09273) 75093 or David Bolton, Park Street (0727) 72917.

TRS-80 Users Group. The group is about to launch a computerised bulletin-board system. Members with appropriate h/ware and s/ware will be able to access a central system outside working hours to leave/receive messages and download programs from the Group's software library. Users of other systems will also be able to use the bulletin board. Contact: Brian Pain, National TRS-80 Users Group, 40A High Street, Stony Stratford, Milton Keynes, tel (0908) 566 660 (office), 564271 (home).

MIDLANDS

Birmingham Computer Club. To be formed shortly, catering for all micro users. Fortnightly meetings planned but venue not yet fixed. Contact: Dr M Bayliss, 021-743 7197.

TRS-80 Independent User Group. Recently formed in Birmingham. Contact Mike Bayliss, 021-743 7197.

LONDON

TRS-80 Users' Group London Branch, recently formed and meets 2nd Friday each month 6pm, at 292 Caledonian Rd, London N1. Contact: J Wellsman, 01-607 0157.

Compucolor User Group, London area. Has contacts with both US and Canadian Compucolor user groups. Contact: Bill Donkin, 19 Harwood Ave, Bromley, Kent BR1 3DX.

380Z User Group, North London Branch. Includes Herts, Cambs, Oxon. Contact: Sheridan Williams, 35 St Julian's Rd, St. Albans, Herts AL1 2AZ.

NOTTINGHAMSHIRE

Ashfield Computer Club. Meets 1st & 3rd Thurs each month at Carsic Junior School, membership £3 pa. Contact Deric Ellerby, tel 0380 753576 or Derrick Daines, tel 0380 870841.

SUSSEX

A PET group is being formed on the Sussex/Surrey border, presently centered on Crawley & Horsham. Aims to meet monthly & produce a monthly newsletter. Contact: Richard Dyer, 33 Parham Rd, Ifield, Crawley RH11 0ET.

YORKSHIRE

Anyone interested in forming a micro group in the Doncaster area, contact Mr P Flinders, tel Doncaster 784954 or Doncaster 868 379, 6—9pm.

GET WELL SOON
A TAPE RECOVERY SYSTEM

Continued from page 107

beyond the header and part of the first copy of the program has been lost. In this case the cassette will not stop, the load will not have been verified and the link bytes will not have been corrected. Hence the need to SYS 883, which calls the routine to put in the link bytes and the pointer to the end of Basic. Second, only the header has been lost and part of the timing tone remains. In this case, the load will have been verified, the link bytes corrected and the end pointer entered automatically.

The program can now be listed and run, but before doing so it is obviously prudent to save it again and to check for any obvious errors, if only the second copy was intact.

One last comment: on trying to list the program only a single line may be displayed, consisting of a strangely high line number, a program name then garbage or spaces followed by a few lines of plus signs. This occurs because the recover program is picking up the header of the target program (which has not been completely erased) or the header of the following program on the tape. This should be checked with an audio cassette-player. If the former happens, make sure you position the target tape just before the end of any timing tone. If there are two timing tones present, the header is complete and the tape should load normally but sometimes, on poor quality tapes, it does not work so it is worth trying a recovery by positioning the tape on the second tone. If the name is that of the program following the target, this is almost certainly due to the erasure having gone beyond the middle marker and the only possible means of recovery is the sledgehammer way.

The uncrash routine is as follows and is suitable only for new ROMs; it is known as 'the hairpin method' and I believe it comes from Jim Butterfield. First, connect pin 5 of the parallel user port to ground — pin 1 on the cassette port is handy for this — then briefly connect pin 22 (Reset line) on the memory expansion connector to ground. This causes the PET to jump to the diagnostic routine in the Monitor and the registers are displayed on the screen. Now enter X, to get out of Monitor, and then CLR to reset the pointers. Finally, disconnect pin 5 from ground. This is not a cure for all ills, crashwise, since some will only respond to switching off.

PLEASE NOTE it is definitely not recommended to go poking about with all sorts of bits of wire so only proper connectors should be used and no responsibility can be accepted if anything untoward should happen while you are using this routine.

COMPUTER GAMES
POKER

Continued from page 91

number of hands in the playing session. The program can then allow for the possibility of the opponent bluffing when making its calculations, possibly by calling a suitable proportion of slightly adverse equity situations.

More players

If you want to get the most fun out of a poker program, I would suggest that you write one for six players, five hands being played by the program and one by the user. You can use similar probability estimates, although the actual calculations will be more complex and you will find the game with more players is more stimulating than the two-handed game.

MULTI-USER SYSTEMS

Continued from page 115

much cheaper than floppy disks on a 'per bit' basis their only problem in small systems is that they generally cost more than the rest of the system put together. The largest hurdle to overcome in order to produce a reasonable multi-user system is not the cost of the hardware but the design and development of the more complex system software required to control the hardware.

Many companies are now looking at the question of providing multi-user micro systems and, in the next article, we will describe how these are being implemented and attempt to provide criteria for evaluating these systems.

PCW SUBSET

Continued from page 123

INC HL twice, instead of decrementing it three times, before restoring the registers.

To alter Paul's RLTVB to handle one-byte displacements from the first byte of the CALL RLTVB, you can insert the instruction SUB +4, following the LD A,(DE), and restrict the displacement to the range -124 to +127.

Geoff goes on to suggest that if either conditional or unconditional relative calls are needed, an unconditional jump, following the CALL, could be used to skip the two-byte displacement thus:

```
        CALL (opt cond), RLTVC
        JR SKIP
        DEFW nn nn ; disp
SKIP:       .
            .
            .
```

The coding for RLTVC, which wouldn't need to adjust the original return address, could be as in Figure 3.

```
PUSH HL        ; save
PUSH DE        ; registers.
PUSH AF
LD HL,+6       ; point to return
ADD HL,SP      ; address on stack.
LD E,(HL)      ; get return
INC HL         ; address in
LD D,(HL)      ; DE
EX DE,HL       ; and HL.
INC HL         ; point ret addr
INC HL         ; past JR to disp.
LD E,(HL)      ; load
INC HL         ; displacement
LD D,(HL)      ; in DE
ADD HL,DE      ; add disp to
               ; ret addr + 3.
LD DE,—6       ; adjust to 1st byte
ADD HL,DE      ; of CALL RLTVC.
POP AF         ; restore
POP DE         ; registers.
EX (SP),HL     ; put new return on
RET            ; stack & jump to it.
```

Figure 3

To alter RLTVC to handle displacements from the first byte of the instruction following the displacement, replace instructions LD DE,—6 and ADD HL,DE with INC HL.

This just about exhausts the possibilities of relative calling. I leave you to select and complete the Datasheet(s) that will best suit your system.

Buffers

For something new, we are again indebted to Jim Chance of Birmingham. He sends the collection of first-in-first-out buffer handling routines, which is the subject of our Datasheet this month. The collection is treated as one item with three entries, as there are so many features common to each part.

It is re-entrant and only one copy is needed for any number of buffers in a program. Designed for maximum general application, the coding may not be the shortest but is the kind really worth having in a library.

If you have a pet subroutine which would make a Datasheet then *send it in!* We welcome subroutines in any micro assembler language, not just Z80. Send it to: Alan Tootill, Sub Set, *PCW*, 14 Rathbone Place, London W1P 1DE.

PRINTERFACING

Continued from page 103

when compared with the system required by the Olivetti printers. The control logic must decide which row is to be printed; it then cycles through all 20 characters stored in the RAM and loads the output into the correct latch. After two digits, the digit select decoder is enabled and the resultant current pulse prints two digits. The control logic then steps to the next two digits and the process is repeated. After ten steps, the next row is selected and the logic again cycles through the line RAM to print the next line of dots. A similar circuit could be used with the commercial interface circuit but some modification will probably be required.

Figure 17 suggests how the interface board can be dispensed with by driving each needle directly. In this case the roll is at Vp potential and to print a dot, the driver connected to a particular needle is switched low and the resultant current flow to ground vaporises the metal film. A 100-bit shift register holds the data for each driver and the enable input ensures that all the drivers are operated at the same time. The five-bit data from the character generator is clocked into the shift register in a serial format and each digit is sequentially read out of the line RAM and into the character generator. The row selection is performed as in the other circuit. Again this circuit is untested but it should work, and anyway a little experimentation is good for the soul.

Anyway, that's it for this month. I hope that you have found this article interesting and informative. If you start to build a system and require more assistance then please drop me a line at the *PCW* office and I will do my best to help. Next month I will again look at several different printer mechanisms.

Suppliers of units mentioned in this article are:
Datac Ltd, Tudor Road, Broadheath, Altrincham, Cheshire, WA14 5TN Tel: 061-941 2361/2.
Data-Plus Ltd, 39/49 Roman Road, Cheltenham, Gloucestershire GL51 8QQ Tel: (0242) 30030.
Marshalls, Kingsgate House, Kingsgate Place, London NW6 4TA Tel: 01-624 0805

TRANSAM TUSCAN

Continued from page 57

standards! The 5¼in disk drives are quoted at £195 but I gather that these are going down to nearer £150.

Board, power supply and 56 ch keyboard	£334
8k Basic + 8k RAM	£102 extra
Case	£85
8k Basic version assembled in case	£621
Dynamic RAM expansion to 56k	£285
Twin 5¼in disk system, total cost	£1481
BD80P printer	£525
CP/M and manuals	£75

Conclusion

Perhaps one is never totally objective about anything for which one has paid good money. At several times during the building I wondered why I hadn't just gone out and bought an Apple, and then I groaned again when the prices of the Superbrains suddenly dropped. However, the excitement of getting that first Basic program working on the machine I had built myself could not have been matched by anything on a machine I'd brought home in a box. The confidence of working on the Benchtest disk system has persuaded me to take mine in for an upgrade.

The thing I like best about Transam is that it is a British firm doing its own designs and marketing its own product. It really cares about its computers, and its customers, come to that. Dealing with the supplier of an imported machine is just not the same as dealing with the makers themselves. It is especially nice to hear Transam staff talking about their plans for the future, knowing that the development work is being done just down the road and not somewhere in California.

Face to Face continued from page 95

```
2060 REM
2070 REM LOOP THROUGH INPUT DATE PROCESSING
2080 REM        EACH CHARACTER.
2090 REM
2100 FOR X = 1 TO LEN(DT$)
2110   C$=MID$(DT$,X,1)    :REM EXTRACT A CHARACTER
2120 REM
2130 REM DETERMINE INPUT CLASS
2140 REM
2150   FOR Y = 1 TO 4
2160     IF INSTR(INCLASS$(Y),C$) ) 0 THEN CLASS=Y:GOTO 3000
2170   NEXT Y
2180 CLASS=3  :REM MUST BE 'OTHER', SO CLASS IS 3
2190 GOTO 3000:REM GO TO PROCESS CHARACTER
2200 REM
3000 REM ****************************************
3010 REM
3020 REM  ROUTINE TO PROCESS THE CHARACTER.
3030 REM
3040   ON MA(STATE,CLASS,1) GOSUB 5000,6000,7000,8000,9000,10000
3050 REM
3060 REM  DETERMINE THE NEXT STATE
3070 REM
3080   STATE = MA(STATE,CLASS,2)
3090 IF STATE = 0 THEN DT$="":RT=1:E$ = "TRY AGAIN."
3100 IF STATE = 0 THEN GOSUB 9000:RETURN:REM EXIT DATE ROUTINE
3110 IF RT = 1 THEN RETURN
3120 REM
3130 REM LOOP BACK FOR NEXT CHARACTER
3140 REM
3150 NEXT X
3160 REM
3170 REM ALL CHARACTERS OF DATE SCANNED
3175 IF STATE()3 THEN STATE =0:GOTO 3090
3180 GOSUB 8000 : REM ACTION FOR YEAR
3200 REM
3210 GOTO 10000
3220 REM
5000 REM ****************************************
5010 REM
5020 REM  ACTION 1.
5030 REM
5040 REM  CONCATENATE DIGIT.
5050 REM
5060      N = VAL(N$)
5070      C = VAL(C$)  :REM NUMERIC VALUE OF C$
5080      N = (N * 10) + C  :REM CONCAT DIGIT
5090      N$ = STR$(N)
5100 REM
5110 RETURN
5120 REM
6000 REM ****************************************
6010 REM
6020 REM  ACTION 2.
6030 REM
6040 REM  STORE NUMBER AS 'DAY'.
6050 REM
6060       D$ = N$  :REM DAY
6070       N$ = ""  :REM CLEAR NUMBER
6080       N  = 0   :REM ZERO NUMBER
6090 REM
6100 RETURN
6110 REM
7000 REM ****************************************
7010 REM
7020 REM  ACTION 3.
7030 REM
7040 REM  STORF NUMBER AS 'MONTH'.
7050 REM
7060       M$ = N$  :REM MONTH
7070       N$ = ""  :REM CLEAR NUMBER
7080       N  = 0   :REM ZERO NUMBER
7090 REM
7100 RETURN
7110 REM
8000 REM ****************************************
8010 REM
8020 REM  ACTION 4.
8030 REM
8040 REM  STORF NUMBER AS 'YEAR'.
8050 REM
8060       Y$ = N$  :REM YEAR
8070       N$ = ""  :REM CLEAR NUMBER
8080       N  = 0   :REM ZERO NUMBER
8090 REM
8100 RETURN
8110 REM
9000 REM ****************************************
9010 REM
9020 REM  ACTION 5.
9030 REM
9040 REM  RESET ALL ITEMS.
9050 REM
9060       N$ = "" : N = 0 : REM RESET NUMBER
9070       D$ = ""         : REM RESET DAY
9080       M$ = ""         : REM RESET MONTH
9090       Y$ = ""         : REM RESET YEAR
9100 REM
9110 RETURN
9120 REM
10000 REM ****************************************
10010 REM
10020 REM  ACTION 6.
10030 REM
10040 REM  CHECK COMPLETE DATE.
10050 REM
10060 REM  FIRST CHECK FOR DUPLICATE FUNCTION.
10070 REM
10080       IF D$ = "" THEN D$ = PD$
10090       IF M$ = "" THEN M$ = PM$
```

```
10100       IF Y$ = "" THEN Y$ = PY$
10110 REM
10120 REM NOW CHECK FOR ERRORS.
10130 REM
10140       D = VAL(D$): M = VAL(M$) : Y = VAL(Y$)
10150 REM
10160       IF D=0 THEN E$="DAY CANNOT BE 0":RT=1:RETURN
10170       IF D)31 THEN E$="DAY CANNOT BE MORE THAN 31":RT=1:RETURN
10180       IF M=0 THEN E$="MONTH CANNOT BE ZERO":RT=1:RETURN
10190       IF M)12 THEN E$="MONTH CANNOT BE MORE THAN 12":RT=1:RETURN
10200       IF M=4 AND D)30 THEN E$="APRIL HAS ONLY 30 DAYS":RT=1:RETURN
10210       IF M=6 AND D)30 THEN E$="JUNE HAS ONLY 30 DAYS":RT=1:RETURN
10220       IF M=9 AND D)30 THEN E$="SEPT HAS ONLY 30 DAYS":RT=1 RETURN
10230       IF M=11 AND D)30 THEN E$="NOV HAS ONLY 30 DAYS":RT=1:RETURN
10240       IF M () 2 THEN GOTO 10300
10250       IF Y MOD 4 = 0 AND D(30 THEN GOTO 10300
10260       IF Y MOD 4 () 0 AND D(29 THEN GOTO 10300
10270       E$="TOO MANY DAYS FOR FEB":RT=1:RETURN
10280 REM
10290 REM
10300 REM   DATE IS VALID
10310 REM
10320 REM   SAVE FOR USE AS PREVIOUS DATE
10330 REM
10340       PD$ = D$
10350       PM$ = M$
10360       PY$ = Y$
10370 REM
10380       RT=0
10385       GOSUB 9000 : REM RESET ALL ITEMS
10390 REM
10400       RETURN
10410 REM
```

PROGRAMS

TRS-80 Target Practice

by Gordon Mills

```
1 '********************************
2 'COPYRIGHT - GORDON MILLS (1980).
3 '********************************
5 DIMA(31)
7 ONERRORGOTO0280
10 CLS
15 SH=15:ST=15
20 PRINTCHR$(23)
30 PRINT@268,"TARGET PRACTICE"
40 FOR TD=1 TO 1000:NEXT
50 CLS:PRINT:PRINT"THIS IS A GAME FOR TWO PLAYERS -"
51 PRINT:PRINTTAB(6)"THE OBJECT OF THE GAME IS TO DESTROY AS MANY TARGETS"
53  PRINTTAB(7)"AS POSSIBLE WITH YOUR FIFTEEN SHOTS.  THE PLAYER ON"
55  PRINTTAB(7)"THE LEFT USES THE LETTER 'Z' AND THE PLAYER ON THE"
57 PRINTTAB(6)"RIGHT THE '/' TO FIRE THE MISSILE.  THE SPEED OF THE"
58 PRINTTAB(6)"MISSILE LAUNCHER MAY BE VARIED BETWEEN FAST AND SLOW."
60 PRINT:INPUT"        ENTER THE NAME OF THE FIRST PLAYER";A$
70 PRINT:INPUT"    ENTER THE NAME OF THE SECOND PLAYER";B$
80 PRINT:PRINT"ENTER SPEED (1 FAST - 10 SLOW)"
90 PRINT:PRINTA$;:PRINT" ";:INPUTA
92 IF A<1 OR A>10 THEN 90
95 PRINT:PRINTB$;:PRINT" ";:INPUTB
97 IF B<1 OR B>10 THEN 95
100 CLS
105 DATA 1,2,3,4,5,6,7,8,9,10,11,12,13,14,15,16,17,18,19,20,
     21,22,23,24,25,26,27,28,29,30,31
106 FOR L=1 TO 31:READ A(L):NEXT L
110 FOR Z=1 TO 10
120 M=RND(31)
130 IF A(M)=0 THEN 120
140 IF M=31 THEN M=10
145 IF M<2 THEN M=2
150 N=M+32
155 IF M+Z*64=0 THEN M=10+Z
160 PRINT@M+Z*64,"#"
170 PRINT@N+Z*64,"*"
175 A(M)=0
180 NEXT Z
200 Y=43
210 FOR X=0 TO 127
220 SET(X,Y)
230 NEXT X
233 PRINT@960,A$;
235 PRINT@995,B$;
240 X=63
250 FOR Y=3 TO 42
260 SET(X,Y)
270 NEXT Y
```

```
280 CT=CT+1:IF CT=150 THEN 800
282 IF SH=0 THEN 310
285 FOR X=1 TO 60
290 Y=42
300 SET(X,Y)
303 FOR TD=1 TO A:NEXTTD
304 RESET(X,Y)
305 G$=INKEY$:IF G$="" THEN 308
306 IF G$="Z" THEN GOSUB 460:GOTO 310
308 NEXT X
310 IF ST=0 THEN 280
315 FOR X=65 TO 127
320 Y=42
330 SET(X,Y)
333 FOR TD=1 TO B:NEXTTD
334 RESET(X,Y)
335 H$=INKEY$:IF H$="" THEN 338
336 IF H$="/" THEN GOSUB 660:GOTO 280
338 NEXT X
340 GOTO 280
460  PRINT@974,"                    ";:SH=SH-1:PRINT@974,SH" SHOTS LEFT";
470 FOR Y=41 TO 3 STEP -2
490 SET(X,Y)
500 FOR W= 1TO 5
510 NEXT W
520 RESET (X,Y)
530 NEXT Y
535 RETURN
660 PRINT@1007,"                    ";:ST=ST-1:PRINT@1007,ST" SHOTS LEFT";
680 FOR Y=41 TO 3 STEP -2
690 SET(X,Y)
700 FOR W=1 TO 5
710 NEXT W
720 RESET(X,Y)
730 NEXT Y
735 RETURN
750 GOTO 280
800 CLS:PRINT:PRINTTAB(10)"DO YOU WANT TO PLAY AGAIN (Y/N)";:INPUTQ$
810 IF Q$="Y" THEN RUN
820 IF Q$<>"N" THEN 800
830 CLS:PRINT:PRINT:PRINT:PRINTTAB(20)"THANK YOU FOR PLAYING"
840 FOR TD=1 TO 1000:NEXT
```

TRS-80 Four in a row

by Spiesoft

This program displays an 8 x 8 grid and two players take turns dropping 'chips' into it. First player to get four in a row wins. Sadly the program doesn't tell you though.

```
I150 'FOUR-IN-A-ROW'
60 'AN ORIGINAL PROGRAM BY SPIESOFT'
70 CLS:INPUT"THE FIRST PLAYER'S NAME";W$
80 INPUT"THE SECOND PLAYER'S NAME";B$
90 CLS:FORY=15TO47STEP4:FORX=28TO108:
   SET(X,Y):NEXTX:NEXTY
100 FOR X=28TO110STEP10:FORY=15TO47:
   SET(X,Y):NEXTY:NEXTX
110 PRINT@272,"1    2    3    4
   5    6    7    8";
120 PRINT@448,"PLAYER 1 :";
130 PRINT@512,"- ";W$;" -";
140 PRINT@576,"PLAYER 2 :";
150 Q=1:PRINT@640,"- ";B$;" -";
160 Z1=0:PRINT@0,"PLAYER";Q:INPUTA
170 IFA<0THEN160
175 IFA>8THEN 160
180 IFA=1THENVV=34
190 IFA=2THENVV=44
200 IFA=3THENVV=54
210 IFA=4THENVV=64
220 IFA=5THENVV=74
230 IFA=6THENVV=84
240 IFA=7THENVV=94
250 IFA=8THENVV=104
260 CC=44
270 IFPOINT(VV-1,CC)THEN280ELSE310
280 Z1=Z1+4:CC=CC-4
```

```
290 IFCC=12THEN350ELSE300
300 GOTO270
310 FORXX=0TO2STEPQ:FORA1=29TO38STEP2:
    SET(A1+(10*(A-1)),44-Z1+XX):NEXTA1:NEXTXX
320 IFQ=2THENQ=1ELSEQ=2
330 GOTO160
340 END
350 PRINT@95,"THAT ROW IS ALREADY OCCUPIED";:
    FORX3=1TO500:NEXTX3:GOTO160
```

PET Maze chase

by Steve Clark

The rest of this month's programs are all for the PET. This isn't a secret plot to promote Commodore's products, it's simply that we receive an enormous number of programs for this machine. Inevitably, by the time the 'bad' are weeded out, we end up looking like a Commodore benevolent society. How about it all you users of other machines? — send in your good programs. After all we do pay and we don't mind what the program is as long as it's in Basic, original, bug free and interesting.

All listings are courtesy of Steve Clark and done on a printer borrowed from Cream Computers.

```
10 PRINT"▮"TAB(12)"MAZE CHASE":PRINTTAB(12)"──────────"
15 FORT=1TO500:NEXT
20 T$="▮▮IN THIS GAME TWO DRIVERS HURTLE ROUND A":GOSUB5000
30 T$=" MAZE AT TOP SPEED.":GOSUB5000
35 FORT=1TO500:NEXT
40 PRINT T$="▮EACH AIMS TO SCORE POINTS BY RUNNING":GOSUB5000
50 T$="    DOWN OBJECTS IN HIS PATH AND BY SHOOTING":GOSUB5000
60 T$="MISSILES AT HIS OPPONENT.":GOSUB5000
65 FORT=1TO500:NEXT
70 PRINT T$="▮▮YOU SCORE POINTS AS FOLLOWS:":GOSUB5000
75 FORT=1TO500:NEXT
80 PRINT T$="▮      '.' = 10 POINTS":GOSUB5000
90 PRINT T$="          = 50 POINTS":GOSUB5000
95 FORT=1TO500:NEXT
100 PRINT:T$="▮DESTROYING OPPONENT SCORES 1000":GOSUB5000
105 FORT=1TO1000:NEXT
110 PRINT:T$="▮▮▮     HIT ANY KEY TO CONTINUE":GOSUB5000:POKE158,0:WAIT158,1
115 POKE158,0
120 T$="▮CONTROLS ARE AS FOLLOWS:":PRINT:GOSUB5000:FORT=1TO500:NEXT
130 PRINT:T$="▮▮     PLAYER #1             PLAYER #2":GOSUB5000
140 PRINT:PRINT"▮         W                      8  "
150 PRINT"          |                      | "
160 PRINT"        A-◆-D                  4-#-6"
170 PRINT"          |                      | "
180 PRINT"          X                      2  "
185 FORT=1TO1000:NEXT
190 PRINT:T$="▮▮HIT 'S' AND '5' RESPECTIVELY TO FIRE.":GOSUB5000
200 PRINT:T$="▮▮▮THE COMPUTER MAY PLACE EXTRA WALLS IN   THE WAY SOMETIMES."
205 GOSUB5000:FORT=1TO500:NEXT
210 PRINT T$="▮THESE WALLS LOOK LIKE THIS: '▒' AND THEYCAN BE DESTROYED."
215 GOSUB5000
220 PRINT:T$="▮   HIT ANY KEY TO START":GOSUB5000:POKE158,0
230 GETQ$:IFQ$=""THEN230
240 PRINT:T$="▮▮▮▮▮▮▮▮▮▮▮YOU HAVE THREE MINUTES, STARTING":GOSUB5000
250 FORT=1TO1000:NEXT:PRINT" NOW"
260 FORT=1TO1000:NEXT:GOSUB1000
490 POKE158,0
500 IFT$="000500"THEN6000
510 GETQ$:IFQ$=""THEN620
520 IFVAL(Q$)<>0THEN580
530 IFQ$="W"THEND1=1
540 IFQ$="A"THEND1=2
550 IFQ$="D"THEND1=3
560 IFQ$="X"THEND1=4
565 IFQ$="S"ANDM1=32767THENM3=D1:M1=A:Y=32
570 GOTO620
580 IFQ$="8"THEND2=1
590 IFQ$="4"THEND2=2
600 IFQ$="6"THEND2=3
610 IFQ$="2"THEND2=4
615 IFQ$="5"ANDM2=32767THENM4=D2:M2=B:L=32
620 X=INT(RND(1)*10):IFX=0THENX=INT(RND(1)*800+32888):XX=PEEK(X):GOTO7000
625 X=INT(RND(1)*1000+32767):IFPEEK(X)=32THENPOKEX,46
627 X=INT(RND(1)*1000+32767):IFPEEK(X)=32THENPOKEX,58
630 OND1GOTO640,650,660,670
640 Z=-40:GOTO680
650 Z=-1:GOTO680
660 Z=1:GOTO680
670 Z=40
680 X=PEEK(A+Z)
690 IFX=32THEN730
700 IFX=46THENS1=S1+10:GOTO730
710 IFX=58THENS1=S1+50:GOTO730
720 POKEA,90:GOTO740
730 POKEA,32:A=A+Z:POKEA,90
740 OND2GOTO750,760,770,780
750 Z=-40:GOTO790
760 Z=-1:GOTO790
770 Z=1:GOTO790
780 Z=40
790 X=PEEK(B+Z)
800 IFX=32THEN840
810 IFX=46THENS2=S2+10:GOTO840
820 IFX=58THENS2=S2+50:GOTO840
830 POKEB,35:GOTO850
840 POKEB,32:B=B+Z:POKEB,35
850 IFM1<>32767THEN3000
860 IFM2<>32767THEN3500
870 GOSUB2000
880 GOTO500
1000 REM***SET UP BOARD***
1010 PRINT"▮":FORT=32768TO32847:POKET,160:NEXT
1020 FORT=32768TO33728STEP40:POKET,160:NEXT
1030 FORT=32807TO33767STEP40:POKET,160:NEXT
```

PROGRAMS

```
1040 FORT=33728TO33767:POKET,160:NEXT
1050 FORT=32931TO33131STEP40:POKET,160:NEXT
1060 POKE32932,160:POKE32933,160:POKE32972,160:POKE32973,160
1070 FORT=1TO4:POKE32989+T,160:POKE32949+T,160:NEXT
1080 FORT=32994TO33314STEP40:POKET,160:NEXT
1090 FORT=33304TO33314:POKET,160:NEXT
1100 POKE32943,160:POKE33042,160:POKE33122,160
1110 FORT=32996TO33196STEP40:POKET,160:POKET+4,160:NEXT
1120 FORT=1TO4:POKE32956+T,160:POKE32996+T,160:NEXT
1130 FORT=1TO4:POKE33383+T,160:POKE33423+T,160:POKE33460+T,160:POKE33500+T,160
1140 NEXT:FORT=33506TO33511:POKET,160:NEXT
1150 FORT=1TO5:POKE33388+T,160:POKE33428+T,160:POKE33586+T,160:POKE33626+T,160
1160 FORT=1TO5:POKE33388+T,160:POKE33428+T,160:POKE33586+T,160:POKE33626+T,160
1165 NEXT
1170 FORT=33393TO33593STEP40:POKET,160:POKET+1,160:NEXT:POKE33592,160
1180 FORT=33279TO33639STEP40:POKET,160:NEXT
1190 FORT=33204TO33484STEP40:POKET,160:NEXT
1200 FORT=33479TO33484:POKET,160:POKET+160,160:NEXT
1210 FORT=33520TO33600STEP40:POKET,160:POKET+1,160:NEXT
1220 POKE33280,160:POKE33202,160:POKE33203,160
1230 FORT=1TO20:POKE33052+T,160
1240 IFT>6ANDT<17THENPOKE33012+T,160
1250 IFT>12ANDT<17THENPOKE32972+T,160
1260 IFT>14ANDT<17THENPOKE32932+T,160
1270 IFT<2THENPOKE33092+T,160:POKE33132+T,160
1280 IFT<7THENPOKE33212+T,160
1290 NEXT
1300 POKE33112,160:POKE33152,160:POKE33192,160
1305 POKE33094,160:POKE33134,160
1310 FORT=32937TO32941:POKET,160:NEXT
1320 FORT=32975TO32977:POKET,160:NEXT
1330 FORT=33454TO33459:POKET,160:POKET+40,160:NEXT
1340 FORT=33572TO33575:POKET,160:POKET+40,160:NEXT
1350 POKE33534,160:POKE33535,160
1360 FORT=33282TO33402STEP40:POKET,160:NEXT
1370 POKE33361,160:POKE33401,160
1380 FORT=33136TO33150:POKET,160:NEXT
1390 FORT=33293TO33302:POKET,160:NEXT
1400 FORT=33177TO33257STEP40:POKET,160:POKET+1,160:NEXT
1410 POKE33341,160:POKE33342,160:POKE33381,160:POKE33382,160
1420 FORT=33577TO33585:POKET,160:NEXT
1430 POKE33625,160:POKE33617,160
1440 FORT=33078TO33198STEP40:POKET,160:NEXT
1450 FORT=0TO4:POKE33211+T,160:POKE33211+40*T,160:NEXT
1460 FORT=33372TO33379:POKET,160:NEXT
1470 FORT=33276TO33636STEP40:POKET,160:POKET+1,160:NEXT
1480 FORT=32849TO32886:POKET,160:POKET+840,160:NEXT
1490 FORT=32849TO33689STEP40:POKET,160:POKET+37,160:NEXT
1500 FORT=33450TO33650STEP40:POKET,160:NEXT
1510 FORT=33659TO33663:POKET,160:NEXT
1520 POKE33451,160:POKE33452,160:POKE33491,160:POKE33492,160
1530 POKE33673,160:POKE33674,160:POKE33564,160:POKE33565,160
1540 POKE32895,160:POKE32905,160:POKE32915,160:POKE33565,160
1550 FORT=32964TO33124STEP40:POKET,160:NEXT:POKE32962,160:POKE32963,160
1560 POKE32889,90:POKE32926,35
1565 POKE33563,160
1567 FORT=33166TO33171:POKET,32:NEXT
1568 FORT=33526TO33531:POKET,32:NEXT
1570 FORT=1TO100
1580 X=INT(RND(1)*1000+32768):IFPEEK(X)<>32THEN1580
1590 POKEX,46:NEXT
1600 FORT=1TO50
1610 X=INT(RND(1)*1000+32768):IFPEEK(X)<>32THEN1610
1620 POKEX,58:NEXT
1621 FORT=1TO10
1622 X=INT(RND(1)*800+32888):IFPEEK(X)<>32ANDPEEK(X)<>160THEN1622
1623 POKEX,102:NEXT
1630 REM***INITIALIZE***
1640 S1=0:S2=0:A=32889:B=32926:M1=32767:M2=M1:TI$="000000":GOSUB2000:RETURN
2000 REM***INFORMATION***
2010 PRINT"SCORE 1:"S1TAB(25)"TIME: "MID$(TI$,4,1)"."RIGHT$(TI$,2)""
2020 PRINT"SCORE 2:"S2""
2025 IFTI$="000300"THEN6000
2030 RETURN
3000 FORT=1TO2
3010 ONM3GOTO3020,3030,3040,3050
3020 Z=-40:P=93:GOTO3060
3030 Z=-1:P=64:GOTO3060
3040 Z=1:P=64:GOTO3060
3050 Z=40:P=93
3060 X=PEEK(M1+Z)
3070 IFX=102THENPOKEM1,Y:POKEM1+Z,42:FORTT=1TO250:NEXT:POKEM1+Z,32:M1=32767:GOT
O860
3080 IFX=160THENPOKEM1,Y:M1=32767:GOTO860
3090 IFX=35THEN3110
3100 POKEM1,Y:M1=M1+Z:POKEM1,P:Y=X:NEXT:GOTO860
3110 POKEM1,Y:POKEM1+Z,42:FORTT=1TO250:NEXT:POKEM1+Z,32
3115 B=INT(RND(1)*1000+32768):IFPEEK(B)<>32THEN3115
3116 POKEB,35
3120 M1=32767:S1=S1+1000:GOTO860
3500 FORT=1TO2
3510 ONM4GOTO3520,3530,3540,3550
3520 Z=-40:P=93:GOTO3560
3530 Z=-1:P=64:GOTO3560
3540 Z=1:P=64:GOTO3560
3550 Z=40:P=93
3560 X=PEEK(M2+Z)
3570 IFX=102THENPOKEM2,L:POKEM2+Z,42:FORTT=1TO250:NEXT:POKEM2+Z,32:M2=32767:GOT
O870
3580 IFX=160THENPOKEM2,L:M2=32767:GOTO870
3590 IFX=90THEN3610
3600 POKEM2,L:M2=M2+Z:POKEM2,P:L=X:NEXT:GOTO870
3610 POKEM2,L:POKEM2+Z,42:FORTT=1TO250:NEXT:POKEM2+Z,32
3615 A=INT(RND(1)*1000+32768):IFPEEK(A)<>32THEN3615
3616 POKEA,90
3620 M2=32767:S2=S2+1000:GOTO870
4999 END
5000 REM***SLOW WRITER***
5010 FORW=1TOLEN(T$):PRINTMID$(T$,W,1);:FORV=1TO25:NEXTV,W:RETURN
6000 IFS1>HSTHENHS=S1:HS$="HIGH SCORE BY PLAYER #1:"
6010 IFS2>HSTHENHS=S2:HS$="HIGH SCORE BY PLAYER #2:"
6020 PRINT:T$="TIME UP":GOSUB5000
6022 IFS1>S2THENT$="PLAYER #1 WINS":PRINT:P1=P1+1:GOSUB5000:GOTO6030
6024 IFS2>S1THENT$="PLAYER #2 WINS":PRINT:P2=P2+1:GOSUB5000:GOTO6030
6025 GD=GD+1:PRINT:T$="GAME DRAWN":GOSUB5000
6030 PRINT:T$=""+HS$+STR$(HS):GOSUB5000
6035 PRINT:T$="GAMES DRAWN:"+STR$(GD):GOSUB5000
6036 PRINT:T$="GAMES TO PLAYER #1:"+STR$(P1):GOSUB5000
6037 PRINT:T$="GAMES TO PLAYER #2:"+STR$(P2):GOSUB5000
6040 FORT=1TO5500:NEXT:PRINT:T$="DO YOU WANT ANOTHER GAME":GOSUB5000
6045 POKE158,0
6050 INPUTQ$:IFLEFT$(Q$,1)="Y"THEN240
6060 END
7000 IFXX=32ORXX=160THENPOKEX,102:GOTO625
7010 GOTO625
```

PET Convoy

by Jeff Aughton

Here's a challenging game in which you have to land shells on a flotilla of moving ships. Once the ships reach the edge of the screen the game terminates. It gets progressively more difficult to play as your skills increase.

```
10 REM CONVOY BY J.AUGHTON
15 GOSUB1000
20 N=3:U=.058:V=.04:P=π/180
30 DIMM(13),S(9)
40 B=0:E=10:H=0:K=0:R=0:L=33733
60 RESTORE:FORI=0TO13:READM(I):NEXT
70 REM DRAW
80 PRINT"",:FORI=1TO19:PRINT"     ";
90 NEXT:PRINT"   "
100 PRINTTAB(29)"          "
110 PRINTTAB(31)"        "
120 PRINTTAB(33)"      "
130 PRINTTAB(36)"   "
140 PRINTTAB(37)"  "
150 PRINT"  "
160 PRINT"     "
170 PRINT"      "
180 PRINT"        "
190 PRINT"          "
200 PRINT"          "
210 PRINT"      +      "
230 FORI=32807TO33767STEP40
240 POKEI,96:NEXT
250 FORI=7TO33:POKEL+I,96:NEXT
260 FORI=1TON:READX:S(I)=X+32888
270 POKES(I),113:NEXT:SB=TI
280 PRINT"  HITS";H;"   ELEVATION";
290 PRINT"";E;"   BEARING";B;" "
300 K=K+1:IFK>NTHENK=1
320 M=PEEK(151)
330 E=E-(E>10)*(M=18)+(E<85)*(M=50)
340 B=B-(B>-5)*(M=42)+(B<90)*(M=41)
360 IF(M<>34)ORRTHEN420
370 POKE59409,52:FORI=1TO7
375 TS=200*SIN(E*P):NEXT
380 POKE59409,60:T=TI
390 R=23*SIN(2*E*P)
400 X=INT(1.2*R*SIN(B*P)+.5)
410 Y=INT(R*COS(B*P)+.5)
420 IFRAND(TI>T+TS)THEN600
430 D=-(RND(1)<U)-40*(RND(1)<V)
440 M=S(K)+D:IFPEEK(M)=96THEN920
450 IFPEEK(M)<>32THEN280
460 POKES(K),32:S(K)=M
500 POKES(K),113:GOTO280
600 REM SHELL LANDS
610 R=0:W=3:Q=L+X-40*Y
620 IFPEEK(Q)=113THENW=10
630 FORI=1TO5:POKEQ,182-I:GOSUB960
640 POKEQ,32:GOSUB960:NEXT
650 FORI=-3TO3:T(I+3)=PEEK(Q+I)
660 POKEQ+I,M(I+W):NEXT
670 IFW=3THEN720
690 FORI=1TON:IFS(I)<>QTHENNEXT
700 S(I)=S(N):N=N-1:H=H+1:T(3)=43
720 FORI=1TO500:NEXT
730 FORI=-3TO3:POKEQ+I,T(I+3)
740 NEXT:IFNTHEN280
800 REM ALL DESTROYED
810 T=INT((TI-SB)/60):POKE525,0
815 PRINT"** GAME OVER **
820 PRINT"YOU DESTROYED";H;"SHIPS
830 PRINT"YOUR TIME WAS";T;"SECS
840 IFKTHEN880
850 PRINT"BECAUSE OF YOUR MISERABLE";
860 PRINT" FAILURE YOU   MUST TYPE ";
865 PRINT"RUN IF YOU WANT TO PLAY ";
870 PRINT"AGAIN": END
880 PRINT"PRESS SPACE FOR A HARDER GAME
890 GETA$:IFA$<>" "THEN890
900 IFH=9THENH=8:U=2*U:V=2*V
910 N=H+1:GOTO40
920 POKES(K),32:FORI=0TO9:POKEM,241
930 PRINT"** SHIP ESCAPES! **
940 GOSUB960:POKEM,113:GOSUB960:NEXT
950 K=0:GOTO810
960 FORJ=0TO70:NEXT:RETURN
970 DATA 147,144,140,129,147,136,161
980 DATA 160,130,143,143,141,161,160
990 DATA 2,7,43,129,50,83,166,89,125
1000 PRINT"A CONVOY OF SHIPS IS SAI";
1020 PRINT"LING S-E AND YOUHAVE TO ";
1030 PRINT"DESTROY THEM ALL USING TH";
1040 PRINT"E GUN  (+) IN THE BOTTOM";
1050 PRINT" CORNER OF THE SCREEN.
1060 PRINT"ELEVATION IS MEASURED I";
1070 PRINT"N DEGREES (10-85)FROM TH";
1080 PRINT"E HORIZONTAL.TO INCREASE ";
1090 PRINT"PRESS 8,TO DECREASE PR";
1100 PRINT"ESS 2.MAXIMUM RANGE OCC";
1110 PRINT"URSWHEN ELEVATION=45 DEG.
1120 PRINT"BEARING IS MEASURED IN";
1130 PRINT" DEGREES FROM -5  THROUG";
1140 PRINT"H 0 (NORTH) TO 90 (EAST).";
```

```
1150 PRINT"INCREASE ▓BY PRESSING ▓6▓";
1160 PRINT",DECREASE BY PRESSING ▓4▓."
1170 PRINT"▓▓TO FIRE (AND START THE ";
1180 PRINT"GAME) PRESS ▓5▓.
1190 GETA$:IFA$<>"5"THEN1190
1200 RETURN
```

PET Wire

by Paul Makin

This game simulates the said show game in which you have to pass a metal ring along a bent wire without ringing a bell. Only one tiny piece of the wire is on view in front of the ring, so swift reactions are needed.

```
2 REM**WIRE-BY PAUL MAKIN**
3 DIMB(100):GOSUB600
5 FORD=1TO18:PRINT"▓";:NEXTD
10 N=33183:M=33183
60 POKEM,64:M=M+1:GOTO80
80 FORZ=1TO100:IFZ>5THEN105
90 B(Z)=1:IFZ=1THEN200
102 GOTO110
105 GOSUB400
107 O=O+B(Z)
108 IFINT((O-32767)/40)<>(O-32767)/40ANDO>32807ANDO<33600THEN110
109 O=O-B(Z):GOTO105
110 IFB(Z)=B(Z-1)THEN200
120 IFB(Z-1)=1ANDB(Z)=40THENPOKEM,110:M=M+40:GOTO230
130 IFB(Z-1)=1ANDB(Z)=-40THENPOKEM,125:M=M-40:GOTO230
140 IFB(Z-1)=-1ANDB(Z)=40THENPOKEM,112:M=M+40:GOTO230
150 IFB(Z-1)=-1ANDB(Z)=-40THENPOKEM,109:M=M-40:GOTO230
160 IFB(Z-1)=40ANDB(Z)=1THENPOKEM,109:M=M+1:GOTO230
170 IFB(Z-1)=40ANDB(Z)=-1THENPOKEM,125:M=M-1 GOTO230
180 IFB(Z-1)=-40ANDB(Z)=1THENPOKEM,112:M=M+1:GOTO230
190 IFB(Z-1)=-40ANDB(Z)=-1THENPOKEM,110:M=M-1:GOTO230
200 IFB(Z)=1THENPOKEM,64:M=M+1:GOTO230
205 IFB(Z)=-1THENPOKEM,64:M=M-1:GOTO230
210 IFB(Z)=40THENPOKEM,93:M=M+40:GOTO230
215 IFB(Z)=-40THENPOKEM,93:M=M-40
230 IFZ 2THEN260
240 A$="6":POKEN,42:N=N+1:GOTO335
260 POKEN,42
270 GETB$:IFB$=""THEN300
280 A$=B$
300 IFA$="8"THENN=N-40:P$="8":GOTO335
310 IFA$="6"THENN=N+1:P$="6":GOTO335
320 IFA$="2"THENN=N+40:P$="2":GOTO335
330 IFA$="4"THENN=N-1:P$="4":GOTO335
332 A$=P$:GOTO300
335 IFPEEK(N)=32ORPEEK(N)=42THEN350
337 FORW=1TO100*Y:NEXTW:NEXTZ
340 PRINT"TIME UP":GOTO1050
350 PRINT"MISSED":GOSUB1000
351 FORW=1TO300:NEXTW:PRINT"ANOTHER GAME?":POKE158,0
352 GETQ$:IFQ$=""THEN352
353 IFQ$<>"Y"THENEND
354 GOSUB710:GOTO5
360 PRINT"WELL DONE":END
400 C=INT(5*RND(1))
410 ONCGOTO420,430,440,450
420 B(Z)=1:IFB(Z-1)=-1THEN400
425 GOTO460
430 B(Z)=-1:IFB(Z-1)=1THEN400
435 GOTO460
440 B(Z)=40:IFB(Z-1)=-40THEN400
445 GOTO460
450 B(Z)=-40:IFB(Z-1)=40THEN400
460 O=M+5:RETURN
600 PRINT"▓";TAB(16);"▓WIRE▓"
610 PRINT"▓▓IN THIS GAME,YOU MUST FOLLOW";
620 PRINT" A WIRE,    WHICH WILL ONLY APPEAR",
630 PRINT" ONE SQUARE AHEAD OF YOU,THE'*'."
640 PRINT" MOVE IN THE USUAL WAY,I.E."
650 PRINT"▓▓▓▓▓8-UP"
660 PRINT"▓▓▓▓▓6-RIGHT"
670 PRINT"▓▓▓▓▓2-DOWN,AND"
680 PRINT"▓▓▓▓▓4-LEFT"
681 PRINT"IT IS ONLY NECESSARY TO PRESS A KEY TO  CHANGE DIRECTION-NOT EVERY MO
VE.";
682 PRINT"TO DO   WELL AT WIRE,I WOULD ADVISE YOU TO ";
684 PRINT"ROCK BETWEEN THE KEYS AS THE WIRE ADVANCES."
686 PRINT"YOUR FIRST TRY...."
690 PRINT"▓PRESS ANY KEY TO START"
700 GETR$:IFR$=""THEN700
710 PRINT"SET ABILITY(1-5,AMAZING-POOR)"
720 GETW$:IFW$=""THEN720
730 Y=VAL(W$):IFY<1ORY>5THEN710
740 PRINT"▓▓                    WIRE                    ▓"
900 RETURN
1000 PRINT"SCORE=";(INT(Z/101*1000))/10;"▓%";
1010 IFZ>20THEN1020
1015 PRINT"-USELESS!":RETURN
1020 IFZ>80THEN1030
1025 PRINT"-ACCEPTABLE":RETURN
1035 PRINT"-NEAR PERFECT!":RETURN
1050 PRINT"SCORE=100%-EXCELLENT!":GOTO351
```

PROGRAMS

PET Android Attack

by P Farquhar

This is a sort of sideways-on version of Space Invaders. The idea is to prevent the androids getting to the right hand edge of the screen.

```
5 GOSUB3000
8 HS=0
10 M=33196:A=0:E=24:NJ=0:V=0:WR=-2:VC=1:C1=0
30 PR=0:RF=0:HC=0:PH=0:WQ=20:PC=0:GC=0:SC1=0:
40 PL$="▀▄▁▁▁":PT$="▌▀▀▀▀▐":PS$="■  "
50 GOSUB1260:GOTO1310
60 TT=0:GOTO90
70 FORP=32801TO33601STEP40:POKEP,103:NEXT
80 POKE32845,31:POKE32925,31:RETURN
90 RF=0:PR=0:PC=0:HC=0:PH=0:PRINT"J"
100 Z=32813:POKEZ,112:POKEZ+20,110:POKEZ+720,109:POKEZ+740,125
110 Z=Z+82:FORY=0TO15STEP2:FORX=0TO16STEP2:POKEZ+X+(40*Y),91:NEXT:NEXT
120 Z=Z-1:FORY=0TO15STEP2:FORX=0TO19STEP2:POKEZ+X+(40*Y),64:NEXT:NEXT
130 Z=Z-39:FORY=0TO17STEP2:FORX=0TO17STEP2:POKEZ+X+(Y*40),93:NEXT:NEXT
140 Z=Z-2:FORY=0TO17STEP2:POKEZ+(Y*40),93:POKEZ+(Y*40)+20,93:NEXT
150 Z=Z+40:FORY=0TO15STEP2:POKEZ+(Y*40),107:POKEZ+(Y*40)+20,115:NEXT
160 Z=Z-79:FORX=0TO19STEP2:POKEZ+X,64:POKEZ+X+720,64:NEXT
170 Z=Z+1:FORX=0TO16STEP2:POKEZ+X,114:POKEZ+X+720,113:NEXT
180 S=3:GOSUB230
190 FORI=ZTOZ+39:POKEI,32:NEXT
200 S=S+4:GOSUB230
210 IFZ=0GOTO300
220 GOTO190
230 IFS=3THENZ=32848
240 IFS=7THENZ=33008
250 IFS=11THENZ=33168
260 IFS=15THENZ=33328
270 IFS=19THENZ=33488
280 IFS=23THENZ=0
290 RETURN
300 R=32774:FORA=57TO49STEP-1:POKER,A:R=R+2:NEXTA
310 POKER,A:POKE32792,48:R=33574:FORA=57TO49STEP-1:POKER,A:R=R+2:NEXTA
320 POKE33592,48:GOSUB1110:GOSUB70:GOTO560
330 YT=0:CC=0:HC=HC+1:PH=INT((HC*10)/100)+1
340 PRINT"SQQQQQQQQQQQQQQQQQQQQQQQ      ";PH
350 PRINT"S"
360 PC=INT(5*(RND(1))+1)
370 IFPH>5THENWQ=12
380 IFPC=1THENPC$="":CP1=32854
390 IFPC=2THENPC$="QQQQ":CP1=33014
400 IFPC=3THENPC$="QQQQQQQQ":CP1=33174
410 IFPC=4THENPC$="QQQQQQQQQQQQ":CP1=33334
420 IFPC=5THENPC$="QQQQQQQQQQQQQQQQ":CP1=33494
430 IFPH=1THENSP$="        ":X=27
440 IFPH=2THENSP$="           ":V=0:X=24:GOSUB990
450 IFPH=3THENSP$="             ":V=2:X=22:GOSUB990
460 IFPH=4THENSP$="               ":V=4:X=20:GOSUB990
470 IFPH=5THENSP$="                 ":V=6:X=18:GOSUB990
480 IFPH=6THENSP$="                   ":V=8:X=16:GOSUB990
490 IFPH=7THENSP$="                     ":V=10:X=14:GOSUB990
500 IFPH=8THENSP$="                         ":V=12:X=10:GOSUB990
510 IFPH=9THENSP$="                          ":V=14:X=9:GOSUB990
520 IFPH=10THENV=16:X=9:GOSUB990
530 IFPH=11THENV=18:X=8:GOSUB990
540 IFPH=11THENGOTO30
550 RETURN
560 GOSUB690
570 PRINT"S"
572 GOSUB330
573 PRINTPC$:PRINTSP$;
575 PRINTPT$;PS$;PL$;
580 LK=1:IFYT=XTHENSYS826:GOSUB1160
590 IFGC=3THENGOTO1230:IFLK=2THENGOTO572
600 IFLK=2THENGOTO572
620 IFMV$="F"THENGOTO640
630 GOSUB690
640 POKEM+160,32:POKEM-160,32:POKEM,31
650 IFMV$="F"THENPK=PK+12:GOSUB760
660 IFMV$="A"THENGOTO570
670 YT=YT+1:GOTO575
690 GETMV$
700 IFMV$="8"THENM=M-160:IFM<=32876THENM=32876
710 IFMV$="2"THENM=M+160:IFM>=33516THENM=33516
720 IFMV$="F"THENFR=M-2
730 RETURN
740 REM
750 FR=M-2:IFPEEK(FR-1)<>32THENGOTO840
760 IFPEEK(FR-1)=32THEN770
770 POKEFR+2,32:IFPK<>12THEN780
780 IFRF=4THENPOKEFR+3,32
790 RF=RF+2:POKEFR,32:POKEFR-2,64
800 FR=FR-2:IFPEEK(FR-1)<>32THENGOTO840
810 IFRF=WQTHENPOKEFR,32:RF=0:PK=0:MV$="":RETURN
820 MV$="F":PK=12:FORR=1TO10:GETTY$:NEXT
830 RETURN
840 PK=12:FORV=1TO4:POKEFR-V,32:NEXT:POKEFR,32:POKEFR+1,32
850 FORK=1TO500:NEXT:FORV=4TO1STEP-1:POKEFR-V,32:NEXT:GOSUB880
860 POKEFR,32:POKEFR-2,32:POKEFR+2,32:MV$="A":PK=PK+10:RETURN
880 PR=RF+2
890 IFPR<0THENPR=0
892 SX=(INT((PR/2)-3)):IFSX<0THENSX=-1
900 SC1=SX+SC1+1+NJ
910 IFSC1<0THENSC1=0
920 IFSC1>SC2THENSC2=SC1
930 FRINT"SQQQQQQQQQQQQQQQQQQQQQQQ"
940 PRINTSPC(15)SC2
950 PRINT"SQQQQQQQQQQQQQQQQQQQQQQQ"
960 PRINTSPC(30)HS
970 RF=0:RETURN
990 IFINT(HC/10)<>HC/10THENRETURN
1000 B=0:IFPH=2THENG=3:GOTO1010:G=3
1010 FORI=(32773+V+B)TO(33573+V+B)STEP40:POKEI,32:NEXT
1020 B=B+1:IFB=3THEN1060
1030 GOTO1010
1040 VC=VC+PH
1060 JK=57:GJ=PH*2+4
1070 FORI=32768+GJTO32793STEP2:POKEI,JK:JK=JK-1:NEXT
1080 JK=57:FORI=33568+GJTO33593STEP2:POKEI,JK:JK=JK-1:NEXT
1090 NJ=NJ+1
1100 RETURN
1110 PRINT"SQQQQQQQQQQQQQQQQQQQQQQQ"
```

PROGRAMS

```
1120 PRINT"PHASE        SCORE        HI-SCORE"
1130 PRINT""SPC(30)HS
1140 RETURN
1160 LK=2:FORZL=1TO750:NEXT:SYS826
1170 PRINT"      "
1180 GC=GC+1:IFGC=3THENRETURN
1190 IFGC=1THENSYS826:POKEM,214:FORU=1TO100:NEXT:SYS826:POKE32845,214
1200 IFGC=2THENSYS826:POKEM,214:FORU=1TO100:NEXT:SYS826:POKE32925,214
1210 RETURN
1230 IFSC2>HSTHENHS=SC2
1232 SYS826:POKEM,214
1235 FORU=1TO5000:NEXT:SYS826:RESTORE:TT=0:GOTO10
1240 RETURN
1260 FORN=826TO863:READA:POKEN,A:NEXT
1270 DATA169,128,133,95,169,0,133,94,162,4,160,0,177,94,201,128,48,6,56,233
1280 DATA128,76,85,3,24,105,128,145,94,200,208,236,230,95,202,208,231,96
1290 RETURN
1300 REM
1310 PRINT""
1360 PRINT"    >>>>>  ANDROID   ATTACK  <<<<<"
1390 PRINT:PRINT
1400 PRINT"            BY P.L.FARQUHAR."
1410 PRINT:PRINT
1490 FORI=1TO100:NEXT
1500 PRINT"      ";:TT=TT+1
1510 PRINTPT$;PS$;PL$;:TT=TT+1:IFTT=37THEN1530
1520 FORU=1TO50:NEXT:GOTO1510
1530 PRINTPT$;PS$;PS$;" "
1540 SYS826:FORU=1TO300:NEXT
1550 REMFORU=1TO100:SYS826:NEXT:SYS826
1560 PRINT"DO YOU WANT INSTRUCTIONS ?"
1570 GETY$:IFY$=""THEN1570
1580 IFY$<>"Y"THEN90
1590 IFY$="Y"THENPRINT"           ANDROID ATTACK"
1600 PRINT"
1610 PRINT" \ = /"
1620 PRINT"THIS LITTLE BOY HAS HIS"
1630 PRINT"LIFE THREATENED BY SOME"
1640 PRINT"MEAN AND NASTY ANDROIDS."
1650 PRINT"THEY WANT TO CAPTURE HIM"
1660 PRINT"SO THAT HIS FATHER WILL"
1670 PRINT"GIVE THEM THE SECRETS OF"
1680 PRINT"HIS COUNTRY'S LASER GUNS"
1690 FORU=1TO5000:NEXT
1700 POKE32972,251:POKE33051,87
1710 PRINT"PLEASEHELPME"
1720 PRINT"  PRESS ANY KEY"
1730 GETY$ IFY$=""THEN1730
1740 PRINT"YOU ARE IN CHARGE OF THE "
1750 PRINT"LASER GUNS AND THE      "
1760 PRINT"ANDROIDS HAVE STARTED    "
1770 PRINT"ATTACKING.               "
1780 PRINT"                         "
1790 PRINT"THREE ANDROID PLANES     "
1800 PRINT"HAVE TO GET PAST YOUR "
1810 PRINT"LASER BEFORE THEY CAN    "
1820 PRINT"CAPTURE THE LITTLE BOY. "
1830 POKE32972,236:POKE33050,74:POKE33051,64:POKE33052,75
1840 PRINT"  PRESS ANY KEY"
1850 GETY$:IFY$=""THEN1850
1860 PRINT"                              "
1870 PRINT"YOUR CONTROLS ARE :-     "
1880 PRINT"8 MOVES THE LASER UP   "
1890 PRINT"F FIRES THE LASER       "
1900 PRINT"2 MOVES THE LASER DOWN    "
1910 REMPRINT"                           "
1920 PRINT" THE SOONER YOU HIT THE "
1930 PRINT"ANDROID. THE HIGHER YOUR"
1940 PRINT"SCORE.                    "
1950 PRINT"                          "
1960 GETY$:IFY$=""THEN1960
1970 PRINT"                              "
1980 PRINT"THE DEFENCE TRACKS BECOME"
1990 PRINT"DAMAGED AS TIME GOES ON."
2000 REMPRINT"                           "
2010 PRINT"THE FATE OF THE LITTLE  "
2020 PRINT"BOY IS IN YOUR HANDS.      "
2030 PRINT"GOOD LUCK!                "
2040 PRINT"                          "
2050 PRINT"                          "
2060 GETY$:IFY$=""THEN2060
2070 GOTO90
3000 PRINT"       COPYRIGHT - P.L.FARQUHAR."
3010 PRINT"         20TH OCTOBER 1980"
3020 PRINT"      PROGRAM   ANDROID ATTACK"
3030 PRINT"         ALL RIGHTS RESERVED."
3040 FORI=1TO1000:NEXT
3050 RETURN
```

PET Anagram

by Jeff Aughton

An anagram is displayed which you have to guess within ten seconds. A visual indication of the time passing creates an alarming sense of panic. Constants M and N represent the word count and number of words given before totalling. Increase the number of words by tacking them on to the DATA statements.

```
120 REM ANAGRAM BY J.AUGHTON
130 M=60:N=10
140 DIM A(20),B(20),A$(20)
150 DEF FNR(X)=INT(X*RND(TI)+1)
160 PRINT""TAB(16)"ANAGRAM"
170 PRINT"I WILL PRINT AN ANAGRAM ";
180 PRINT"WHICH YOU HAVE  TO UNSCRA";
190 PRINT"MBLE WITHIN 10 SECONDS.ONC";
200 PRINT"E YOUHAVE TYPED A LETTER ";
```

```
210 PRINT"I WON'T LET YOU DEL-▮ETE I";
220 PRINT"T AND INCORRECT OR OVERTIM";
230 PRINT"E WORDS  ▮WILL BE CHARGED ";
240 PRINT"AT THE FULL 10 SECOND   ▮R";
250 PRINT"ATE - SO WATCH IT !!!▮▮
260 PRINT"AFTER";N;"WORDS I WILL";
270 PRINT" PRINT YOUR SCORE.▮▮
280 PRINTTAB(10)"▮PRESS SPACE TO PLAY
290 GETA$:IFA$<>" "THEN290
300 P=33607:S=0:O=0:C=0:W=0:G=0
310 PRINT"▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮
320 PRINT"┌──┬──┬──┬──┬──┬──┬──┬──┬──┬──┐";
330 PRINT"0  1  2  3  4  5  6  7  8  9▮"
340 PRINT"▮HERE IS YOUR WORD:-
350 PRINT"▮▮";TAB(14);
360 REM FIND WORD
370 RESTORE:R=FNR(M)
380 FORI=1TOR:READW$:NEXT
390 REM ANAGRAM IT
400 L=LEN(W$):FORI=1TOL:A(I)=I:NEXT
410 FORI=LTO1STEP-1:R=FNR(I)
420 B(I)=A(R):A(R)=A(I):NEXT
430 IFB(1)=1THENB(1)=B(2):B(2)=1
440 FORI=1TOL
450 PRINTMID$(W$,B(I),1);:NEXT:PRINT
460 REM INPUT ROUTINE
470 PRINT"▮▮YOUR GUESS ? ";
480 J=1:K=0:G$="":POKE525,0
490 A=TI
500 IFTI-A>15THEN550
510 GETA$(J):IFA$(J)=""THEN500
520 G$=G$+A$(J):PRINTA$(J);
530 IFJ=LTHEN700
540 J=J+1:GOTO500
550 K=K+1:POKEP+K,226:IFK<40THEN490
560 O=O+1:PRINT:PRINT"▮▮OVERTIME!!";
580 REM CHECK WORD
590 T=10:PRINT"-THE WORD IS ";W$
600 S=S+T:PRINT"▮YOUR SCORE IS:-▮
610 PRINTC;"CORRECT  ";W;"WRONG  ";
620 PRINTO;"OVERTIME"
630 FORJ=1TO2000:NEXT
640 G=G+1:IFG<NTHEN310
650 PRINT"▮AFTER";N;"WORDS YOUR ";
660 PRINT"AVERAGE TIME IS";
670 PRINT(INT(10*S/N+.5))/10
680 POKE525,0:PRINT"▮AGAIN (Y/N)?"
685 GETG$:IFG$="N"THENEND
690 IFG$="Y"THENPRINT"▮":GOTO280
695 GOTO685
700 PRINT"▮":IFG$=W$THEN720
710 W=W+1:PRINT"WRONG !!!";:GOTO590
720 C=C+1:T=K/4:PRINT"CORRECT !!!";
730 PRINT"YOU GOT IT IN";T;"SECONDS
740 GOTO600
800 DATAADULT,BATTLE,CASTLE,DENTIST
810 DATAEQUATE,FRIEND,GUITAR,HOUSE
820 DATAINSIDE,JAMBOREE,KIMONO,LEGAL
830 DATAMIGHT,NOBODY,ORACLE,PICTURE
840 DATAQUEST,RUBBER,STRENGTH,TORNADO
850 DATAURCHIN,VIVID,WITNESS,YEAST
860 DATAZEALOT,ANAGRAM,BRIGHT,CHEESE
870 DATADEPICT,ENDURE,FRIGHTEN,GHOST
880 DATAHUDDLE,ISLAND,JOUST,KITTEN
890 DATALEATHER,MATADOR,NOISE,OBVIOUS
900 DATAPREVIEW,QUIETLY,RIBBON,STRAIN
910 DATATERRIFY,UNUSUAL,VIOLENT,WHALE
920 DATAYOUTH,ZENITH,ATTIC,CUSTOM
930 DATAFEATHER,INTEREST,LICHEN,NURSE
940 DATAPASSIVE,RANCID,TREMBLE,WONDER
```

PET Obstacle Course

by I Platt

This game gets you to drive along a moving road littered with obstacles. Your success is dictated by the time elapsed before a collision.

```
10 REM
15 REM
```

PROGRAMS

```
20 REM ********************************
25 REM **                            **
30 REM **      OBSTACLE COURSE       **
35 REM ** IN PET BASIC--BY I.PLATT   **
40 REM **         MARCH 1980         **
45 REM **                            **
50 REM **    NOTE - OLD ROM PETS     **
55 REM **   CHANGE PEEKS IN LINES    **
60 REM ** 570,580,700,710 TO 515     **
65 REM ** AND ADJUST VALUES TO SUIT**
70 REM **                            **
75 REM ********************************
110 REM
115 REM ***** INSTRUCTIONS ************
120 POKE59468,14
130 PRINT"▯          ┌|●|♠┬└¯ ┬┌╱─●¯"
140 PRINT     "        ──────────────────"
150 PRINT"▧ DU ARE DRIVING A CAR ALONG AN"
160 PRINT"▧ENDLESS TRACK. |HE TRACK IS FILLED WITH"
170 PRINT"▧OBSTACLES WHICH YOU HAVE TO TRY TO"
180 PRINT"▧AVOID. ⌐F, HOWEVER, YOU HAPPEN TO CRASH"
190 PRINT"▧INTO SUCH AN OBSTACLE, THEN THAT, I'M"
200 PRINT"▧AFRAID, IS THE END OF THE GAME.  DU'RE"
210 PRINT"▧TIME WILL BE DISPLAYED AND SHOULD YOU"
220 PRINT"▧WISH TO PLAY AGAIN, YOU MAY, PROVIDED"
230 PRINT"▧WE THINK YOU HAVE DISPLAYED AN ADEQUATE"
240 PRINT"▧ABILITY"
250 PRINT"▧PRESS ANY KEY TO CONTINUE"
260 A$="":GETA$:IFA$=""THEN260
270 POKE59468,12:PRINT"▯              CONTROLS"
280 PRINT"         ─────────"
290 PRINT"▧▧▧          '4'---------- LEFT"
300 PRINT"▧▧          '6'---------- RIGHT"
310 PRINT"▧▧▧     HIT ANY KEY TO START"
320 GETA$:IFA$=""THEN320
325 REM ***** PRINT UP INITIAL TRACK **
330 PRINT"▯"
340 FORI=1TO24:PRINT"          ▚                   ▚":NEXTI
350 DATA"▚▒                ▚"
360 DATA"▚ ▒               ▚"
370 DATA"▚   ▒             ▚"
380 DATA"▚     ▒           ▚"
390 DATA"▚       ▒         ▚"
400 DATA"▚         ▒       ▚"
410 DATA"▚           ▒     ▚"
420 DATA"▚              ▒▚"
430 FORI=1TO8:READA$(I):NEXTI
440 K=32828:TIME$="000000"
450 POKEK,251:POKEK+1,236
455 REM ***** PRINT LINE OF TRACK *****
460 M=9
480 N=INT(RND(1)*2)*4-2
490 FORO=1TO2
500 M=M+N:IFM>20ORM<1THENM=M-N
510 I=INT(RND(1)*8)+1
520 FORJ=1TO2
530 PRINTTAB(M)A$(I)
540 IFPEEK(K+40)=102ORPEEK(K+41)=102THENK=K+40:GOTO650
550 IFPEEK(K)=127ORPEEK(K+1)=127THENK=K+40:GOTO650
560 POKEK,251:POKEK+1,236
565 REM ***** ACCEPT CONTROL **********
570 IFPEEK(151)=41THEND=1:GOTO600
580 IFPEEK(151)=42THEND=-1:GOTO600
590 NEXTJ:NEXTO:GOTO480
595 REM ***** MOVE CAR ****************
600 IFPEEK(K+D)=102ORPEEK(K-40+D)=102THENK=K+D:GOTO650
610 IFPEEK(K+1+D)=102ORPEEK(K-39)=102THENK=K-D:GOTO650
620 IFPEEK(K+D)=127ORPEEK(K+1+D)=127THENK=K-D
630 POKEK,32:POKEK+1,32:POKEK-40,32:POKEK-39,32:
    K=K+D:POKEK,251:POKEK+1,236
640 POKEK-40,251:POKEK-39,236:NEXTJ:NEXTO:GOTO480
645 REM ***** PRINT OUT ***************
650 POKEK-40,251:POKEK-39,236:FORX=1TO500:NEXTX
660 PRINT:PRINT"▀";
670 PRINT"▧TIME▧":PRINTMID$(TIME$,3,2);"  MINS";"
    ";RIGHT$(TIME$,2);" SECONDS
680 PRINT"▧HIT ANY KEY FOR ANOTHER GO  SPACE BAR TO▧FINISH"
690 FORX=1TO10:GETA$:NEXTX
700 IFPEEK(151)=255THEN700
710 IFPEEK(151)=6THEN730
720 GETA$:RESTORE:GOTO270
730 FORX=1TO10:GETA$:NEXTX:PRINT"▯▧▧▧HAVE A NICE DAY":END
```

LEISURE LINES

We had a very good response to Puzzle 14 — over 200 entries, in fact. Many offered five possible solutions corresponding to the ways in which the £2 could be exactly spent on the stated denominations of stamps.

But the real test was to use the information given in a logical way so as to eliminate all but the correct solution, which was:
4 x 12p stamps
6 x 14p stamps and
4 x 17p stamps.

One of our correspondents said the problem was impossible since 14p stamps don't exist! Well, I hope he has been watching the papers lately and noticed the new postal charges coming soon — don't say that *PCW* didn't give you The Warning!

Anyway, the randomly-chosen winner was Mr Peter Cowley of Wrexham. Congratulations, Mr Cowley — a book token will be on its way to you just as soon as we can wake up the Editor.

Quickie

Here's a simple multiplication problem in which each letter represents a different digit:

```
  IF X
    AT
  ----
  FIAT
```

As usual, no answers required, so no prizes.

Prize puzzle

Here's an old problem which should set a few micros and calculators whirring.

Every four years in the village of Poorihana in Burma, the rice-piling ceremony takes place at the appointed hour on the given feast day.

When the ceremony begins, one grain of rice is placed in a chosen spot outside the witch-doctor's hut. Exactly one hour later, two grains are added; after a further hour, three more grains are added and so on — every hour, one more grain is added to the pile than was added at the previous hour.

The ceremony continues non-stop until there are exactly enough grains to give each of the 23 poorest villagers a meal consisting of a quantity of rice grains that is a perfect square — each villager receives exactly the same.

Assuming that the ceremony ends before the next one begins, what is the number of rice grains that each of the 23 villagers receives?

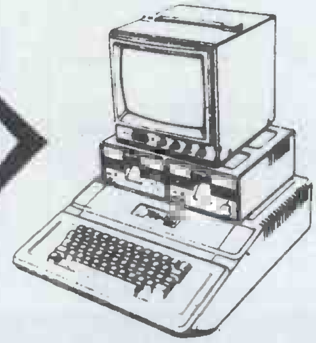
Answers on a *postcard*, please, to *Puzzle No 17*, PCW, *14 Rathbone Place, London W1P 1DE*, to arrive no later than *31 January*.

Submitting programs to PCW

Our programs section thrives on contributions from you, the readers. In particular we're looking for original ideas (no more Nim, decimal-hex conversions, Masterminds, digital clocks, etc please!) and we're not just interested in games — if you've a handy business/scientific/educational program then we'd be interested to hear from you.

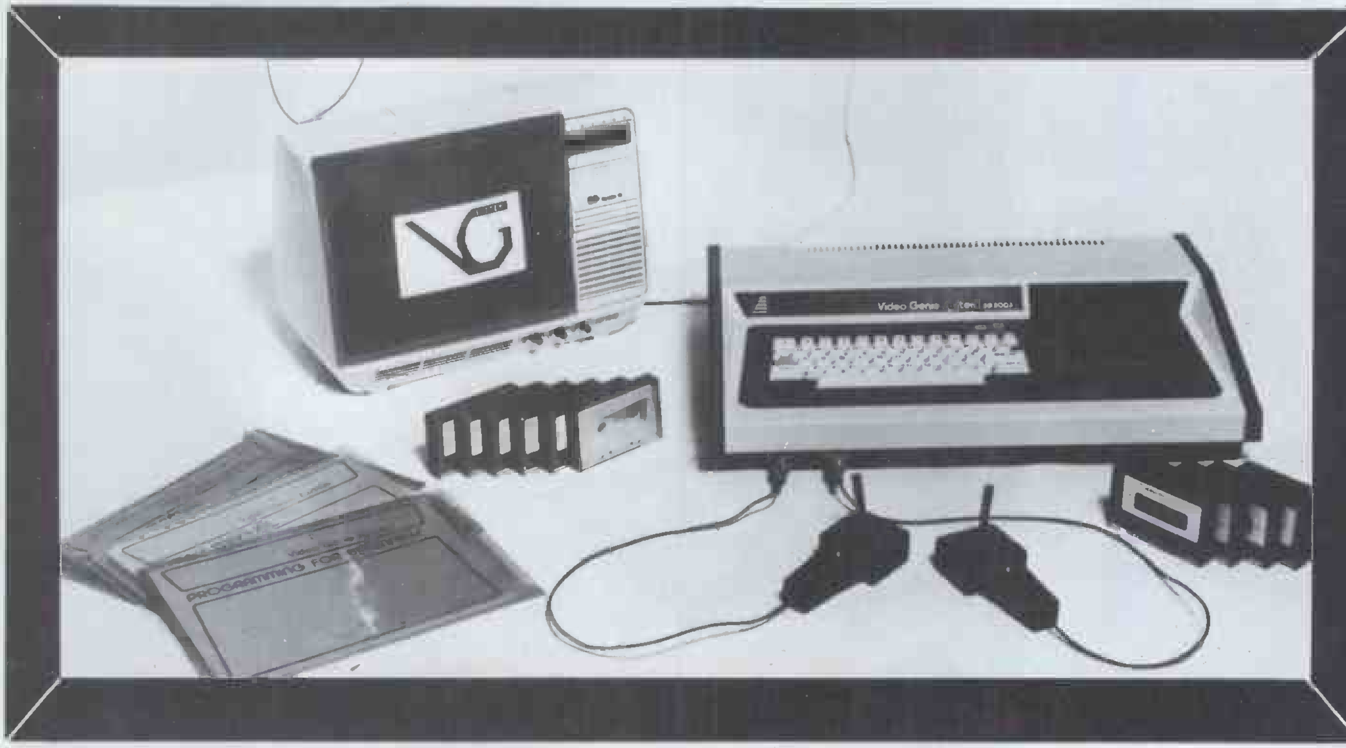
Once you've written and *thoroughly* debugged your program, send it to us on cassette or disk with, if possible, a clear printout made with a new ribbon on plain (not lined) paper. Write a covering letter stating briefly what the program is, *exactly* which machine it's for (ie old/new ROM PET, or TRS-80 Level I or II) and how much memory it requires. On a separate sheet list any special instructions which aren't included in the program and write your name and address on each piece of paper you send us as well as on the cassette/disk. If you'd like your cassette/disk returned then enclose a suitable SAE.

Send your programs to: PCW Programs, Personal Computer World, 14 Rathbone Place, London W1P 1DE.



ComServe

COMPUTER SHOP *PRESENTS*



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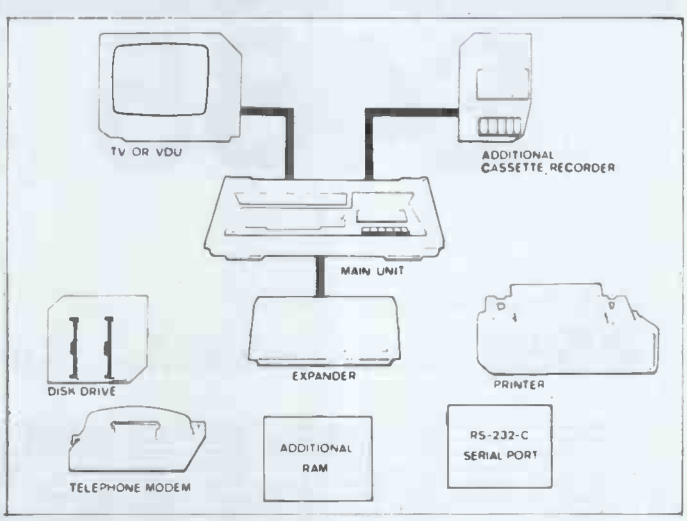

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S.A.E. for further information. Items and prices are as at time of going to press and are subject to alteration.

Price-bombing is fun...

...especially if you're the buyer!

We've bombed the prices of peripherals again...about £120 off the price of a popular terminal and printer, and a really low price on a brand-new heavy-duty printer for the commercial market.

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TVI 912C £475

Anacom 150 printer

A fast and practical printer for commercial use — printing up to four copies as well as the original. 150 characters per second, bidirectional printing, full upper and lower case character set with true descenders on a 9×9 matrix, and programmable double-width characters. Adjustable tractor feed, for up to 15" wide paper; 6 or 8 lines per inch, 10 columns per inch character spacing. Programmable top-of-form and skip controls, 11" standard form length. Parallel or serial (RS232) interfaces. **Anacom 150 £699**

now only ***£349***

Microline 80 matrix printer

Lightweight but heavy-duty, the now well-known Microline at our unbeatable price of **£349**. Full upper and lower case ASCII character set, plus 64 pixel-type graphics characters. Standard, double-width and condensed character sizes; six- and eight-lines-per-inch line-spacing. 80 characters per second print speed. New-style print head is lighter, quieter and more reliable than conventional counterparts. Pin-feed and friction feed for up to 9" paper as standard; adjustable tractor feed option. Roll-holder for paper roll as standard. Parallel interface as standard; serial interface (RS232 or 20ma) option.

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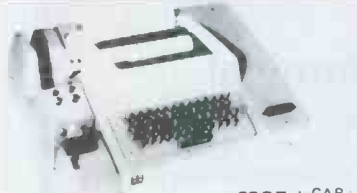
TELETYPE ASR33 I/O TERMINALS



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Fully fledged industry standard ASR33 data terminal. Many features including: ASCII keyboard and printer for data I/O, auto data detect circuitry, RS232 serial interface, 110 baud, 8 bit paper tape punch and reader for off line data preparation and ridiculously cheap and reliable data storage. Supplied in good condition and in working order. Options: Floor stand £12.50 + VAT
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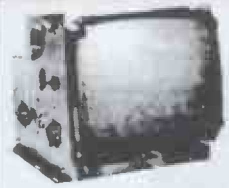
£325 + CAR + VAT

Made under licence from the world famous GE Co. The ICL Termiprinter is a small attractive unit with so many features it is impossible to list them in the space available! Brief spec. as follows; RS232 serial interface, switchable baud rates 110, 150, 300, (30 cps), upper and lower case correspondence type face, standard paper, almost silent running, form feed, electronic tab settings, suited for word processor applications plus many more features. Supplied in good condition and in working order. Limited quantity.

SCOOP PURCHASE 9" VIDEO MONITORS



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Made by the famous MOTOROLA CO. The 9" video monitor type XM226-16 is a self contained unit featuring a quoted bandwidth of 10Hz to 10MHz with 800 lines resolution at the screen centre. The printed circuit board and power transistors are both plug in for ease of servicing. All controls are easily accessible from the rear. By connection of any 75Ω composite video signal and 12v D.C. you have a professional monitor to do any MPU/CCTV system proud!
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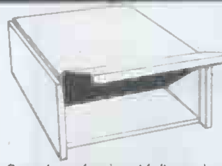

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Following the recent "SELL OUT" demand for our 5v 3 amp P.S.U. we have managed to secure a large quantity of ex-computer systems P.S.U.'s with the following spec.; 240 or 110v A.C. input. Outputs of 5v @ 3-4 amps, 7.2v @ 3 amps and 6.5v @ 1 amp. The 5v and 7.2v outputs are fully regulated and adjustable with variable current limiting on the 5v supply. Unit is self contained on a P.C.B. measuring only 12" x 5" x 3". The 7.2v output is ideal for feeding "on board" regulators or a further 3 amp LM323K regulator to give an effective 5v @ 7 amp supply.
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Believed working but untested, unguaranteed.

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VIA OUR EX-GPO MODEM UNITS

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NOTE: Units believed working, but untested, unguaranteed. Permission may be required for connection to G.P.O. lines

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*Carriage — please enquire for specific quote.

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The printer you have been waiting for
* 9x9 matrix (true descenders in lower case)
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* 96 ASCII character set, plus 64 graphics incorporating 4 switch selectable European language options.
* Programmable forms handling
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* Operator controls and indicators, including self test feature.
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128 characters maximum record size – 9 character field names.
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The ANACOM 150 CPS printer that prints its 9 x 9 dot matrix bi-directional whilst logic seeking the quickest way to print the next line, it has an 136 column format, but accepts tractor feed paper of any width, vertical format is programmable as are double width characters. Interfacing is accomplished by use of a personality board with parallel or series interface. Its modular construction combines rugged quality with convenient serviceability. It is fully warranted with a comprehensive service facility available for continued customer protection.

FEATURES: **150 chs per sec. *Bi-directional printing, logic seeking *Paper width 3" to 15" *9 x 9 Dot Matrix *Upper and lower case with descenders *Double width chs *10 chs per in - horizontal *6 or 8 lines per inch - vertical *Adjustable tractors *Original and 4 copies *Extended life head *Paper out sensor*

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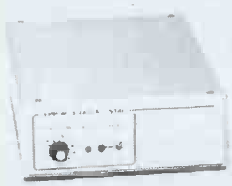
BARCLAYCARD

UV 140, UV ERASER



Two easy to use units designed for both the professional and amateur UV-prom user

Features
- Can erase up to 14 proms.
- Special short wave ultraviolet tube.
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Supplied complete with mains plug and flex

Model UV141. Price £77.70

Also available without timer as

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TEX MICROSYSTEMS "EPROMPT" UV ERASER

A low cost alternative to the above erasers (UV 140/141) claimed by the manufacturer to erase up to 32 chips in 15-30 mins. This is the cheapest eraser we have seen. The unit has no timer, power switch or safety interlock switch. The user places up to 32 chips into loose conducting foam in the erasure tray (16 along the base, 8 on each side). The chips are held in place by the UV tube which sits in the tray. (Unlike the UV 140/141, no special precautions have been taken to prevent the seepage of UV light, but the manufacturers state that incident light from this device is quite safe at distances above 12 inches.)

(Dimensions — 325×64×38mm)

EPROMPT ERASER Price £33

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4006	95p	4045	£2.63	4098	£1.92	4415V	£5.24	4536	£3.69
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4009	40p	4048	77p	40101	£1.69	4435V	£5.40	4539	97p
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4022	£1.00	4066	55p	40162	£1.54	4507	55p	4561	81p
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4031	£4.31	4076	£1.07	40257	£2.31	4518	£1.00	4583	90p
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4033	£2.63	4078	29p	4161	98p	4520	£1.00	4585	£1.27
4034	£2.00	4081	27p	4162	98p	4521	£2.50	4597	£2.44
4035	£1.10	4082	27p	4163	98p	4522	£1.11	4598	£2.98
4037	£1.99	4085	£1.35	4174	90p	4526	£1.08	4599	£6.95
4038	£1.20	4086	£1.35	4175	£1.15	4527	£1.50	4700	£1.75
4039	£2.78	4089	£2.91	4194	£1.16	4528	£1.20		
4040	£1.00	4093	80p	4408	£9.37	4529	£1.30		
4041	£1.59	4094	£2.50	4409	£9.37	4530	70p		

74C

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		74C83	£1.34	74C164	£1.08	74C904	57p	74C926	£5.01
		74C85	£1.34	74C165	£1.08	74C905	£7.53	74C927	£5.01
74C00	28p	74C86	67p	74C173	93p	74C906	57p	74C928	£5.01
74C02	28p	74C89	£4.62	74C174	93p	74C907	57p	74C929	£17.90
74C04	28p	74C90	89p	74C175	93p	74C908	£1.00	74C930	£17.90
74C08	28p	74C93	89p	74C192	£1.15	74C909	£1.69		
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74C30	28p	74C151	£2.55	74C221	£1.41	74C914	£1.66	80C98	92p
74C32	28p	74C154	£3.81	74C245	£2.98	74C915	£1.15	82C19	£6.20
74C42	95p	74C157	£2.29	74C373	£1.79	74C918	£1.10	88C29	£2.90
74C48	£1.43	74C160	£1.49	74C374	£1.79	74C921	£17.07	88C30	£2.90
74C73	57p	74C161	£1.15	74C901	57p	74C922	£3.78		
74C74	59p	74C162	£1.15	74C902	79p	74C923	£3.86		

74LS

74LS00	14p	74LS55	30p	74LS151	96p	74LS244	£1.70	74LS374	£1.95
74LS01	14p	74LS63	£1.50	74LS153	76p	74LS245	£3.50	74LS375	£1.60
74LS02	16p	74LS73	46p	74LS154	£1.70	74LS247	£1.90	74LS377	£2.12
74LS03	16p	74LS74	41p	74LS155	96p	74LS248	£1.90	74LS378	£1.84
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74LS05	20p	74LS76	40p	74LS157	76p	74LS251	£1.34	74LS384	86p
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74LS09	22p	74LS83	£1.15	74LS160	£1.28	74LS257	£1.10	74LS390	£2.30
74LS10	20p	74LS85	£1.18	74LS161	98p	74LS258	£1.46	74LS393	£2.30
74LS11	22p	74LS86	43p	74LS162	£1.38	74LS259	£1.60	74LS395	£2.18
74LS12	23p	74LS90	60p	74LS163	£1.18	74LS261	£4.50	74LS396	£2.15
74LS13	38p	74LS91	£1.04	74LS164	£1.14	74LS266	52p	74LS398	£2.76
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74LS30	22p	74LS113	50p	74LS183	£2.98	74LS298	£1.68		
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74LS54	28p	74LS145	£1.08	74LS241	£2.32	74LS367	65p		
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4.800 MHz	£3.23
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5.000 MHz	£3.23
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5.185 MHz	£3.23
6.000 MHz	£3.23
6.144 MHz	£3.23
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0.1" Pitch with copper strips

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4.7"×17.9"	£3.14

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3¾"×2½"	38p
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Terminal pins	£1.50/500
V-Q DIP board	£1.17
DIP breadboard	£2.91
Spot face cutter	93p
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SOLDERCON PINS

100 50p 1000 £3.95

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8/14/16 pin 10p/12p/13p
18/20/22 pin 18p/20p/25p
24/28/40 pin 30p/40p/50p
24 pin Textool lever type zero insertion force £8.50

EDGE CONNECTORS

43 way, 0.1" pitch, wire wrap, polarizing slot pin 37
Single sided (1×42) £3.11
Double sided (2×42) £4.10

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NE555/556 29p/49p

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CA 3130E	84p
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UA 741 (Texas)	22p

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DL-704E	99p
DL-727E/728E	£2.00
DL-747E/750E	£1.80
FND 500/560	£1.20

LIQUID CRYSTAL DISPLAY

4×0.5" Digits 40 pin DIL £9.95

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AY-5-1224A	£2.60
MK 50253	£5.50
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MK 50395/6/7	£9.90
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AC 5221S 5V/10A	£69.90
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FULLY ASSEMBLED P C B CARD 197 x 108 x 52mm Outputs +5V/6A, −5V/0.5A, +12V/1A, −12V/1A
Type AC9251 £79.80

MODULAR COMPUTER SYSTEM CARDS

A range of International (114 x 203mm) size cards which may be purchased individually as desired, or to build up a complete system. Further details available on request. All boards are epoxy glass with gold plated edge plug.

VDU A, B, G (set of 3)	£27.20
SC/MP-P SC/MP CPU	£9.40
MPA-7 Buffered SC/MP CPU	£9.40
MZB-3 Z80 CPU	£9.40
MXA 1 2K of 2102	£9.40
MXA 3 8K of 2114	£9.40
MXD 2 16K of 4116	£9.40
PRM 2 4K of 5204	£9.40
PRM-8 8K of 2708	£9.40
RRM-14 8K of 2516 + 6K of 2114	TBA
SIO-2 RS-232 (two)	£9.40
TPA 2 Tape Interface	£8.90
IP-2 Input Port	£9.40
DCR-6 Keyboard Input	£8.90
OP-3 Output Port	£9.40
PP-2 PROM Programmer	£9.40
PSU-A4 Power Supply	£8.90
PSU-B 5V Power Supply	£5.50
PSU-C 25V Power Supply	£5.50
13-slot backboard, can be used with most of the above boards, 13" x 4⅝" ISBUS-1 1	£11.50

FLOPPY DISK CONTROLLER BOARD

This is used in conjunction with Kemitron Z80 boards to interface to twin single density S/S 8" floppy disks. It is not available as a bare board, but only built and tested, less circuit diagram £165.00

To run CP/M on the system a serial interface (e.g. SIO board) to some sort of VDU or terminal is required and 32K of RAM (e.g. two MXD-2 boards). The MZ8 3 board has facilities for power on jump and a boot prom to load the CP/M operating system from the disk.
Boot PROM (2708) £19.95
CP/M (8" 6 disk) £95.00

T.V. MONITOR P.C.B. for OEM users

This is an assembled P.C.B. size 130 x 190mm which you add to your own 12"/14" black and white C.R.T. (90 degree, 20mm dia. neck), to obtain a T.V. monitor at modest cost. (Regrettably we cannot supply the C.R.T. at present.)

Preset controls, contrast, brightness, etc., are included, and the only inputs needed are 15 Volts ± 10% AC at 1.5 Amps and 1 Volt pk-pk composite video input.
Supplied with circuit diagram £33.50

KEYBOARD CASES

405 x 210mm Panel size 380 x 188mm	£9.66
510 x 340mm Panel size 430 x 115mm	£24.98

DOT MATRIX PRINTER

This is about the same price as for example the Nascom Imp, but has many features only previously found in models costing hundreds of pounds more:
Standard interfaces (not "extras") RS-232, 20mA, IEE 488, Centronics I/O. 15 baud rates to 9600. 100 characters per second. 64, 72, 80, 96, 120 or 132 characters per line, rear, bottom or front paper loading, friction or tractor feed, can accept user defined characters, can also print graphics under program control, has "self-test" facility. Supplied with mains cable and full operator's manual.
Base 2 Model 800 £325.00

DAISYWHEEL PRINTER

High quality printer for use with word processing packages running under CP/M. 45 characters per second RS-232 interface. (Check stock position before ordering.)
Qume Sprint 5 Model 45 RO £1495.00

EUROCARD 19" CARD FRAME

Kit of 2 end plates + angles, 2 front and 2 rear tie bars, 4 guide location strips £27.47

Accessories

Card guides (pack of 10)	£1.40
Eurocard Plug (64 way DIN 41612)	£2.22
Eurocard Socket (64 way DIN 41612)	£3.39
Connector mounting strips (pair)	£3.12
Case conversion kit	£18.86
(or fit into separate 3U 19" D-type case)	£28.17

MICROPROCESSORS

Z80

Z80 CPU (2½MHz)	£5.95
Z80-CTC (2½MHz)	£3.95
Z80-PIO (2½MHz)	£3.95

(Add £1 for the 4MHz version of any of the above 3 chips.)

6800

6800 MPU	£5.95
6802 MPU	£9.95
6809	£19.95
6810 (128 × 8 RAM)	£3.25
68A10 (128 × 8 RAM)	£3.75
6820, 6821 PIA	£3.50
6845	£22.30
6850 ACIA	£4.85
MC6880	£2.64

SC/MP II RAM I/O

SC/MP II (4MHz)	£10
INS 8154 RAM I/O	£9.40

CMOS

COSMAC CDP 1802CE	£6.50
COSMAC CDP 18021	£10.85
CDP 1864	£7.25

STATICS (Mostly 450nS)

2102—1K x 1	£1.20
2111—256 x 4	£2.25
2112—256 x 4	£2.25
2114/4045—1K x 4	£2.25
8 x 2114	£17.84
2114L—1K x 4	£5.50
4118—1K x 8	£8.95

DYNAMICS

MK 4116 16K 200nS £2.75

UV ERASABLES

5204 (512 x 8)	£9.95
2708 1K x 8	£3.50
2716/2516 2K x 8 single 5v	£5.95
2532 4K x 8 (5v)	£19.95

5204/2708/2516 Programming Service £7.50/£7.50/£15.00 each prom. (Price does not include prom. We accept handwritten/typed source code — must be hexadecimal)

PROM WASHING SERVICE
50p each prom

UV PROM ERASER

UV140	£61.20
UV141	£77.70
EPROMPT	£33.00

INTERFACE

81LS95/6/7/8	£1.40
1488 (RS232)	90p
75491 LED driver	50p
75492	92p
ZN425	£3.95
8T26/8T28	£2.64
8.74	48p

CRT Controller: Uarts

AY-5-1013	£4.00
AY-5-1013A	£4.70
AY-3-1014A	£5.60
AY-3-1015	£5.60

CHAR. GEN. KEYBOARD ENCODER

MK 2302	£15.29
RO 3-2513 (5v Uppercase)	£6.00
DM 8678 CAB/BWF	£14.27
AY-5-2376	£9.75

FIRMWARE

ZMON for Z80 (1 x 2708)	£14.95
2K Tiny BASIC for Z80 (2 x 2708)	£19.95
4K NIBL for SC/MP (4 x 2708)	£49.95
4K NIBL-[illegible] for SC/MP (4 x 2708)	£49.95
1K Various, for SC/MP (1 x 2708)	£14.95

(Descriptive leaflet available on above. Ref SW4. 5)

1K Elektor Junior (1x2708)	£19.95
1½K ELBUG (3 × 5204)	£35.00
ETIBUG 1 (1 × 5204)	£14.95
ETIBUG 2 (1 × 5204)	£14.95
SCM P/KB (1 × 5204)	£14.95

UHF MODULATORS

UM1111 E36 Vision modulator, T.V. game or cheap computer type £2.80
UM1231 E36 Wide bandwidth, computer VDU type, pos./neg. transfer characteristic £4.95
UM1233 E36 Wide bandwidth, computer VDU type £4.70
UM1286 E36 Combined wide bandwidth vision modulator with intercarrier sound, high performance £8.25

VOLTAGE REGULATORS

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7905	£1.08
7812	97p
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Ideal for use in otherwise 5V only systems to obtain +12V, −12V, or dual ± 12V power for ASCII keyboards, RS-232 interfaces, dynamic RAMs etc. All types need +5V input.
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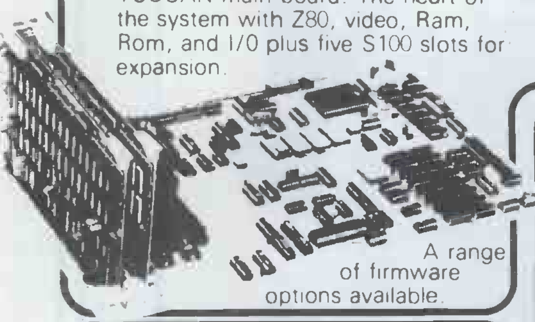
NEW THE TUSCAN S100

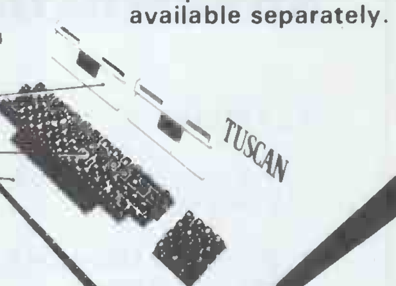
A Z80 based S100 Computer System.

Available in Kit Form or Assembled. All components available separately.

TUSCAN main board. The heart of the system with Z80, video, Ram, Rom, and I/O plus five S100 slots for expansion.



A range of firmware options available.



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Nasbug T4 2 x EPROM	25.00
Tiny Basic 2 x EPROM	25.00
Super Tiny Basic 3 x EPROM	37.50
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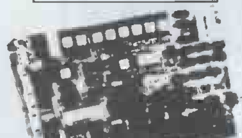
ZEAP 2 tape and documentation for Nas-sys	30.00
8K BASIC tape and documentation for N1	15.00

nascom-2 MICRO-KIT COMPUTER WITH IMPROVED 16k B RAM Board



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EPROM CARD (NASCOM compatable) KIT. Suitable for 16 x 2708 or 16 x 2716 or mixed 1 x NASCOM 8k BASIC ROM £55.00. BASIC programmers aid. Self locating tape £14.95.

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FOR NASCOM and any other Z80 8080 Microcomputer with an uncommitted P10

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- The Henelec controller card plugs direct into a Z80 P10 and controls up to **3 double-sided mini-floppy drives giving a maximum 480K system.**
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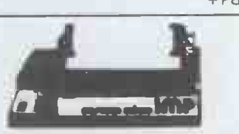
Built price £140 + VAT.

Nascom-1 Kit Price £125 Plus VAT +P&P £1.50



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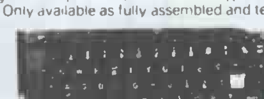

CARTER 57 key ASCII keyboard. Conventional key board. 128 ASCII characters including control keys. Parallel output with strobe. Shift lock. + 5 V and —12 V DC. 12" x 5.5" x 1.5" Black keys with white ledgends.

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Model P1

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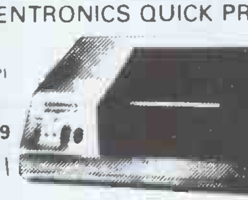

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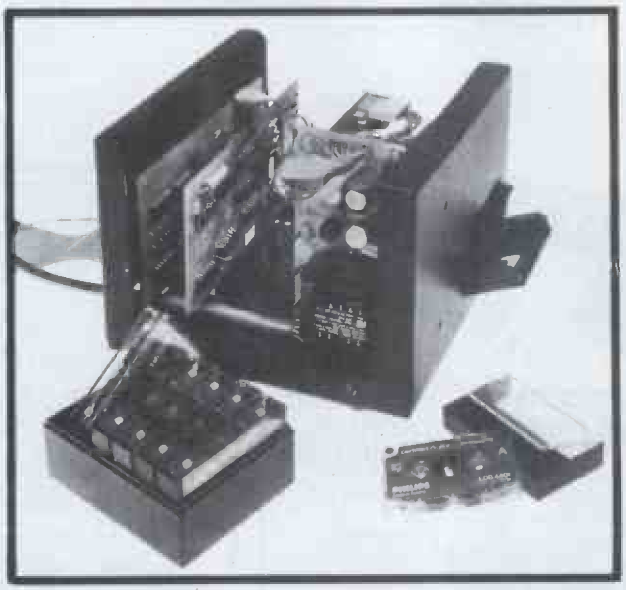

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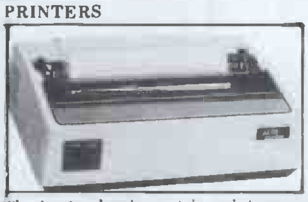

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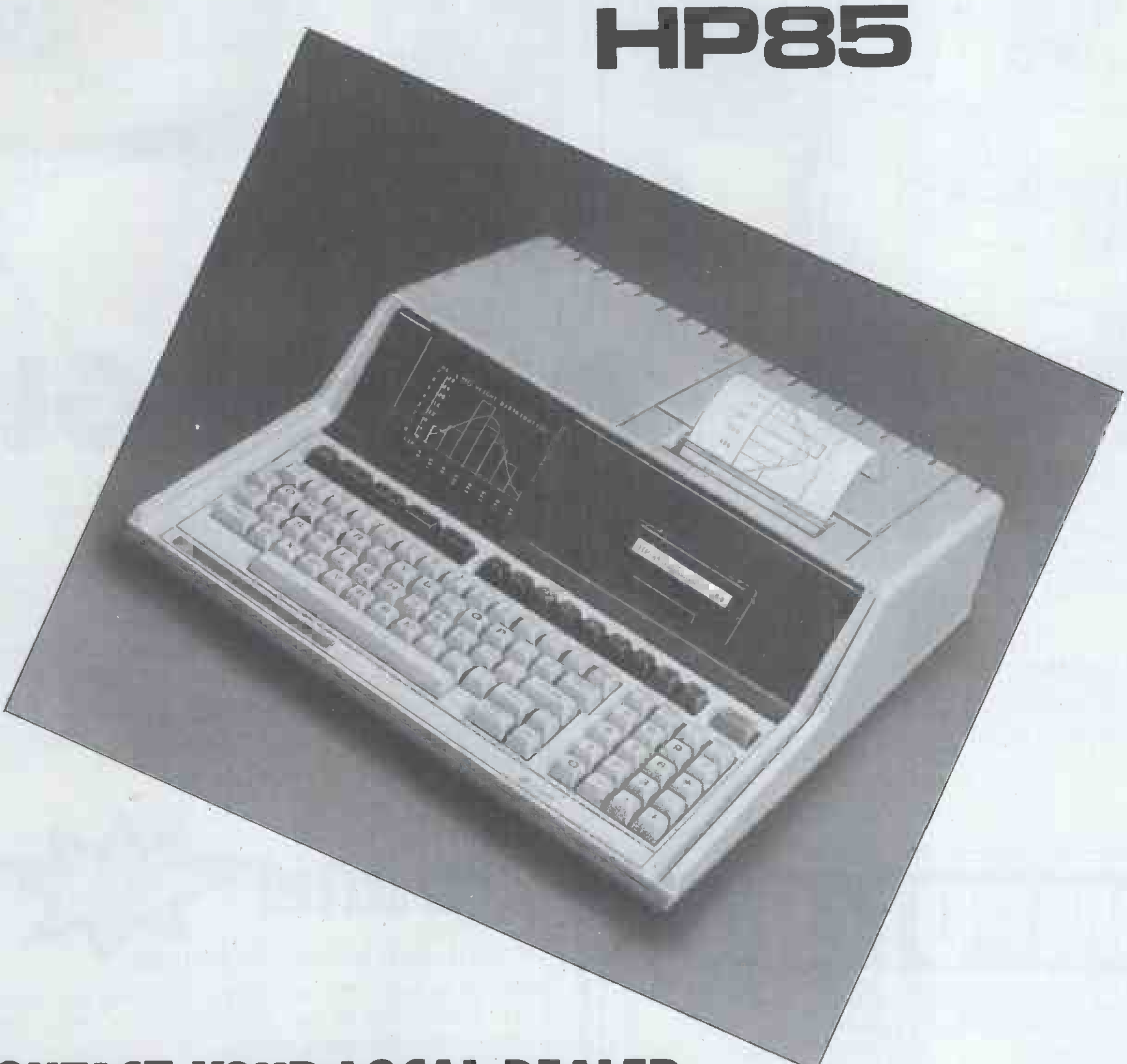

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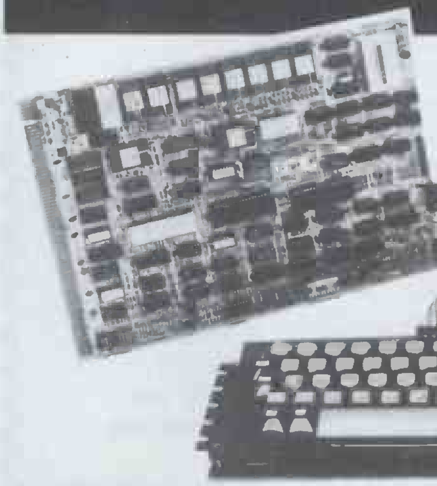

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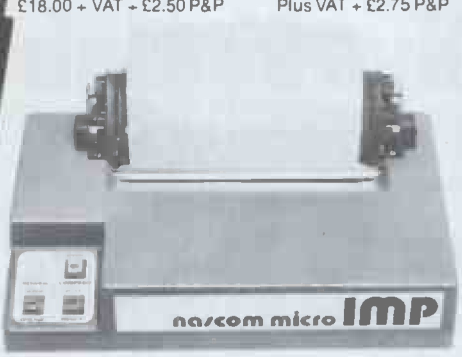

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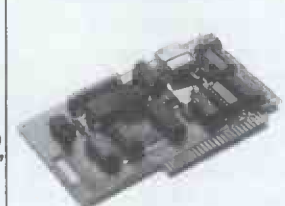

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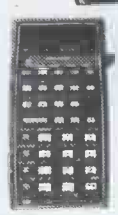

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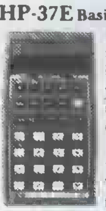

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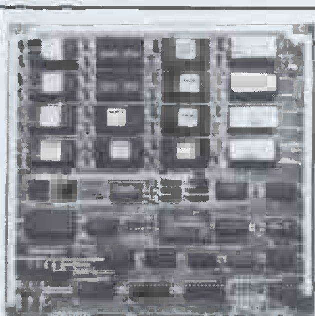
The Kenilworth case is a professional case designed specifically for the Nascom 2 and up to five additional 8" x 8" cards. It has hardwood side panels and a plastic coated steel base and cover. A fully cut back panel will accept a fan, UHF and video connectors and up to 8 D-type connectors. The basic 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 £7.50+Vat • 5-card support kit £19.50+Vat

INTERFACE 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 mutes 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 handshake.

Castle Interface Unit .. **£17.50** + Vat



EPROM EXPANSION

The Nasbus compatible EPROM board accepts up to 16 2708 or 2716 EPROMs. It has a separate socket for the MK36271 8K BASIC ROM for the benefit of Nascom-1 users. 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
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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 multiplexed between four channels - all software selectable. Sampling rate is 4KHz. Sensitivity is adjustable.

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Milham A-D Converter (built and tested) **£49.50** + Vat

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PROGRAMMER'S AID.
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DUAL MONITOR BOARD. A piggy-back board that allows N1 users to switch rapidly between two separate operating systems. **Price (kit): £6.50+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, delete lines, find, compacting command, plus a comprehensive line re-numbering facility. **Price: £13+Vat.**

PROM-PROG MKII.
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: £25.95+Vat.**

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.

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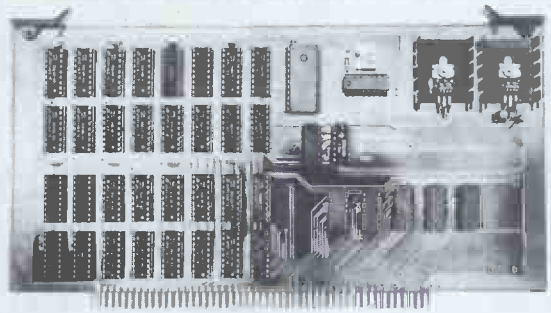

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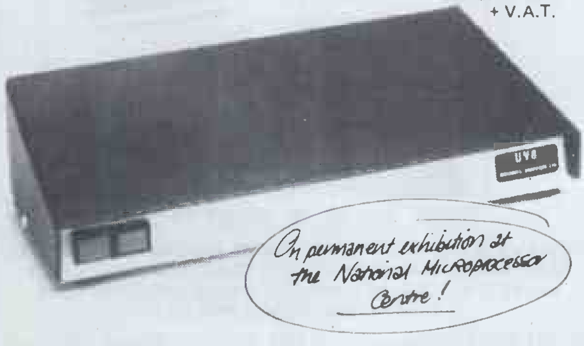

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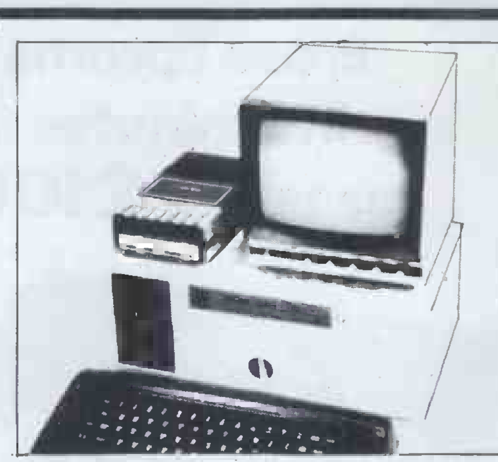

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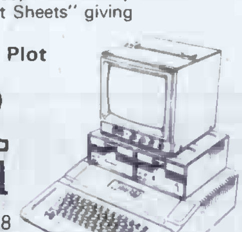

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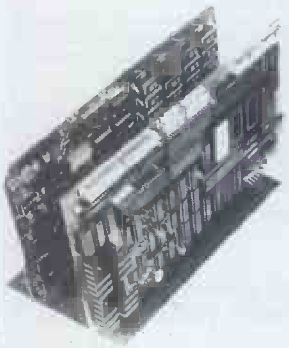

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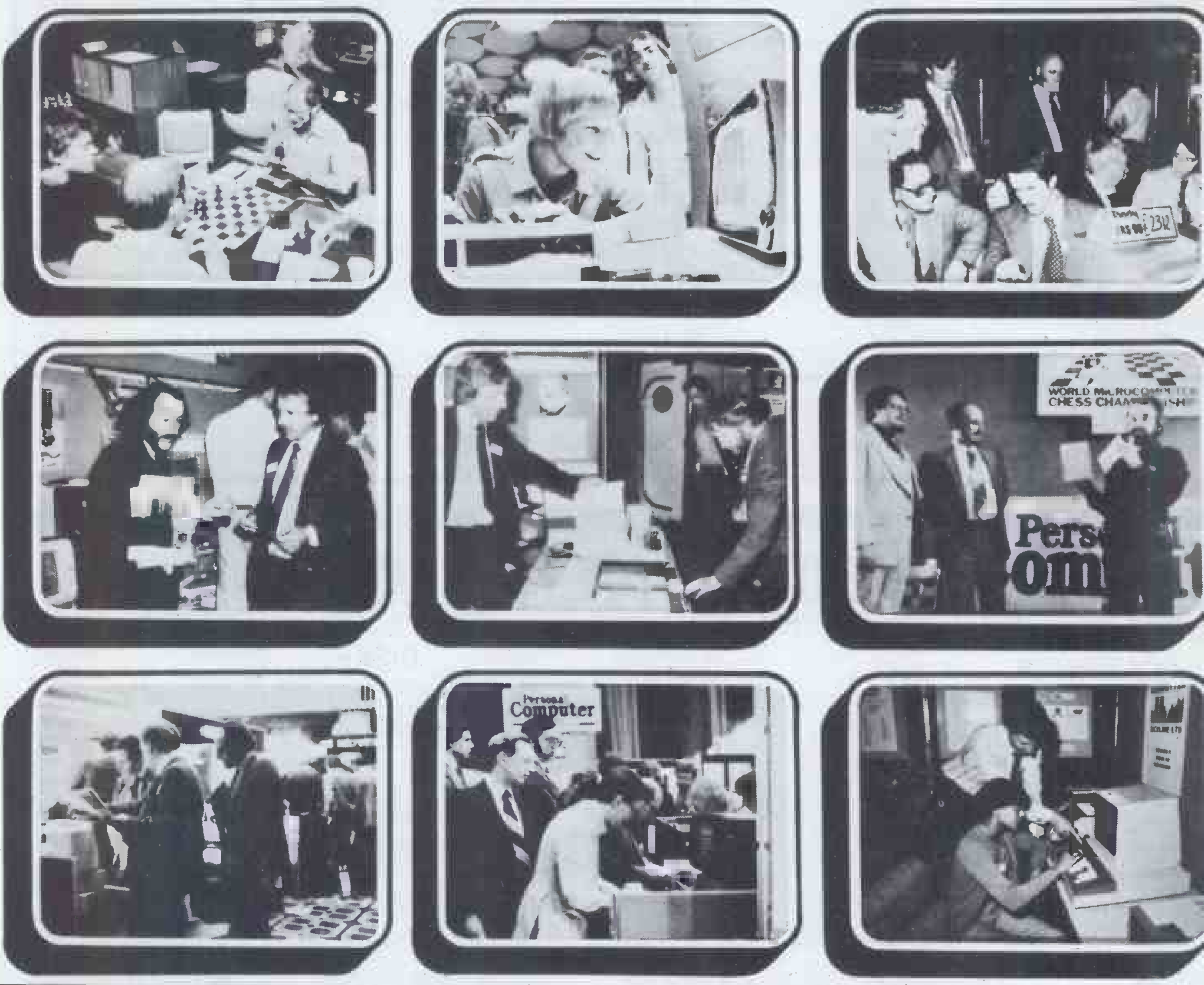
Cunard Hotel Hammersmith 10-12 September 1981



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To discuss how the 4th Personal Computer World Show could form the focus of your 1981 promotional calendar contact Timothy Collins on 01-486 1951 or write to him at Montbuild Ltd, 11 Manchester Square, London W1.

ADVERTISERS INDEX

CHIP CHAT

A certain company is rumoured to have produced a disk-based program which can copy the Visicalc system 'for security purposes'. Does Personal Software know about this, we ask ourselves . . . At the Electronica show in Munich recently an enterprising exhibitor kindly distributed his brochures in the Gents' thunderboxes (and in the ladies, too, for all we know). We presume they were left there to be read. . . Last year Canon produced a micro with a printer and a single-line display, saying that VDUs were bad for the eyes. Now, we notice, Canon micros are sporting VDUs. . . Personal Computer Ltd's Compec stand was bristling with lovely ladies but the biggest attraction was a velvet-clad Mike Sterland, complete with revolting — no, *revolving* — bow tie. . . Would you believe that Atari's international marketing man Fred Mitchell and *PCW*'s Editor share a common background in — wait for it — the cardboard box industry?!!. . . 'The Money Programme' (on t'telly) said recently that Uncle Clive Sinclair made £500,000 net profit in the first six months of 1980. Hmmm. . . Our humble thanks to reader J J Sandford for sending in his Reader Survey. Why are we thanking him? Because he sent it in a year late, that's why. . . Henry Budgett (he of *Toady* fame) is now known in the trade as 'Shoestring'. Apalling pun apart, he does bear an uncanny resemblance to said character and the West Country detective is alleged to have once worked in the computer industry. Surely Henry isn't moonlighting as an actor — is he? . . . Roger Derry, if you're out there please get in touch — we've lost your address and we owe you some money. . . Supersoft's Peter Calver has a PET name for partner Pearl Wellard. Pearl has threatened the Editor with all sorts of dire horrors if he reveals that it's Pearl*****. (A prize for the first correct entry.). . . Nice to see 'Bumper' Harris back in the country. Isn't it time you wrote another article for us, 'Bumper'?. . . *PCW* has made it to the dizzy heights of the *Silicon Gulch Gazette* with a report on our West Coast Fair jolly. What? You don't know about it?! GOTO page 48 immediately . . . Deputy Editor Rodwell trotted along to the dungeons of the Cafe Royal recently to participate in a Commodore party. He'd been expecting a roasting from Kit Spencer (see recent 'Chip Chat' and 'Newsprints') but the nearest he got was a flood of candle grease down his lapel and Kit asking him to pass the sugar. . . Finally, a happy New Year to all of you from all of us at *PCW!*

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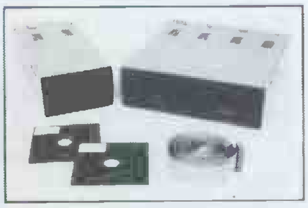

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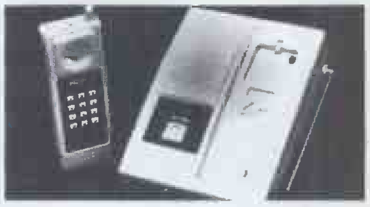

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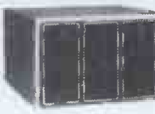

500K per Drive gives total of 1.5M Byte — 1 Drive plus Cabinet £799 + VAT

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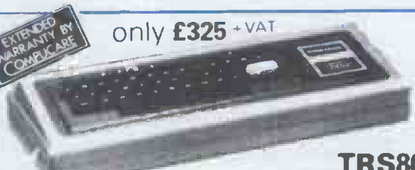

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