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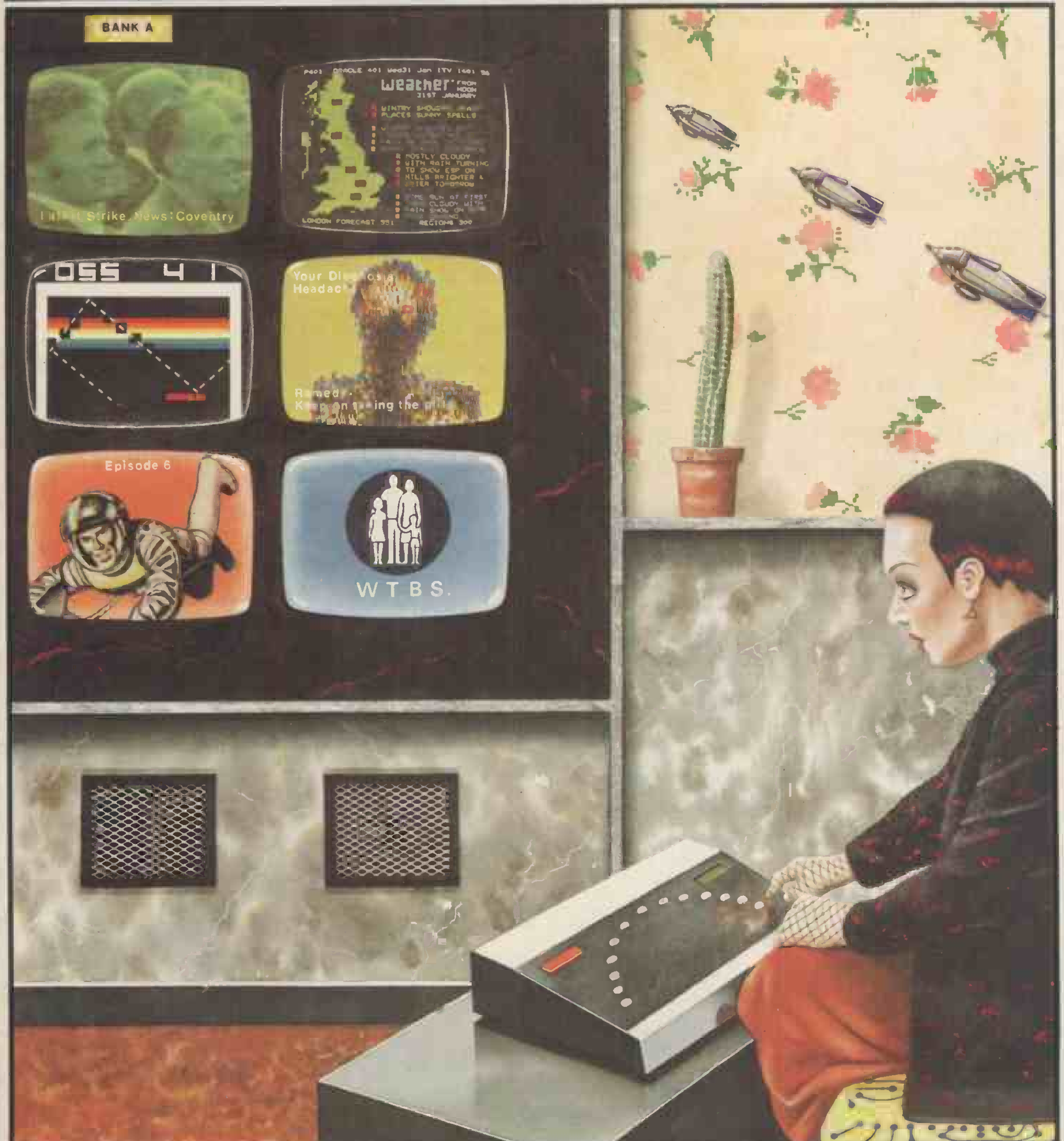

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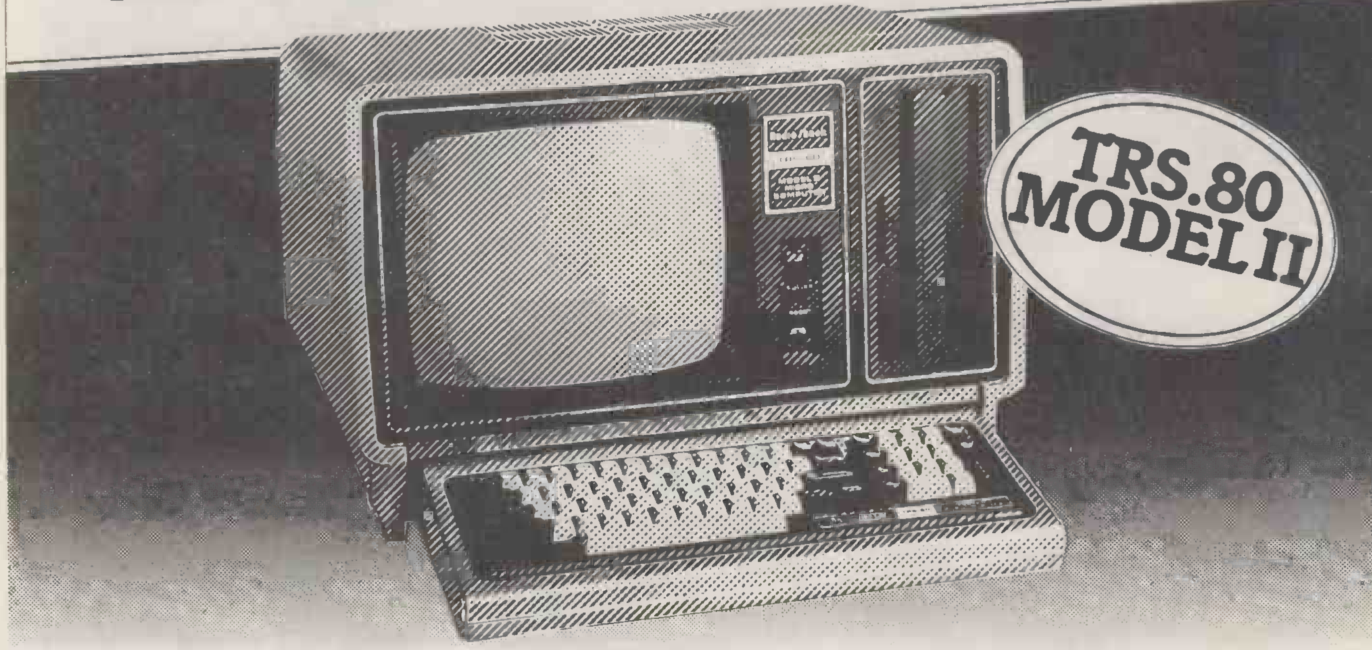

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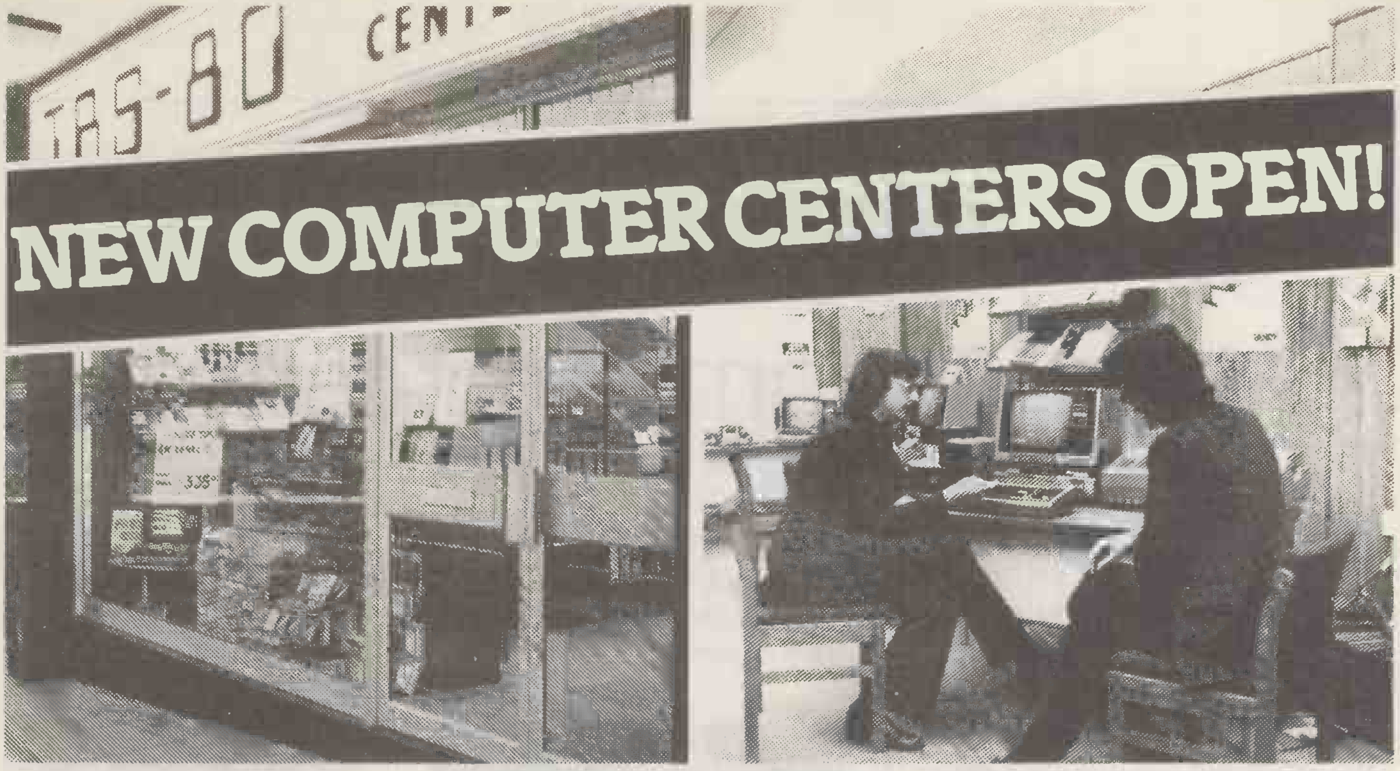

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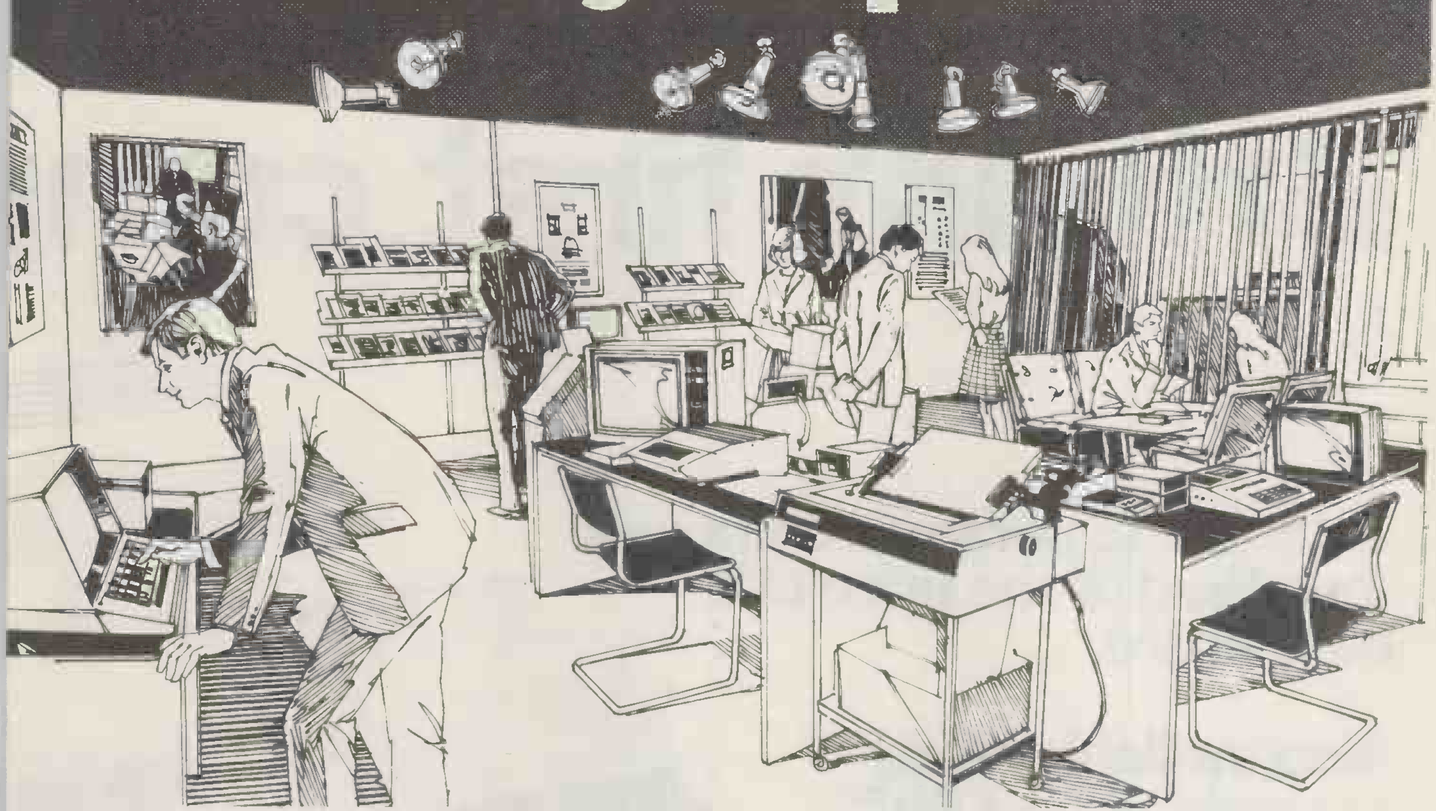

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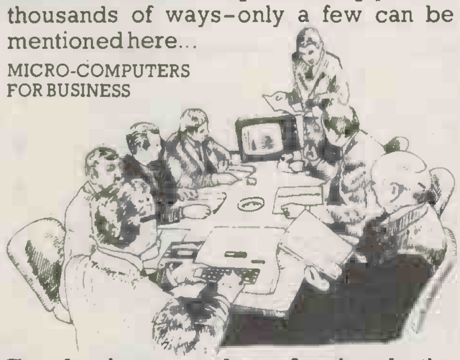

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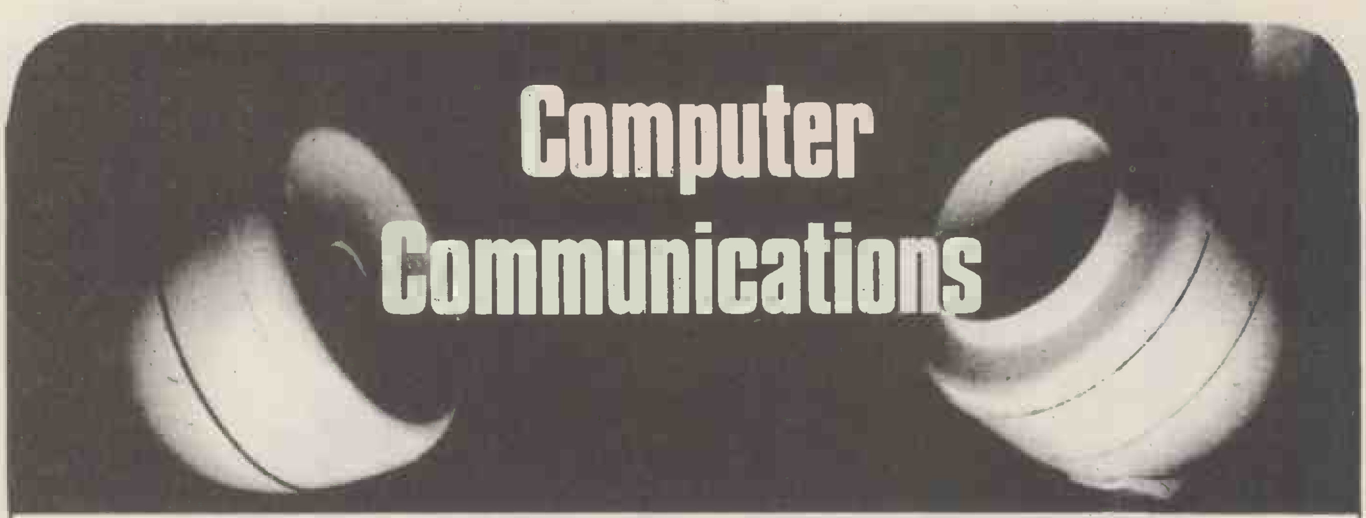

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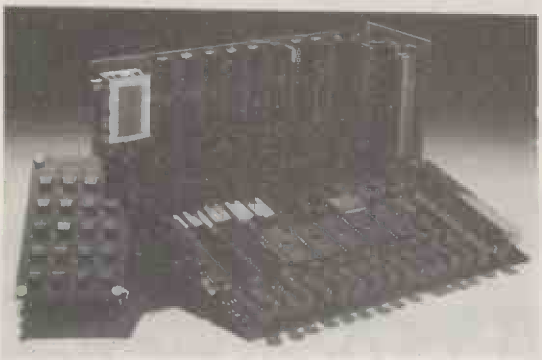

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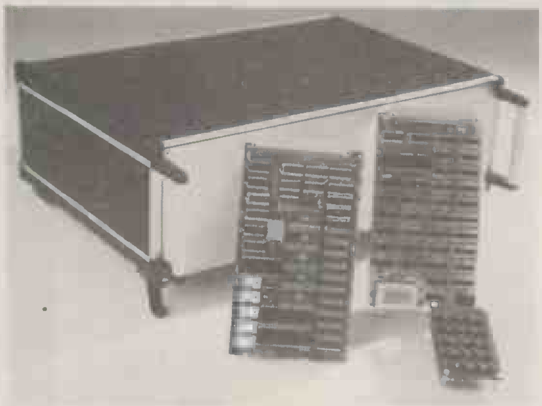

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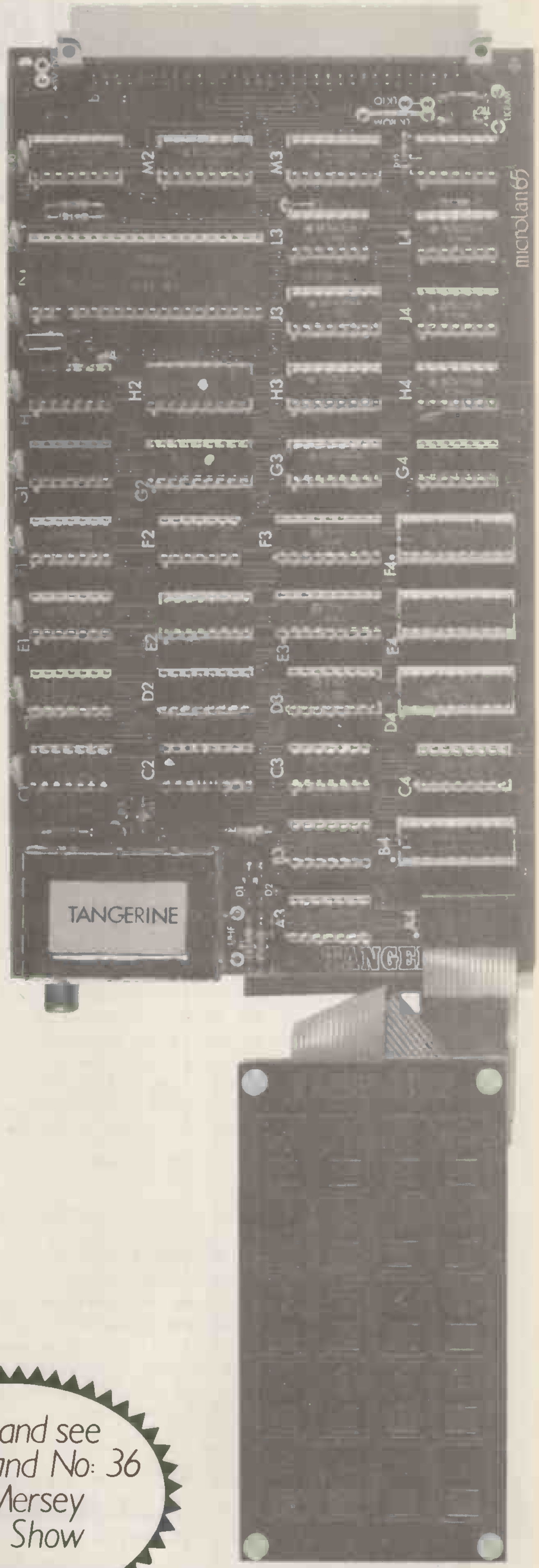

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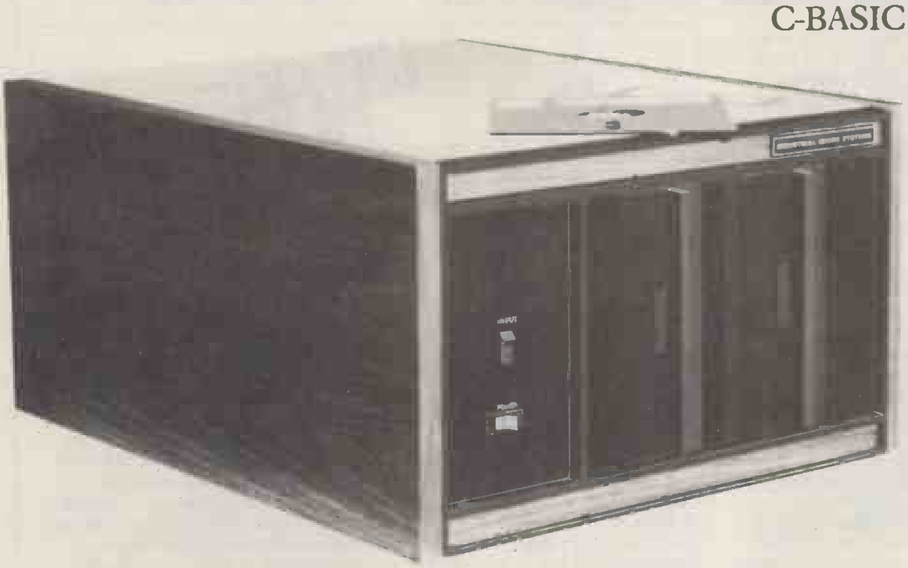

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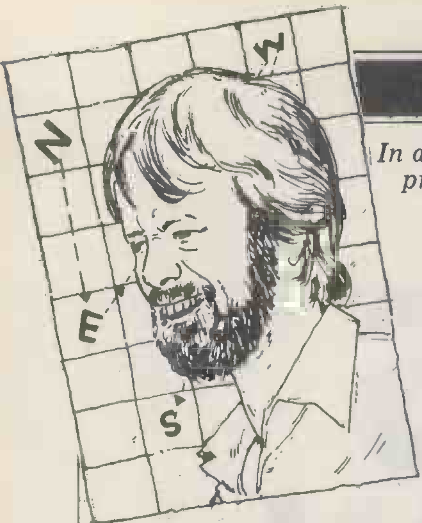


NEWSPRINT

In addition to his normal run through the general news, this month Guy Kewney presents a special Stateside Supplement.

The ups and the downs

Many firms have gone bust in the micro business both in the UK and in America — including famous ones such as Byte Shop and less famous ones such as Sphere. The question of why they went under is important. To Clive Sinclair, the answer is clearly "competition". He is very nervous about the market lead he has established with his ZX80 £100 computer, and will not say anything about how the inside works.

To people with less at stake, the reason that companies like Processor Technology (American maker of the Sol computer) died is simple: bad management, and an apparently mindless determination to destroy themselves. As far as I have been able to find out, nobody with microprocessors to sell has been unable to sell them. More, even those without microprocessors to sell, have been able to get money in advance, with which to design them.

Where most of the companies that have gone wrong, went wrong, was in trying to move "up market" and in trying to supply "business machines". The new micro men have all arrived in the computer business by mistake, and it isn't surprising that they should be tempted by the "up market" argument. They weren't around for the Small Business Crash of six or so years ago.

At that time, the advances of technology which made the minicomputer possible, had led to the VRC — the visible record computer. Its strong point was that it was cheap, and that it was a very basic do-nothing machine. That was in about 1968; and around then, the idea that these things were "really" computers began to tease the minds of their makers.

If the machine is "really" a computer, reasoned the buyers, they could do all the things on the machine that big computer owners could do on their machines. It took a while for this attitude to feed back to the computer makers . . . to Phillips, Olivetti, Kienzle, Triumph Adler, and similar office computer makers. But when it did, the result was: disaster.

In theory, a machine which does accounts under control of software can, indeed, do anything else. In practice, the cost of getting it to do something else is prohibitive. Very roughly, the cost of an item of software, to a commercial enterprise producing it by paying clerks, is £10,000. The cost of marketing it, and supporting it, is estimated as between another £10,000 and three to four times that figure.

The office minicomputer companies found that their salesmen were promising to supply programs to do anything from stock control to planning of salesman's rounds, for an additional fee of around £3000 "or more". The "or more" naturally turned out to be anything up to £20,000 — on a computer costing under £10,000.

Is all this starting to sound familiar?

The simple fact is that unless a man writes his own software in his own time, software costs that sort of money. To sell a £30,000 package for £300, you have to sell 100 identical packages. Moving "up market" immediately tells your customers that you are in fact going to do a little better, and that you can tailor the software to their requirements; this usually costs much more than either side expects.

The logic usually advanced to justify a move "up market" is: "We've saturated the hobbyist market, and have to cater to the small business, which is more profitable anyway; so we've packaged the system and put the price up."

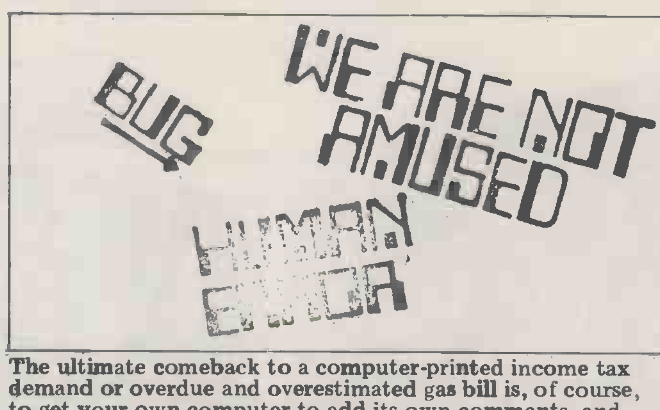
What has actually happened is often a lot simpler. The product has gone out of date. If the market for hobbyists has indeed become saturated, why is Clive Sinclair selling at a rate of well over 1000 systems a month? Because he has gone up market? At £100 including tax? I doubt it.

All this is about as long an introduction as even I can be expected to write, to front the news that Nascom has packaged its Nascom 2. From the tone of the introduction, readers will gather that the packaging and "moving upmarket" doesn't impress me. The only thing about the new-look Nascom that does impress me is the new memory board with 48 Kbytes of memory chippery — and a paging system.

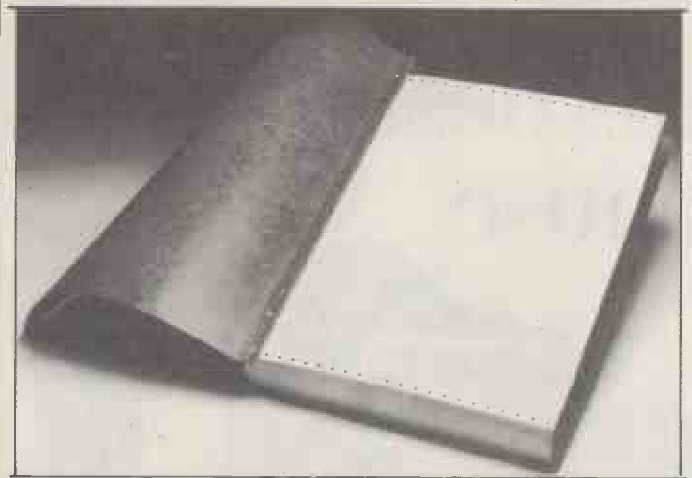
Look at Nascom from historical experience: when the first machine was announced, the choice was between the Motorola D2, the Kim 1, American systems retailing at a couple of thousand pounds, or the first rumours of the PET (to sell at £1000 at today's prices). The Nascom was the first cheap system that you could build with a real typewriter keyboard, a real video output, and a whole 2 Kbytes of memory. By contrast, the competition had 16 grotty keys, had to be programmed in hex, and could output only hex numbers on six calculator-type display characters, from a mere 256 bytes of store.

Technology has not got stuck since then, and if Nascom truly wants to sell the way it did in the early days, a £500 system (using a central processor that looked reasonable when it was originally announced but won't be available till nearly a year later) is not going to steal any thunder from Clive Sinclair. Well if Nascom did it once, why not again? The answer, if you want my opinion, is that Nascom isn't in the business of stealing thunder, but of cushioning our ears. It doesn't want to upstage the Nascom 1 too much.

There is the subsidiary problem; that the money which should have been transforming the Nascom 2 into the Nascom 3 (the way the Apple I was transformed, utterly, into the Apple II) has been kept off stage in the wings. Nascom boss John Marshall has arranged about £1 million worth of finance, jointly from the NRDC and the City (Grovewood Securities, in North London geographically, but in the City nonetheless) . . . he's not used a penny of it. Grovewood tells me that he has until June to make up his mind about whether he wants it. John Marshall himself tells me he has plans and hints that they involve other sources of finance, and asks for secrecy while he wheels and deals. He won't want my advice, but here it is: he is almost a genius at buying semiconductor parts, and producing products that are much cheaper than anyone else could arrange. He should stick to his genius.



The ultimate comeback to a computer-printed income tax demand or overdue and overestimated gas bill is, of course, to get your own computer to add its own comments, and return it. While waiting for the price of printers that can do this to come down to your budget level, a mere $11.00 will get you these stamps — plus a red stamp pad and a small carrying bag. Get them from New York firm Martha Herman, 5 East 17th Street, NY, NY 100003; send enough for postage/packing . . . maybe $2. It'll be chocolate with byte-sized prices next; we computeers are becoming a truly consumer market.



Three different sizes of computer print-out can be filed in the Cavadex binder. For those who think printouts are only for the big computer rooms that can afford line printers turning out words at 300 lines a minute, here is a little thought. Call round to one of these places, and get as much used, scrap paper as they have left after teachers, children and other paper hoarders have had their cut — and use the back. Cave is in Northampton on 0604 48125.

Acorn's mighty Atom

At last a new computer! A genuinely new personal machine is to be launched by the Cambridge firm Acorn, in May, at about £125 kit or £150 built. It's called the Atom.

The machine incorporates that fundamental necessity for a cheap system . . . it's on a single board. It includes a BASIC which Acorn people say is three to five times faster than Apple Integer BASIC, and has the unique feature of including an assembler in the interpreter.

Normally, a BASIC interpreter is the program that a computer runs all the time; even when it appears to be running your own program it's actually doing nothing of the sort. The interpreter program is handling your BASIC instruction list data. The output from the data is what the BASIC expected, but the BASIC is not what does it.

In the case of Atom BASIC data supplied includes standard 6502 mnemonics. When the interpreter finds and recognises this data, it actually runs it, rather than calculating output from it.

Acorn directors, Herman Hauser and Chris Curry explain the ingenious nature of this BASIC by pointing at the writer, Roger Wilson. He happens to have a 6502 assembler in his head, and can at any stage in the program, apparently recall what is in the various registers, stack pointers, and status flags; he can do amazing short cuts.

As an example, the diskette operating system is a routine that is run by the machine every time data comes in from the diskette. The data interrupts the machine, which responds by running this routine. Nobody else has found a routine quick enough to run in this way: Acorn's diskette operating system therefore runs at least three times faster than anyone else's.

At the back of the Atom, there will be a 64-way connector that is exactly the same as the one on the bottom of today's £70 Acorn two-card system. There will also be outputs to cassette tape, TV colour, and to other Atoms.

The "other Atom connection" is a daring innovation, and looks very like an idea first proposed by Chris Moller, an engineer at Modular Technology (the minimodem makers) two years ago. Each Atom can have a receiver/transmitter (not wireless, wired) with its own station code; this is done with what's known as a universal asynchronous receiver transmitter . . . or UART. Any Atom can transmit the station code of any other Atom in the circle of connected computers, and the UARTs of all remaining machines in the circle immediately set themselves to a "do not transmit" position until the other two have finished talking. The conversation runs at 9600 baud. The Acorn people see this as a classroom technique first; the teacher can take over any of the pupils' machines and see what's going on — and they can print messages on the screen.

The machine looks, to me, like a slightly more polished version of what Clive Sinclair has produced in the ZX80; it has a proper typewriter keyboard, and as things stand right now, the video offers a few extras in sophistication. The price is proportionately higher, but still in an acceptable bracket to make it credible as a higher priced alternative for buyers in a hurry, or people with differing tastes.

Acorn will announce firm prices at the official launch, which may not come until June.

Z80 on the line

By the end of this year, the Sinclair ZX80 will have a Prestel circuit and a diskette both at prices "in keeping with the price of the machine", as Uncle Clive put it. This means that the machine will be able to talk to other ZX80s down the phone line.

The alterations that will make the ZX80 a Prestel machine are slight, points out Sinclair. It offers 32 characters on a TV screen now: it only has to offer eight more to be Prestel compatible. The changes will involve a completely new read-only memory chip, since that contains the BASIC interpreter, the operating system, and the video character generator. The ROM was going to be changed anyway: a new, enhanced (floating point arithmetic) BASIC with all the trigonometric and logarithmic functions currently omitted, will be with us some time soon.

The Prestel attachment is still in fact in Uncle Clive's eye. However, he has had this twinkle undimmed since he first conceived the machine. "I would have mentioned it at the launch, only nobody asked me about it," he told me.

The modem that talks to the central Prestel computers, he hopes will work by acoustic coupling. The idea is that a plug-in socket for the normal sort of Prestel modem would cost too much compared to the cost of his coupler. "Definitely the main objective is to get the machines able to communicate," he added, "so it won't be a standard Prestel modem with slow transmit and different (fast) receive, which can't talk to itself."

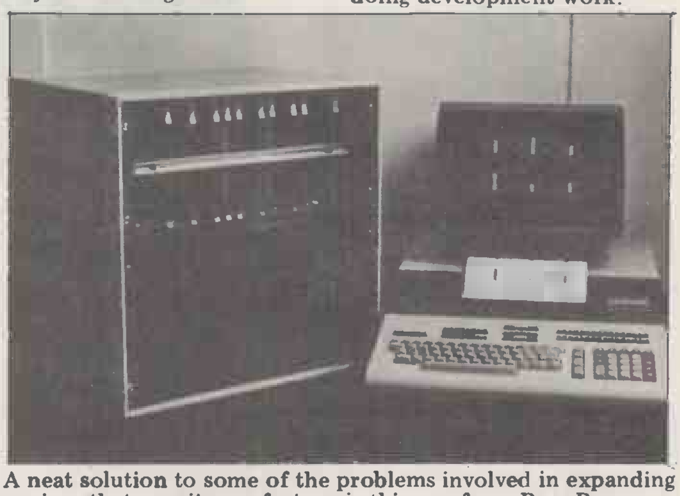
The diskette drive will happen this year, but only "if we can get the price down to a comparable level with the machine." That means well under £200 he agreed, but wouldn't say if it also meant well under £150. Tantalisingly, he also refused to confirm that it would be a five-inch minifloppy.

Paging Nascom

About the cleverest idea to emerge from the Nascom stable so far this year is a deeply buried technical specification in a paragraph dealing with details of the new 48 Kbyte memory board. It's the fact that "four of these boards can be plugged into a system simultaneously."

Normally, plugging four 48 Kbyte boards into a system using the Zilog/Mostek Z80 chip would be a waste of three of them. The machine has 16 wires with which to address memory, and the maximum memory that can give is 64 Kbytes (65,536 memory locations, in strictly accurate point of fact, that number being the possible permutations of 16 dots and dashes, or 2 to the power 16). Nascom has done its trick by "paging". An output instruction addressed to port FF of the Zilog cpu chip sets any one of the boards to read, and any of the boards to write. They can be the same board, but they don't have to be.

According to technical director David Wadham: "I use the paging system to keep a protected copy of my software in memory when doing development work.



A neat solution to some of the problems involved in expanding a micro that monitors a factory is this one from Burr-Brown: each input/output card has its own memory on the board. The IOS 2000 10z also keeps the software needed to run the I/O cards on them, so that the system is always the right size for the number of lines being controlled. 0923 33837.

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You make the copy by executing the copy instruction, LDIR (check that) from each byte to itself. But you set one board to read, and a different one to write, so you end up with one board copied to the other. Then you set the original board to write-protect, and you can't corrupt it."

Paging systems are as simple as that — plus the associated simple chip on each memory board which decides what page that board actually is. But the snag with paging is that without modification, programs written for one system of paging will not run on another. The modification may look trivial at code level . . . but compilers and assemblers don't work at code level. They have to decide at the time they write code whether it will fit on the page, or whether it's time to turn over — and loading programs have to make the same decision.

The result is that any paging system tends to stay around for ever, providing it catches on in the first place. As Nascom's ex-marketing man Kerr Borland said, this one offers almost the same capacity as a floppy disc, at about the same price. It could well catch on.

Ingersoll dangles carrot

Prices for the Atari 400 and 800 video computers have been set by Ingersoll — provisionally. The 400, with 16 Kbytes of memory, is expected to cost £395 (including tax) and the 800, £695.

My immediate reaction is that Apple dealer Microsense has already arrived at a price level where these machines pose little threat to the Apple. Ingersoll, the importer of Atari (remember that picture of two video games players dressed in basket ball gear) seems to think so too. The company has decided to recruit its existing users as salesmen.

The deal is: if you are a member of the Atari Owners Club and introduce a new member (subject to a dealer's proof of purchase) you get a free set of Atari keyboard controllers, worth £19. The controllers, which look like pocket calculators on leads, are used for certain Atari games. But that's the video computer, not the 800. To make one take the 800 more seriously, Ingersoll has announced a price of £500 for the Atari printer, and £525 for the disc drive. Don't get too excited before July, however, because nothing will be available generally before then. More details from Ingersoll on 01-226 1200.

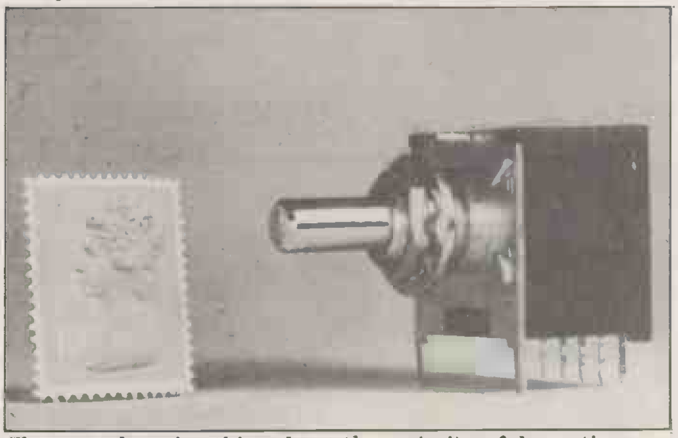
Pet collection

A free catalogue of ACT Petsoft PET goodies: that is how Julian Allason describes the Pet Collection. There are 16 pages, covering programs from Personal Software, Programma International, Understanding (Petplan business simulator), Hipposoft and, of course, Petsoft. All are said to be available through the 220 PET dealers. Copies from 021-455 8585.

Yes or no?

Should you be using a computer? Ask yourself this question, together with a few other likeminded sceptics, at a seminar costing £28 on Thursday June 17. It's a "practical seminar" organized by the London Chamber of Commerce and Industry (members get a £6 discount) from 2.15 pm to 5.15 at the LCCI premises in 69 Cannon Street EC4N 5AB. Queries on 01-248 4444 and talk to Ann Measures.

Typing at a video is a great way to enter errors into a computer, especially if the output is appearing line by line on a printer somewhere else. This is an idea from Data Dynamics; the video on this Zip KDP terminal slides from side to side, above the printer/keyboard, and can be swivelled about to cut out reflections, or accommodate people who type with their heads on one side (a lot do). I'd tell you the cost, only DD is, as usual, unaccountably coy about mentioning money . . . try 01-848 9781.



The most daunting thing about the majority of domestic systems is their insistence that the user know exactly what the computer thinks is going on. Turn the power on, and the system says "?" without any clue given as to what on earth you are expected to do. My favourite way of solving the problem involves a set of different firmware programs; the user sets a switch on the panel to "expert" through "quite bright" down to "idiot" (and ending with "journalist") and the machine treats him accordingly. This switch will give you ten such options: your monitor/program can read it and see what decimal number (coded in binary) appears across its four contacts — and act accordingly (when set to Journalist, it can phone up the Thought Police, for instance). Impectron, the maker, is on 0403 50111.

Original is not the greatest

Where the Americans today pay the penalty for their cleverness in being first to use colour television — theirs is crude, sensitive to transmission troubles, and most unlifelike even down cable TV lines — we are likely to find the boot on the other foot when it comes to Prestel.

So say the Canadian viewdata people who offer a system called Telidon. It's hard to disagree: Telidon generates images using basic geometric shapes which can be positioned all over the screen. By contrast, Prestel (and the French system, Antiope) think the screen is really a sheet of paper, and type blobs starting from the top left corner, line by line. Putting a convincing picture on Prestel is an art more satisfying as a pure intellectual challenge than as a visual stimulus.

And if you didn't know about it, you've just missed the chance to see Telidon at the Viewdata 80 exhibition which ran from March 26-28 at Wembley Conference Centre. I'd have told you sooner, but the Canadian High Commission (bless their Maple leaf socks) didn't announce it until Feb 21, and a fat lot of good that is to us monthly journals.

Gassing on oil

The application of process control computers in oil and gas industries will be discussed by the British Computer Society specialist group on process control on April 23 and 24 at the Waldorf Hotel, London. Speakers are from Ferranti, Kent, Honeywell and Shell, as well as British Gas and British National Oil. Details from Deborah Hart 01-637 1471. Prices from £60 for BCS students to £115 for non BSC members.

Translator transformation

The translation machine I got so excited about a couple of issues back — the Lexicon — is now officially the Nixdorf. It has the Filing System module that is supposed to

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But to take first things first, we mention a few colourful facts. After Scandinavian scientists had proved how close-range human vision could benefit from working with orange light, orange tubes quickly replaced green as standard for most Scandinavian videos. A few years behind, we in Britain still belong to the Green Screen Club – but as indifferent members when it comes to monitors. With DDP's new monitor, however, you can experience Scandinavian sophistication. And all the difference it makes to operating profits when allowance is made for operator fatigue.

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turn it into a genuine personal computer system, and the price is £85 on 30 days delivery, according to PhoneAids, a distributor. The company will sell through two offices: one at Brackley, Northants in premises quite noticeably similar to those of Portable Microsystems, and with the aid of one Heather Ayres, of the same surname as Mike at Portable — ah, probably coincidence. Also at Southampton. Phone 0280 704761 for Heather, or 0703 771400 for Andy White.

LSI go business

Four micro-based systems under £10,000 have been launched by LSI Computers aimed at the businessman. Smallest is the M-One Model I at £6000 with twin floppies, screen and printer: biggest is the £10,000 Model V with faster printer, two terminals, faster processor and bigger floppies. Software announced includes a bill of materials processor, an inventory management package, and a modular account packate — Bomp, Imp and Map. Details: 0344 54471.

8080 lives

A reminder that the Intel 8080 is far from dead: a microtutor called Microtutor, made by Northwich company Limrose, has been bought by the Post Office and the Navy. Actually the Navy ordered 48 and the PO 36 — in two lots of 18. The Microtutor has been around a while: it was one of the machines on show ready-built at the very first Build Your Own Computer Show (run by Online four years ago) where such things as the RML 380Z were nests of wire-wrap, and the Bear software was all kapok stuffing. Limrose is on 0606 41696, and all the other people who make things called Microtutor needn't bother ringing me up unless theirs pre-dates the RCA Cosmac microtutor.

On the button

This week's prize in the "at the touch of a button" award goes to one of our own consultants, Stephen Castell. He used the phrase in the announcement that BBCData was getting involved in the Prestel International market trial.

You needn't feel guilty at never having heard of BBC Data — because it's new. It's the trade name under which the BBC is sending "a unique and integrated database covering World Business and Trade Personalities and Events, to Prestel's international service".

As a man who has used Prestel, and occasionally even discovered that the information he could not find was definitely not in the system — rather than merely disguised under some other heading — I feel that the Rest of The World should be disabused of the notion that the information, (which "a typical overseas businessman will be able to see on his TV screen,") is available at the touch of a button.

It was I who, when Computing Consultant of New Scientist — a mantle which passed, after I was fired, to our own Malcolm Peltu (*Shame! Ed.*) — sat down one evening and touched buttons until the system eventually asked me to "Enter Password". It was I who, wondering what it did if you entered the wrong password, touched a few buttons at random. It was, therefore, I, who at the touch of a button, rendered the entire New Scientist database inaccessible to New Scientist staff by creating a password which not even I knew. That is the only thing I've ever done on Prestel at the "touch of a button" . . . all else took blood and tears and sweat and persistence.

Lisp for the big questions

The words "Artificial Intelligence" are equated in too many minds with some vague picture of a lunatic scientist trying to create a Computer That Lives.

A man called Aaron Sloman describes the actual benefits of artificial intelligence much more accurately. In a grotesque summary of his superb book "The computer revolution in philosophy" it could be said that Sloman has found a real use for both philosophy and artificial intelligence by observing how well they solve the limitations of each. In particular, he accuses philosophy of building theories without the barest models of Mind to test them on. By testing concepts of Mind in artificial intelligence one can quickly find out if it is possible to create a set of rules that express the concepts: and from that, whether the rules (simulated on a computer) actually produce "behaviour" that parallels observable intelligent behaviour.

All this is by way of saying that the language Lisp, used by artificial intelligence researchers, is eventually going to be the sort of tool that enables someone to define "sense of humour" accurately, and freeing philosophers from protesting that, sure, they're concerned with the problems of real life — like, what do we mean by "real" and what is an empirical definition of "life"? (with acknowledgements to The Hitch Hiker's Guide to the Galaxy). And Lisp is now available from Microsoft, together with another product written by the Soft Warehouse, for micros. The package is called muLisp (microlisp) and costs $200, to run under CP/M. The other package is a maths package, muMath at $250.

The muLisp package "offers all of Lisp's unique programming features," says Microsoft: "including 83 Lisp functions, flexible program control structures, and infinite precision integer arithmetic in any desired radix from base 2 (binary) to base 36." Dealers, contact Microsoft on (206) 455 8080 in the USA.

Cut-price Hazeltine video terminals: Electronic Brokers offers "as new" standard models at £425, and editing versions at £695. Details on 01-837 7781.

One of these test devices would be a comforting thing to see in the back room of the place you buy your system. It is a Millenium microsystem analyser — now revealed to be the machine which National Semiconductor refers to (internally) as an ICAT . . . that is, in-circuit automatic testing. It combines the "signature analysis" test system developed by Hewlett Packard as a very good fault pinpointing aid for systems that are nearly working correctly, with the in-circuit emulation (ICE) system that exercises components on a board that is definitely not working. It's available through Microsystem Services, and anyone bright enough to use one is bright enough to sort out your system in minutes. With luck. 0494 41661.

Business guide update

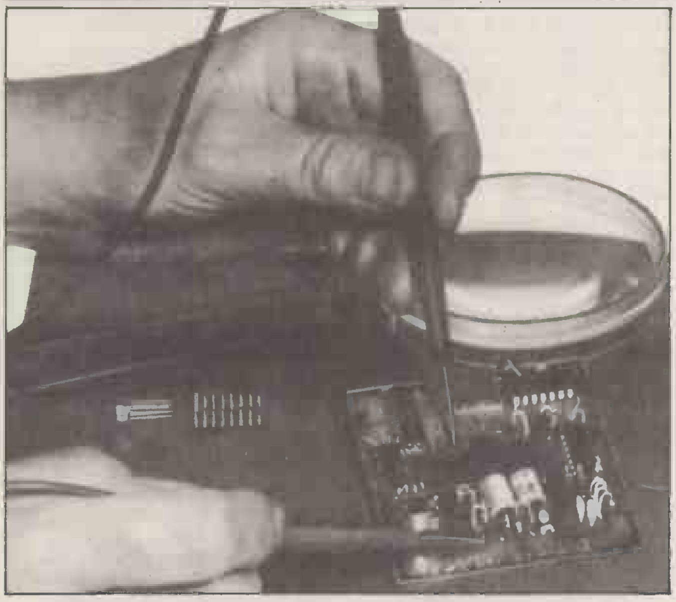
A guide to some 900 different computer systems is available for £24 from ECC Publications: it's the Guide to Small Business Systems, and it covers machines from £100 £1000 up. Last year's edition had 250 systems fewer and sold well, according to Cathy Lane at ECC. It's designed "primarily for the businessman with little or no computing knowledge." Details from Cathy on 01-359 7481.

File it

The Intelligent Filing System advances further into our midst: Compsoft has enhanced DMS, its information storage and retrieval system, to run on a 32 Kbyte PET. It will organise up to 5,000 items on one diskette and manipulate them for even the least sophisticated user, says Compsoft: for details please phone Guildford (0483) 39665.

Courses

A wide range of four-day courses on micros has been announced by ICS Publishing.



The important object in this picture is the background: it's a non-slip mat. The idea is that one hand holds the soldering iron, the second holds the component and the solder, and instead of the tiny board immediately tobogganing off the bench, it stays put. Impressively the "coefficient of friction" quoted by the maker, Cobonic, is close to 12; by comparison, the quoted figure for steel to rubber is ½. It will work on the wall, they say. Details on 01-767 6780.

Subjects range from Hands-on micro trouble-shooting to Voice input and output for computers, and the program starts from April 4, with seminars in London and Amsterdam. Details from ICS UK at Leatherhead (03723) 79211.

Ongoing

I quite like Prime — a mini-computer-making company that will obviously go far. The company's reputation is not being enhanced, however by its persistence in sending information to PCW care of a man who stopped being its editor last August, to an address which we haven't use used for even longer. Other dozies, please copy.

Centronics News from

A £555 printer from Centronics is to marketed by Rair, aimed at the micro user. It's the Model 730 mini-printer. Details on 01-836 4663 for anybody who can't get the X-Data Oki 80.

Who's who

One of the most visible men in the UK computing world is the director of the National Computing Centre — a job that can steal as much limelight as that of the secretary of the Computing Services Association. When the CSA lost Alan Benjamin, it did take care (by employing Doug Eyeions) to ensure that everybody knew there was a new man in the job. The NCC, by replacing David Firnberg with David Fairbairn, has been rather less careful — especially as Fairbairn, like Firnberg, is ex-ICL. Now all together: who is NCC Director? No, not Benjamin Fairberg, try again . . . .

Database Primer~free

A free primer on database, attempting to explain it both to users and prospective users, has been launched by the Lafayette producer of micro database systems, MDBS, mentioned in our last issue. The primer runs to 54 pages, and is free as long as stocks last from MDBS Inc, PO Box 248, Lafayette, Indiana 47902.

Curry sauce

The arrival of the washing machine chain, Curry's, into computers is planned for April 8th. Derek Moon has announced that they will carry PET and ITT 2020 for the business he calls "traffic" with the Sord and National Panasonic computers supplying the business end. Stores will be opening in Birmingham, Nottingham, Bristol, and New Malden in South London.

As you were

In the March edition of "Newsprint" I referred to "a lawsuit" which supposedly existed between Nascom and Mine of Information. In fact, although "sabres were rattled" towards the end of last year, up to this moment no direct legal moves have been made. I will of course keep you informed of any future developments.

The source of the trouble

In theory at least, the Post Office's Prestel system of publishing information on TV screens could have a chance in America as its biggest competitor is now widely tipped to go under. The competitor is The Source, a network of information providers that's connected to home users via two existing networks — called Tymnet and Telenet.

Normally, these two networks are used by people who need to retrieve information from very large scientific databases. . . chemical, legal, all the way through to current affairs. And normally, these people are company librarians, who have considerable skill in chasing down the information they want, and who have practised the virtuoso performance of entering passwords and signing on, many many times.

The idea of using Tymnet and Telenet to carry the information was a good one, in that they already existed and were in good working order. By comparison, when the Post Office set up Prestel, the salesman who sold them the first GEC 4000 computer ended up earning more (in commission on that and subsequent sales) than his corporate boss, Sir Arnold Weinstock; you get some idea of the money that was needed to set it up.

What the idea had going for it there was countered, technically, by the fact that first, you can't call up Tymnet and Telenet on your television, and second, there is a lot more to it than just pressing a button and finding a page index.

It's quite true that the Prestel page number system can be infuriatingly slow and tedious for the sophisticated user who longs for short cuts in the search for the elusive bit of information. And it's also true that in the UK, the television sets are in short supply, and the information available is still not all that comprehensive (although I did find out, in flying over here, that Pan Am puts its standby ticket status on a Prestel page. It said: "NIL", but never mind).

However on The Source, the routine of signing on is a bit like casting a magic spell. One full stop wrong, and the genie escapes out of the bottle and eats the terminal

Computer store owners have to sell subscriptions to The Source, and they describe it as a hard sell. They say they get a once-off payment of $100 for every subscriber signed up, that they have to keep stocks of the sign-up kit, and that confused subscribers keep coming back to try to work out what they are doing wrong. Perhaps, all this might matter less if the company had not run into financial trouble.

No official word has been released yet from Telecomputing Corporation of America, which runs The Source; but it has written a pleading letter to its creditors, asking for time to pay its debts. The theme of the letter is disturbing to its recipients. It doesn't say, jauntily: "We may be short of cash, but we're signing up a thousand users a day, and while this costs us a thousand times a hundred dollars, now, revenues of at least $5 per month and $15 per hour connect. . ." and so on. Instead it says that, of course, if they really want to insist, then creditors can get some money by forcing TCA into bankruptcy under Chapter 11. . . after which assets will be frozen until the company is wound up, and then they'll only get a level of repayment to be decided by the authorities; gloom and doom is the name of the game.

Dealers tell me to interpret this as meaning The Source will be closed down in three months or less. They also speak highly of the deal offered by competing service Micronet, which promises dealers 25% of all revenues generated by any of their subscribers, for ever.

Whatever happens (and the situation has not been helped by the fact that, since former TCA boss William von Meister left the company, a great many more debts have been discovered) it would be a tragedy if the idea failed. What The Source offered (that Prestel is still dreaming of) is instant communication with any other user, plus actual data processing power to boost the micro user's system.

Apple change of heart

The heart of the Apple II computer has been transplanted — an astonishing bit of surgery that has drastically changed its character. The standard Apple II computer uses the 6502 micro and therefore cannot run any of the software available to users of systems with Z80 or 8080 micros (which have the standard CP/M operating system). This gap in the Apple's abilities has prompted one of the two best-known suppliers of computer control software — Microsoft — to produce a card which gives the Apple II a Z80 processor.

This unexpected grafting allows the Apple II to run the piece of software produced by the other best-known systems software company — Digital Research — that is, the CP/M operating system. The cost of the new processor board and two diskettes (with the CP/M software) is $349.

Microsoft executives at the West Coast Faire promise that the package will be available by May. . . good news from their point of view as the card will be a way to sell more copies of disc BASIC. Microsoft BASIC, included in the package price, "has all the features not found in Applesoft, plus exclusive new features added to take advantage of the Apple II's special capabilities".

And adding the Z80 softcard doesn't stop the Apple being an Apple. "It allows you to use either the 6502 or the Z80 processor — whichever is needed to run a particular program", says Microsoft: "and switching between the two processors is as easy as typing in a particular command. All the features that you love about your Apple stay intact".

The only caveat is that programs and data generated on the Apple in CP/M are not transferable to the normal Apple. It's either one, or the other. . . never both.

Pearls for the swine

The newcomer to computing quickly finds that he can either buy programs or write them — and that writing programs is exactly the sort of job (tedious, repetitive, nitpicking and long) that he thought the computer was going to save him from.

The obvious step of getting the computer to write the programs for you has now been achieved by many. Not all are successful, not all are cheap, but usually it's easier for the complete beginner to write in high level languages and get the computer to write the machine code.

The concept is moving further: an example was released at the Faire in the form of PEARL levels 1 and 2 which actually write the high level language instructions.

Where Pearl (Producing Error-free Automatic Rapid Logic) differs from other systems is in its $90 listing.

The level 1 cannot cope with difficult subtleties of computing such as multiplication and division, but it can, and does (according to Computer Pathways Unlimited) write useable personal programs.

It can do data validation — something human programmers often neglect — operator messages, and data editing. It can generate reports, and control input and output.

Level 2 is for business applications; it has an indexing function which it can build into your programs. And when levels 3 and 4 arrive, they will be capable of generating saleable programs, according to Pearl's creator, Dan Miles: they will also be more costly. Currently Pearl runs under CP/M, but Computer Pathways hopes to have versions for the PET within a year.

No UK agent was booked at press time: hopefuls should contact CPU on (503) 363 8929.

Disc deals

Users of the Apple II who think they need to store 10 million characters inside the machine can buy the well-known Corvus hard disc from Tim Keen. Keen has the import exclusive on the device — which uses a mechanism made by disc company IMI in America.

However, Keen doesn't have the exclusive on the IMI drive; that has been sold to, not Corvus, but Lobo of Goleta California. At the Faire, I saw an Englishman setting up a deal to import the Lobo product.

The differences between the two devices, technically, is not large. Where the Corvus drive is electronically disguised as 20 floppy discs, the Lobo drive is configured (that means disguised) as one drive, which the Apple II operating system will think is a normal floppy disc, 11 million characters long.

The differences between the two in price could be something else. Trade price of the Corvus drive here is around $3500 whereas the Lobo sells for $500 less. The Englishman (he has requested anonymity until the deal is clinched) hopes to reflect the buying price in his UK selling price.

Tandy to Tandy

Any Tandy computer in America can talk to any other TRS-80 via a $250 telephone modem that plugs into the processor. . . and the company that makes it is hoping to sell the modem in the UK.

That company is the Micro Peripheral Corp. of Mercer Island, Washington 98040, and the story they tell is that the device will need very little adaptation to be used on UK phone lines.

What is needed, however, is for somebody to get the specification approved by the Post Office for connection to Buzby's knitting. That somebody should contact Don Stoner about the device — called The Connection — on (206) 454 3303.

Guy Kewney is Technology Editor of Computing.

COMMUNICATION

PCW welcomes correspondence from its readers. Be as brief and concise as possible and please add "not for publication" if your comments/questions are to be kept private.
Address letters to: "Communications", Personal Computer World, 14 Rathbone Place, London W1P 1DE.

Software datasheets

Nothing makes me so wild as to hear computer hobbyists being told that any program that more or less works is a good one.

Bad programming, whether perpetrated by professionals or amateurs, is an abomination that pollutes the mental processes of anyone, including those who actually wrote it, who might later want to use and modify it.

Hobbyists do not have to use machine code programming of anything but the highest quality.

Any software takes time to develop and test into something the originator can use. Just a little extra time could turn it into something that could be shared and improved by others, so that everyone finishes up with a set of first class software products.

I would like, through PCW, to get a group of people writing Z80 general purpose subroutines, to define standards, for criticism and improvement by others. Those submitting the original routines could choose whether their offerings were anonymous or signed.

Final, improved, versions of the most useful routines would then form a collection of Software Datasheets. Magazine, book and EPROM publishing rights of the Software Datasheets would belong to the magazine but the right to use and list them, as part of applications software, would belong to anyone.

I would edit and check that contributions worked and conformed to standard and even supply routines, if necessary, for the first few months, to get the project off the ground.

To illustrate the standards I have in mind, I list Rules and Documentation standards for the routines, together with an example. I would try to improve on the presentation of these, perhaps PCW readers could help with this.

The ideas of the Z80 routines could, of course, be worked in 6502, 6800 and other machine codes as well. A useful set of BASIC general purpose routines might also be worth developing.

Rules and Documentation for Software Datasheets for Z80 general purpose subroutines. (Developed from the paper "Microcomputer Software Design" by Thomas P. Hughes, Dwight H. Sawin III and David R. Hadden Jr. of the U. S. Army Electronics Command.)

RULES

1. Registers not being used to convey data into or out of the routine will, if used by the routine, be saved on entry to and restored before exit from the routine.
2. It is assumed that the general routines library will always be in memory (possibly ROM) so that routines may call other general routines.
3. RAM addresses, outside the general routines' library, will never be explicitly specified in routines. References to RAM may be made through the contents of registers, which the caller supplies as pointers or as address parameters immediately following the call in the main routine.
4. Registers HL, DE, IX and IY will be used as pointers to RAM.
5. Registers B and BC will be used to pass single and double byte counts.
6. To avoid having areas of RAM that need to be defined by the user, the stack may be used for local RAM.
7. Data may be supplied to a subroutine as parameters immediately following the call in the main routine.
8. The alternate register set will not be used by routines, to leave it available for processing interrupts.
9. Routines that call no other routines are classed as level 0 and all others as level 1.

DOCUMENTATION

1. The first part of the documentation, marked ";=", contains a brief textual description of the routine.
2. The second part, marked ";/", contains a technical description developed after a format used by Nicoud:-
Line 1 gives the name and level of the routine.
Line 2 gives a one-line description.
Section 3 gives the main actions carried out by the routine.
Section 4 specifies flags, registers, parameters, stack or other areas assumed to have meaningful values when the routine is called.
Section 5 specifies flags, registers and other areas containing results when the routine returns.
Section 6 gives the registers disturbed by use of the routine.
Section 7 gives the maximum number of bytes that could be added to the stack, including growth from the routine calling other routines.
Section 8 gives the memory size of the routine.
Section 9 lists any monitor or general purpose routines on which the routine depends.
Section 10 gives any I/O interfaces and peripherals needed.
Section 11 states whether or not the object code is 8080 compatible.
3. The third part is a complete listing of the routine, with assembler mnemonics, comments and object code.

Alan Tootill, Enfield, Middlesex.

```
; = DL1S — One second delay at 2MHz
;/ "DL1S" — Level 0
;/ To use 2000000 time states, inclusive of call, without other effect.
;/ ACTION:  ( SP—2 ) ← L
            ( SP—1 ) ← H
            H ← ( SP+1 )
            L ← ( SP )
            repeated 42,551 times
;/ INPUT: None
;/ OUTPUT: None
;/ REGs USED: None
;/ STACK USE: 6
;/ LENGTH: 19
;/ SUBr DEPENDENCIES: None
;/ INTERFACES: None
;/ 8080 COMPATIBLE?: No
DL1S
        PUSH AF       ; save flags                   F5
        PUSH BC       ; & registers                  C5
        LD BC,42551   ; set loop counter             01 37 A6
        PUSH HL       ; main                         E5
        POP HL        ; delay                        E1
        DEC BC        ; decrement counter            0B
        LD A,C        ; set zero flag only if both   79
        OR B          ; bytes of BC are zero         B0
        JR NZ,—5      ; jump if not zero to loop     20 F9
        PUSH HL       ; make up                      E5
        POP HL        ; delay to                     E1
        NOP           ; 1,999,983                    00
        NOP           ; time states                  00
        POP BC        ; restore registers            C1
        POP AF        ; and flags                    F1
        RET           ; return                       C9
```

A very interesting letter. I agree with Alan's sentiments and would like to help him move this idea forward. The magazine welcomes all ideas, proposals and modifications from interested readers; some we'll publish and all will be passed to Alan. Please write stating your area of interest and likely involvement, marking your envelope "standards". If you do not wish your letter to be printed please write "not to be published" on it. I look forward to hearing from you — Ed.

Suffering systems

For the past three months I have read the software reviews by Mike Rose with increasing frustration and annoyance. These really are the worst sort of review to publish in an influential magazine such as yours and are guaranteed to confuse and even mislead any potential purchaser.

Here are my specific complaints:

1. By reviewing only a small proportion of the available packages it leaves the potential buyer no better off as he does not know if there is a better system available which was not reviewed.

Can you imagine *Which* only reviewing 6 brands of washing machine and leaving the rest to the imagination? No way.

By not being reviewed there is a stigma attached to other software, which is unfortunate since in all cases the best available software has not been reviewed.

2. The reviews themselves are not sufficiently thorough. Many of the important aspects of the packages are completely ignored whilst trivial information is provided. As an example, the one on stock recording packages ignored the important subject of response times to an enquiry. There is a world of difference between the best (about 3 seconds

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with 1500 items) and the worst (30 seconds or more). In this same review the author listed as a desirable point a facility to link assemblies to components — a facility that has nothing to do with the majority of stock recording applications and is most difficult to achieve within the restraints of a microprocessor system.

3. Such items as system capacity do not seem to be consistent. Some systems are quoted on a per diskette basis, while others are for a maximum configuration of four discs.

All in all, a poor series, especially as Mike Rose advertises himself in your magazine as an expert in the field. The general impression given is one of a quick half hour read of the manuals rather than a thorough try-out of the working systems. Perhaps you should try again with a somewhat larger budget!

Mike Collier, West Yorkshire

Thank you for your interesting letter. You have actually highlighted the need for us to restate our objectives from time to time — if not every month. I see you have only been reading this feature for three months; you will therefore not realise that our intention is purely to examine documentation made available to us by software package suppliers and to report on the various claims made. Bearing this in mind I shall now take your points one by one.

1. The Stock Control feature was the first review in the series, following the introduction in the previous issue. We underestimated the time it would take for suppliers to respond to our questionnaires and requests for documentation. We were also surprised by the generally low response. We are about to repeat the sequence, starting with Stock Control, so this will give those companies that missed us first time around another chance (dealers,please contact us for inclusion). We cannot hope to review every package on the market because a) we haven't the time and b) even if we did, we wouldn't have enough space in the magazine.

2. At no time did we ever intend to set up dummy systems and test the programs themselves; our intention is simply to save the reader a bit of "leg work" by getting hold of the information that would be made available to him anyway, analysing it and producing a comparative report. The series has the added benefit of outlining the sort of things a buyer might need to consider when purchasing a package.

Any in-depth reviews will be occasional and based on a real-life user's experience of his chosen package. (Users please note — if you are soon to implement a standard package and don't mind being put "under the microscope", then why not contact us and we shall be pleased to consider you as a case study.)

As far as the comment regarding sub-assemblies etc was concerned, I think Mike said something along the lines of "If we do manufacture then we probably want details of the relationships between parts, sub-assemblies and assemblies". Note: "If we do manufacture. . ."; *in fact, none of the packages considered this requirement and, provided that you are not a* manufacturer *looking for these facilities, then there is no problem.*

I suppose that we could have quoted response times as claimed by the brochures but these do rather depend on the chosen test circumstances, which in a selling brochure are likely to be "loaded" at the very least.

3. This information is based on that provided by the supplier.

I trust that these replies have helped clarify the situation regarding "Systems"—Ed.

Praise indeed

Under no circumstances must you do anything which would alter "Bookfare"! Malcolm Peltu is the only technical book reveiwer (that I know of) who does not treat his readers as a bunch of mindless jerks waiting for the Sirius Cybernetics Corporation to emply them.

Clive Jackson, Tewkesbury, Gloucester

Look Sharp

I have recently acquired a Sharp MZ-80K Personal Computer with 22K User RAM after a close evaluation of its competitors (the PET Apple, Sorcerer, etc.) on performance and price. I can only say that I am entirely satisfied with the capabilities of the machine. I would be grateful if you could publish my intention to form a London and South East Sharp MZ-80K User Group in your magazine to enable all members to exchange ideas, software, etc. Interested parties should write to me or telephone during the evenings on Hornchurch (STD 04024) 42905. Affiliation of the Group to other User Groups will be considered at a later stage, depending on the response from members.

Do you know if Sharp Corporation have any plans for establishing a Software Bank along the same lines used by the American producers? If not, this may be a profitable venture for your magazine!

Joe Seet, 16 Elmhurst Drive, Hornchurch, Essex, RM11 1PE.

Sharp have looked at this problem and have appointed HB Computers to manage this task. HB Computers have confirmed that the marketing exercise is well under way with 25 programs already available and more arriving daily. Catalogues are available on request. HB Computers welcome high quality software for inclusion in the catalogue. Royalty terms are negotiable. All enquiries to Johnnie Johnson 0536-83922 /520910 — Ed.

School games

At our school, we are forming a program library for all the computer users. We need to find a source of cheap programs. It was suggested that I write to you for help. If you would please write a list of programs you have included in earlier issues, with the issue number and the length of the program in Kilobytes, I would be very grateful. We have only a PET microcomputer. When you send us this list, we will be able to send off for some of the back issues of the programs. Thank you very much.

R. J. Lewis, Winchester

Sorry, we can't help with the sizes but you'll find that the programs have been listed in our Back Issues advertisements — Ed.

Program power

It has been apparent for some time that there has been a lack of software available for Nascom 1 & 2. We are certain that a substantial number of near-professional standard programs have been written, but knowledge of these probably remains with the author or his local Nascom club. Not least amongst the reasons will be the variety of monitors which have been available at one time or another.

To remedy this situation, "Program Power" has been set up to act as a form of program exchange. We will undertake to make programs available nationally to owners of Nascoms, at a price which will enable us to pay reasonable royalties to the authors. We hope this will generate the enthusiasm to finish off those brilliant ideas which are almost saleable programs and perhaps generate a few more original thoughts. We shall be concentrating on 8K BASIC and machine code programs.

In this respect if there are any authors out there, of BASIC programs written for TRS 80,PET or other micros who could provide listings for conversion to Nascom,we would love to hear from them.

Nascom have produced some terrific hardware and we would like to see an equally terrific and complementary software base established.

R. G. Simpson, "Program Power", 5 Wensley Rd, Leeds LS7 2LX

Right and wrong

Congratulations on publishing Macronoia, the best example of program documentation I have met in any magazine, British or American. May it soon become the accepted standard, for any and every non-trivial program or short routine, to:

— Explain the model and give a flowchart of it.
— Explain how to "play" or use the program.
— List the equations (algorithms).
— List and identify all variables.
— Identify the computer on which the program was developed.
— Generalise the BASIC, to work on most machines.
— Modularise the program, with adequate REMarks.
— Show a program flowchart.

A good piece of work like this whets the appetite for more and if you want to do even better may I suggest reproducing results of a typical run?

You probably know about the errors. I hope you will be able to publish the corrections promptly before too many readers lose interest in the original.

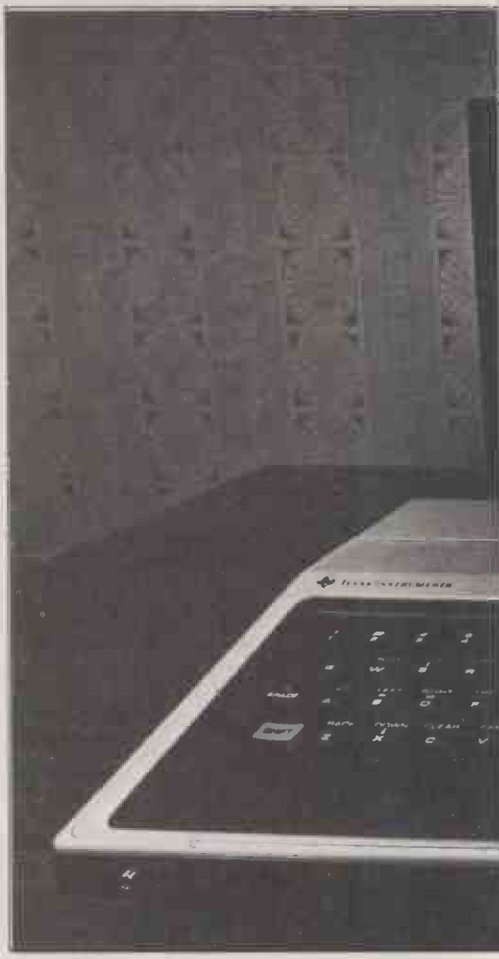
Peter Reynolds, Tunbridge Wells, Kent

Thanks for the comments, Peter, we certainly endorse them. The errors were corrected in Blunders last month and this month — Ed.

TI99/4 HOME COMPUTER

The long awaited launch of the TI99/4 marks the beginning of a "new wave" of personal computers aimed at the home. Like most electronic consumer goods, it's well made, well packaged and would hardly look out of place in the living room alongside the family hi-fi.

by David Tebbutt



Introduction

The 99/4 had been designed for domestic use and it makes absolutely no pretence of being a business computer. I suspect, however, that a businessman would find it useful provided that he can set sensible limits on his expectations.

The machine comprises a single unit which can be connected to the domestic television (more on this in a moment) and a normal audio cassette player. It even has a lead for connecting to the hi-fi system for those with a yearning for computer music in full stereo. Unfortunately, there is one drawback to this approach — you need a television which can accept American NTSC colour signals. (In the UK we use the PAL system, which is quite incompatible). This is not the end of the story, however, because you can buy dual standard televisions which accept both types of signal. In view of this difficulty, Texas are packaging their home computer with a variety of televisions at prices ranging from £750 for the 99/4 plus black and white monitor (or a modification to a suitable existing set), to £1300 for the 99/4 and a really swish dual standard, colour set with remote controls and viewdata options.

Should you prefer your viewing and computing to be kept separate then you would need to buy some sort of television anyway, so the point may become somewhat irrelevant. Therefore, enough said, except perhaps to add that, although TI engineers are working on the problem it will be some time yet before the machine itself comes suitably modified.

The 99/4 has a slot which accepts "Solid State Software Command Modules" i.e. preprogrammed ROMs. A wide variety were supplied with the review machine, the favourites being the games and Beginning Grammar.

As well as running programs from the command modules, it's possible, too, to write your own in TI BASIC and to save them on cassette.

There's one other feature — a rather curious one which I have never seen implemented elsewhere. It's called an equation calculator and it does just that. The user keys in details of a calculation just as he would write it algebraically, assigning letters or names to all the variables. (The equation is shown on the screen while each variable is given a value.) Once they've all been entered, a press of a button and the equation is evaluated. In this way the exercise can be repeated with different values, but without any need to rekey the equation. It's halfway between employing the BASIC in direct mode and actually running a program . . . and much simpler to use than a programmable calculator.

All in all, the 99/4 is elegant looking, well made, easy to set up and simple to use. The major drawback, in my view, remains its inability to plug straight into a PAL television.

Hardware

In this section I shall consider each of the hardware elements separately, starting with the CPU and working outwards to the keyboard, screen, sound unit, and cassette.

As the name would suggest, the 99/4 is built around Texas' 16 bit processor — the 9900. Thus it has far greater inherent mathematical precison than the more common 8 bit micros. In fact its display shows an apparent 10 digit decimal precision whereas the internal precision is between 13 and 14 digits, depending on the value. One would expect the machine to perform well on benchmark programs, but partly because of the extra effort needed to maintain this level of precision and partly because of the speed of the interpreter, the test results were nothing to write home about. Exactly 26K of ROM looks after the BASIC and the operating system, while 16K of RAM is available to the user. "Only 16K eh?", I hear you say. Yes, despite the 9900 being a 16 bit machine and therefore capable of addressing much more memory, TI are offering 16K — no more, no less. My feeling is that later they may just decide to provide some add on memory, but I shouldn't let this form part of your decision to buy — just in case I'm proved wrong.

I only managed to make the system go wrong once and that was as a result of a poor cassette recording (probably caused by the overwriting of something else). The effect was to make the system ignore the end of file record, thus loading rubbish at the end of a program. The fun began when I tried to list or run the program — it would get to this bit and then dive off in a loop, throwing up spurious patterns all over the screen. I must stress that this only happened once and I mention the fault not because it was terribly important but rather it was something out of the ordinary. With this one exception the system was completely idiot proof.

The keyboard (comprising 40 slightly dished keys) has a very nice feel to it; it's small and laid out in the normal qwerty format. Having allocated letters and numbers the remaining 4 keys are used for space, shift, enter and full stop. There is also a space bar but everything else has to be found using the shift key. This can be very irritating, especially with common things like mathematical symbols and punctuation

The TI 99/4 connected to a Skantic dual standard television. The TI power supply is to the right.

marks. The keyboard is provided with a useful overlay which indicates the use of various keys when in EDIT mode. Other overlays are supplied with some of the command modules to show which functions are assigned to which keys.

The screen comprises 24 lines of 32 characters each of which can have a foreground colour and a background colour. The screen itself may be any one of 16 different colours as may be the character foreground squares, it's simply a case of defining the same foreground and background colours for a character.

By now you may have realised that high resolution graphics are not provided on this machine, although it is possible to redefine the pattern of each of the 128 characters. In this way it would be feasible to improve the resolution — although that's something you'll have to work out for yourself. Each character comprises an 8 x 8 matrix which may be redefined by using a 16 character hexadecimal string. For character graphics this is a great approach because it means you'll be able to produce just about any shape you're ever likely to need.

The TI manuals suggest that you ignore the first and last two characters of every line on the grounds that, on a poorly adjusted television, they could get lost. This was no problem on the machine I had but it's nice to note that Texas have taken their own advice, with all their displays fitting in positions 3 to 30.

The only other point worth making is that the connecting lead between computer and screen is mighty short. I found continued proximity to the screen a bit too dazzling and would strongly recommend getting an extension or persuading TI to provide something longer.

The 99/4 has a built in loudspeaker which drives you round the bend after a while (although I'll admit the kids didn't seem to mind it at all. In fact one of the games got played for hours, simply because they loved the jingles that went with it — we seem to lose something in the process of growing up). The machine can play three part music plus one part noise and it's possible to vary duration, frequency and volume, thus giving a very wide range of effects. The top end of the frequency range is reputedly 44733Hz (great for sending the dog up the wall) but my machine could only get up to 14911Hz. This may have been limitations in the internal amplifier and speaker, but I'm not sure; I didn't fancy connecting the system to my hi-fi to find out. Braver men than me (at TI) have tried and said there are no problems — I believe them.

Another useful thing about the internal speaker is that you can hear the cassette loading and, because you have a manual volume control, it doesn't shatter your eardrums. The system and command module software is also designed to make the machine "peep" at you when it requires an action, or when it doesn't like something you've done. If you are a particularly selfless individual there's an earphone socket at the front of the machine that will enable you to compute in complete privacy.

The cassette connection, comprises a 9 pin plug at one end and five jackplugs at the other, enabling you to connect two cassette recorders — one for reading and writing and the other for writing only. Occasionally, as on my Panasonic machine, the motor control jack polarity is the wrong way round. This is easy enough to solve although I didn't bother . . . I just kept switching the recorder on and off. You may have some difficulty setting the playback volume correctly but once cracked you will have no further problems.

TI recommend that any recorder used with this machine should have the following features: volume control; tone control; microphone jack; remote jack; earphone or external speaker jack and a digital tape counter to help you find your recorded programs or data. TI are currently evaluating all the cassette recorders commonly available in the UK to see which ones perform best with the 99/4. No doubt in due course they will make their conclusions known to their dealers.

Just one or two more hardware related comments to go. First, I haven't yet mentioned sprites, yes — sprites. These are used in the command modules but cannot be employed by the BASIC programmer. They are the images that move around the screen . . . things like targets and gunsights. The clever bit is that the 99/4 will detect a coincidence, thus increasing the realism of certain types of game. It's a shame that the BASIC doesn't allow access to these as it's probably one of the most useful features in games programs.

Another thing I noticed was a vibration on the metal part of the computer whenever the television was plugged in. This was presumably a fault with the television although I couldn't locate the problem (TI are now getting it fixed). And there are a couple of sockets that I haven't yet mentioned — one is for the attachment of joysticks and the other for a speech synthesis unit, an RS232 interface (for two devices), a disc controller and a print controller. None of these extras are available at present but they are on the way (see Expansion). Each of these plug in modules carries the 41 way edge connector so they can be piggy backed on to each other.

The only other thing is that the manuals are full of dire warnings about touching the machine and causing static problems. In fact, they advise you to always touch something metallic before using the 99/4. Those with children will know there is no chance of enforcing this rule. I didn't remember and nor did the man from TI. I suspect it's a case of excessive caution, although I think that you should steer well clear of edge connectors and suchlike, just to be on the safe side.

System software

Invisible — that was my first thought when I came to write this section of the benchtest. Of course, it's not invisible at all, the system software is there to help you key in, test and run programs. Apart from that I suppose you could say it's invisible. When keying a program you are first of all struck by the fact that the syntax checking is pretty strict. You must flank reserved words with

spaces or operators, for example. My own view is that this is a jolly good discipline, making your program much more intelligible than, say, some of the PET programs I have seen. The editing is a joy — key EDIT followed by the first line to be edited and from then on any adjacent lines to be edited will be presented when you hit the cursor down or up keys. Insertion and deletion as well as cursor right and left are all provided making it very quick and straightforward to use.

Before a program actually runs, the code is checked through and the system reports any errors it might find. This always happens when you type RUN. Should you encounter persistent problems then there are two facilities to make your debugging easier. The first is the BREAK function which allows the program to stop running at the lines at which you have set breakpoints. Provided you do not amend any variable values, the CONTINUE command will resume the running of the program. Secondly, you have the TRACE facility which lists the line numbers being executed in a program. This is particularly helpful when your program is looping and you can't see why. Indeed it was when tracing one of my programs that I felt the need for a printer; easier to browse through a listing than trying to debug from a moving display. I'd like it if TI were to offer a printer option on this particular facility.

The final points on system software relate to the user friendliness aspects of the machine. It's very helpful in that it always gives full instructions to the operator, issuing messages like "REWIND CASSETTE CS1 THEN PRESS ENTER"; it will then issue another message telling you what to do next — all jolly good stuff. Another nice touch — although to the experienced user quite superfluous — is that when a program terminates, the message **DONE** appears, followed by the usual operator prompt. It's superfluous because a) we have the prompt and b) the screen has a natty way of changing colour according to whether or not a program is running — light green when running and cyan when not. Finally, you will notice that after about ten minutes of non use the screen goes blank. Don't be alarmed; this is quite intentional and hitting any key will bring the display back again.

ROM Software

"Solid State Software" is supplied in a brightly coloured card box containing the Command Module itself, an instruction booklet and, when appropriate, a keyboard overlay. The command module comprises a single pcb carrying from one to five ROM chips (depending on the complexity of the package) all contained in a black plastic cartridge about the size of an 8 channel cassette which slides into the front of the 99/4. Once inserted you have the option of any of the packages contained on the module, as well as TI BASIC and the equation calculator. The children loved them, for a while at least, especially the moving colour graphics and the Stylophone-like tunes.

Some of the packages were very good, in particular the games and grammar packs. The pre school learning package seems a bit confusing — it uses lower case letters (quite rightly) but the keyboard is exclusively upper case. It may be that there should have been a suitable keyboard overlay supplied, in which case this is an unfair criticism. Another package insisted that I press the key marked BKWD when the overlay had BACK written on it. Attention must be paid to this sort of detail when dealing with the home consumer; however obvious to the experienced DP person, it can be very confusing to the beginner. Another package offered was the previously mentioned Keep Fit, in which little graphic people show you how to do an exercise; the machine plans a sequence and talks you through. I'm sure that this sort of thing goes down a treat in the USA but I wonder if it will catch on over here?

Our very own David Levy has written a chess program for the TI 99/4, although it will be a while yet before the ROMs are produced. I suspect that this is going to be quite something, and I'm not saying that just because he writes for us!

Finally the sprites again. They are used in several of the games and their size can be from one to four characters in each direction; they move around the screen quite freely, without any sign of jerkiness. It's possible to move them vertically, horizontally or diagonally using (refer to a keyboard) the WERSDZXC keys. I'm sure this is done just to make you covet joysticks!

TI BASIC

The BASIC seemed fairly normal although Texas prefer to use some of their own command names rather than the more familiar ones. Extra instruction sets are included to handle colour, graphics and sound as well as a fairly comprehensive set of file handling instructions. GCHAR is the equivalent of the more familiar PEEK except that it only works on the screen memory — you can't ferret around inside the other parts of memory. KEY is a touch more than the equivalent of a GET instruction, in that it returns the value 1 if a new key is pressed, —1 if the same key is pressed again and 0 if no key is pressed.

The BASIC can handle string constants up to 112 characters long, although these can be concatenated to the string limit of 255 characters. Variable names can be up to 15 characters in length and every character counts, giving an enormous number of possibilities. Numeric variables may carry the same name as string variables, the difference being that the string variable name is terminated with the conventional $. A number of string functions are offered, most of them familiar to BASIC aficionados but one or two are unusual. The functions are: ASC, CHR$, LEN, POS, SEG$, STR$, and VAL. POS will find the position within a string of any specified sub-

Basic

ABS	ASC	ATN	BREAK
BYE	CALL CHAR	CALL CLEAR	CALL COLOR
CALL GCHAR	CALL HCHAR	CALL JOYST	CALL KEY
CALL SCREEN	CALL SOUND	CALL VCHAR	CHR$
CLOSE(DELETE)	CONTINUE	COS	DATA
DEF	DELETE	DIM	DISPLAY
EDIT	END	EOF	EXP
FOR. .TO. .STEP	GOSUB	GOTO	IF. .THEN. .ELSE
INPUT (REC)	INT	LEN	LET
LIST	LOG	NEW	NEXT
NUMBER	OLD	ON. .GOSUB	ON. .GOTO
OPEN			
OPTION BASE	POS	PRINT(REC)	RANDOMIZE
READ	REM	RESEQUENCE	RESTORE
RETURN	RND	RUN	SAVE
SEG$	SGN	SIN	SQR
STOP	STR$	TAB	TAN
TRACE	UNBREAK	UNTRACE	VAL

string and SEG$ is our old friend MID$ in disguise.

Alphabetic or numeric arrays are available,each up to 3 dimensions. You also have the option of defining the base of the array as 0 or 1, thus avoiding great confusion.

Several graphics commands are available enabling you to colour the screen, the individual characters and their own backgrounds. You could, for example, have a cyan screen with a black letter on a red background while the letter next door could be green on a yellow background (ugh!). Two instructions exist to enable you to repeat a character horizontally or vertically. Two nested loops containing these instructions would produce a rectangle of the chosen character.

The characters from 96 to 159 are undefined . . . you may create whatever characters you like using these codes. You may also redefine characters in the range 32 to 95, replacing the conventional character with one of your own choosing. If you were to redefine 32 (space) for example and then issue a CALL CLEAR instruction, the screen will be covered in your chosen character instead of spaces.

TI BASIC has commands to handle files on cassette and disc. They comprise OPEN, CLOSE, INPUT, PRINT, RESTORE and EOF. Files can be held sequentially or randomly on disc, with fixed or variable length (sequential only) records. The information may be stored in internal or display format, that is to say packed or ASCII. Files can be opened in input, output, update or append modes — thus minimising the risk of data corruption. EOF reports the logical or physical end of file when reading from disc while RESTORE puts the record pointer back to the beginning of the file.

All in all a pretty comprehensive BASIC although the graphics potential is restricted through the lack of plotting facilities.

Documentation

A lot of thought has gone into the documentation for this machine. Three books are provided — Read This First (quick steps to get you set up and started now), the Beginners BASIC manual and the Users Reference Guide; each is ideal for its respective audience. A BASIC reference card is also supplied which is simply a memory jogger containing the syntax for each of the BASIC commands, together with lists of things like frequencies associated with the C Major scale and a hex to decimal conversion table. Each cartridge comes with its own explanatory booklet. There's not much one can say when presented with documentation such as this except that it is very good.

Potential use

By now, the aim should be quite clear . . . the TI 99/4 is intended for the home where it can be used to educate, play games or handle tasks like household accounts. I've no doubt that some people working from home will slip in the odd business application, but this will not be the prime reason for purchase. The fact that you can learn to program in BASIC on this machine means that the possibilities for use are, as always, only limited by the users' imagination.

Expansion

Lots of things are planned although none of them are available as yet. In the order that they are likely to appear, the add ons are speech synthesis, RS232, joysticks, printer and discs. The printer will be 32 columns, thermal and therefore almost silent. Up to 3 disc drives may be attached each being single sided, single density, 5" and 90K Byte capacity. The speech synthesis will be user programmable (if you're clever) and contain vast numbers of words and phrases already programmed in; according to TI it will be "much better than our Speak 'n Spell". All I can say to that is "Thank goodness"!

The RS232 interface means that all sorts of non TI devices may be hooked up, not forgetting the acoustic modems which are to become increasingly important in this game (just ask David Hebditch). Prestel is being considered although there are no firm plans for it to be introduced. The problem here centres around the fact that Prestel demands 24 lines of 40 characters and a 240 x 240 resolution graphic capability — the 99/4 has 24 lines of 32 characters and no high resolution graphics facility as such. Don't write it off though, because internally the 99/4 can work in compressed character mode which (surprise, surprise) offers 40 characters per line.

TECHNICAL DATA	
CPU:	9900, 16 bit, 3.58MHz
Memory:	16K user RAM, 26K ROM
Keyboard:	40 keys
Screen:	32 x 24, NTSC
Cassette:	Audio
Bus:	Unknown
Ports:	TI's own, RS232 on the way
Language:	TI BASIC

Benchmark Timings (in seconds)	
BM1	2.9
BM2	8.8
BM3	22.8
BM4	24.5
BM5	26.1
BM6	61.6
BM7	84.4
BM8	38.2

Conclusion

This machine, very smartly packaged in silver and black, will look good in your home and will undoubtedly provide hours of pleasure. It has a good BASIC and high precision mathematics. Its drawbacks are that it needs a special, or modified, television and, surprising for a "gamey" type of machine, lacks high resolution graphics facilities. The add ons will undoubtedly make this a very attractive machine, especially with a speech synthesis that's likely to be ahead of anything seen so far. It comes rather expensive to my mind, at £655 plus the cost of the special TV or modification, but on the other hand, it certainly has a lot to offer. The question is, are people in the UK yet ready to spend this sort of money on a home computer?

Prices

TI-99/4 with B/W monitor	£750
TI-99/4 with modification to existing set	£750
TI-99/4 with 14" dual standard colour TV	under £1000
TI-99/4 with 20 or 26" colour set, remote controls etc	£1300
Command Modules	£14.95-£44.95
Speech module (due April)	under £90
RS232 interface " "	under £150
Joysticks (due May)	under £30
Printer (due May)	under £270
Discs (due July)	n/a

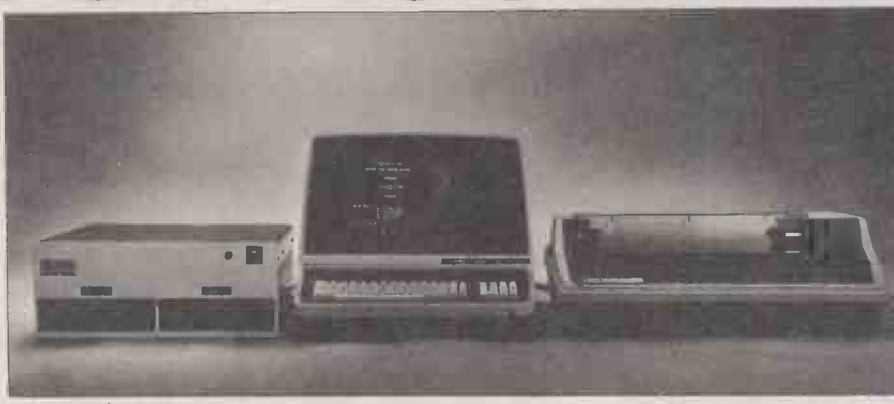
At a glance

FIRST IMPRESSIONS	
Looks	*****
Setting up	****
Ease of use	****
SOFTWARE AND LANGUAGES	
BASIC	****
System software	***
Home and education packages	**
PERFORMANCE	
Processor	**
Cassette Interface	***
EXPANDABILITY	
Memory	n/a
Cassettes	**
Discs	coming
Speech synthesis	coming
Printer	coming
COMPATIBILITY	
Hardware	n/a
Software	**
DOCUMENTATION	****
VALUE FOR MONEY	**

***** excellent
**** v. good
*** good
** fair
* poor

BENCH TEST

ALTOS ACS 8000-2



As designers develop methods for putting more and more circuits onto a single chip so the computer designers develop complete systems with fewer and fewer components.
The American manufacturer ALTOS has taken advantage of the situation to produce a range of single board computers with the power of bus based systems. The British company Logitek have put together a turnkey business system, based on the ALTOS range of computers, complete with accountancy packages and a word processor. Sue Eisenbach reports. . .

Hardware

The Altos ACS 8000-2 computer is a Z80 disc based computer that comes in a box 7" high by 18" deep by 17" wide. The box normally sits in a specially designed desk, but because I live in a flat (and not a computer showroom — which may come as a surprise to some of my closer friends!), Logitek thoughtfully supplied the review machine without its "office" housing. The lid comes off the box by the removal of six screws, revealing the single board computer on the right side and one of the disc drives and its related circuitry on the left. By unscrewing the single board computer the second disc drive plus circuitry becomes accessible. The CPU is a Z80A running at 4 MHz and the 64K of RAM is dynamic. A 1K ROM containing CP/M bootstrap and monitor with the usual set of commands is also on the board.

The ACS 8000 range of computers uses a Z80-SIO and two times Z80-PIO for communications. Each of these controls two ports. The first serial port is used by the console while on the review machine the second was linked to a printer (it can be used for a modem instead). One PIO is used to control disc operations while the other is connected to an external parallel connector and may be used for a printer, EPROM programmer or any other parallel device.

The disc drives are controlled by a 1771-1 floppy disc formatter/controller which is able to cope with both single and double density discs. For double density the formatting is as follows:

Track	Density	Sectors Per Track	Bytes Per Track
0—1	Single	26	3328
2—76	Double	48	6144

So, when formatted, each disc holds 450K. The disc drives are Shugart's SA800 and are mounted horizontally, but with their controlling circuitry on top. In other words, the discs are positioned with their front facing down.

In addition to the configuration I had, the literature reports that a Z80-DMA controller and an AM9511 Arithmetic Processor (for floating point trigonometric and other mathematical functions) are available as options. An EPROM programmer is listed in the table of contents of the Altos system manual although the manual itself reveals that this feature has yet to become available.

The review machine came with an Adds Regent 25 VDU and a Texas 810 printer. The VDU keys, which have an extremely firm feel, require a lighter touch than I am used to. There are 76 of them and that includes a separate numeric/cursor pad. The layout is good and includes both shift and case keys so that upper case typing does not require shifting to get to the numbers. There's no repeat key but the "repeat" function occurs when a key is held down longer than usual. The printer (with single printhead which produces a nine by seven dot matrix) is bidirectional at the rate of 150 characters per second. The one I had for review had options for compressed print (so that 132 columns can fit on an A4 piece of paper) and compressed lines (8 to the inch rather than 6). Both peripherals seemed robust.

System software

The review machine came with both CP/M 1.4 and CP/M 2.0. The major enhancement which CP/M 2.0 has over 1.4 is the ability to deal with up to sixteen logical drives each containing up to eight megabytes — its directories can hold 512 names. Random access facilities have been improved over previous versions: CONTROL H now backspaces properly and Delete or Rubout can be altered to send ^H There are four differences between 1.4 and 2.0 at CCP level. DIR lists four elements per line (in MBASIC format) while a USER command allows the maintenance of up to 16 different logical areas in a directory. ERA now only deletes the current user's files while SAVE no longer alters the memory image and STAT and PIP have been extended. STAT VAL gives a summary of the available status commands, STST DSK produces a drive characteristics table for all currently active drives and STAT USR produces a list of user numbers which have files on the currently addressed disc.

Any file can be made Read Only (R/O) or a system file — e.g. PIP — and system files won't feature in a DIR listing, but will appear under STAT. PIP has three new functions: Gn for setting a file from user n's area, W for writing over R/O files and R for reading system files. ED now standardly verifies lines and to disable this a "—V" command is needed. There's a new utility, XSUB, which allows the SUBMIT facility to include line input to programs as well as to the CCP.

CP/M 2.0 is upwardly compatible with 1.4 but only downwardly compatible if none of the new features are used.

Most of the Altos utilities supplied with the review machine (and these come supplied with any Altos 8000 computer regardless of the choice of CP/M version) dealt with the density of the discs. The Altos utilities are:

SINGLE X — sets drive X to single density.
DOUBLE X — sets drive X to double density.
REFORM — allows the formatting of discs in IBM or ISIS single density or Altos double density.
SETUP — for changing the bootstrap loader with reference to disc density and printer baud rate.
COPY — for copying a single density disc.
DCOPY — for copying a double density disc.
PROMMR — not available yet, but for programming 2708's and 2716's.
DTEST — tests disc drives.
MTS — tests memory.

Like most CP/M software, the Altos

utilities are supplied in single density format; the user requiring double density operation must transfer into Altos double density. This is a sensible arrangment since it allows the user to purchase any CP/M software and also to transfer to and from non-Altos CP/M systems. Unfortunately, I was unable to succeed in producing double density discs under single density CP/M 2.0 (although I had no difficulty using the same utilities under CP/M 1.4). Using two discs of different densities was not quite as straightforward as I would have liked. When the system is bootstrapped it takes on the density of the disc from which the bootstrap occurs. If the second drive is to be of the other density then a SINGLE B (or DOUBLE B) will allow access. However, there's no command which enables the user to find out the density of a particular disc. I feel that the system should take care of changes in disc density automatically, or there should at least be some command that will allow a human check to be made. All I could think of doing was using STAT and counting the Kbytes, or taking a chance on which density it was — thereby risking a disc read error (BDOS error) and having to re-boot the system.

Languages

The Microsoft BASIC is release 5.1 and has a few features not found in release 5.0 — in particular:

RANDOMIZE now prompts with "Random Number Seed (−32768 to 32767)"
INKEY$ returns either a one character string (from the terminal) or a null string if nothing has been typed in. No characters are echoed. (similar to PET's GET$).
VAL now strips leading blanks, tabs and linefeeds.
VARPTR(#<file number>) for random access files returns the address FIELD buffer instead of the disc I/O buffer.

The other languages provided were CBASIC, Fortran 80 and Cobol 80.

Photography by Ian Dobbie

The processor/disc unit with its lid removed showing the single board computer to the right and one of the drives visible on the left.

Applications software

The Logitek Business System comes with a full range of application software; Wordstar is provided for word-processing. The rest of the business packages come from Interface Software Ltd (which is half owned by Logitek). They have anglicized (and improved) the Peachtree business packages which hailed originally from Retail Sciences of Atlanta, Georgia.

I had never seen Wordstar before and I must say that I was impressed. It's easy to use (menus at the top of the screen eliminate the need to turn to a manual) and extremely powerful; it was fun watching lines justify themselves before my eyes. By following the menus it's a simple matter to insert and delete individual words, re-arrange lines, re-format whole pages, insert external files into the middle of the text and of course output the file on the printer. In theory editing and printing can occur at the same time (using different files). . . in practice, without the DMA chip, keyboard input must be so slow (to avoid losing the odd character or command input during a disc swap) as to make it worth letting the printer have the processor to itself. My other criticism, as a touch typist, is that all cursor controls involve the CONTROL key and one of the left-hand keys, which must be depressed simultaneously. In the interests of balanced action, it would be more comfortable if the right-hand keys were used in conjunction with the CONTROL key.

The Interface Software packages that were provided with the review machine included Inventory Management, Mailing Address System, Nominal Ledger, Sales Ledger and Purchase Ledger. The payroll package was not available at the time of the review. All the software was written in Microsoft BASIC 5 and although the version that I had was in interpreted BASIC, there are plans for the next release to be compiled. The programs are all menu driven and well laid out on the screen (they don't scroll up but rather come down from the top of the screen).

Interface Software Ltd. provided an automatic demonstration of the ledger packages which took its input from a file rather than the terminal. When I ran the packages manually there was obvious confirmation that data input was being vetted; anything unacceptable caused a "beep" and a request for another input. During disc transfers the user is asked to wait. If a user has the full set of accounting packages, during month end processing, ledger information can be transferred to the Nominal Ledger Transaction File for an integrated ledger system.

To give some idea of the level of sophistication of the packages in general, the following is the list of programs in the Sales Ledger package:

Set today's date; Customer file maintenance; Enter transaction; Delete transaction; Open credit reconciliation; Invoice report generation; Statement report generation; Aging report; Transaction report; Customer account report; End of period processing; Query customer activity; Verify file structure; System initialisation; Create demonstration data files.

The one criticism I have of the packages is that disc maintenance must be done through the operating system. From the

point of view of the beginner, it would have been easier if a disc maintenance option had been included, thus allowing formatting and disc copying without the need to be aware of CP/M.

Potential

The Altos ACS 8000-2 has been put together to appeal to the businessman. Logitek say that their desk consists of a leather-topped table, plus separate cabinet fitting neatly underneath (which can be used to house additional floppy or Winchester drives).

Although potential business users are at liberty to build up their own suites from the available range of CP/M system and applications programs, they are unlikely to do so since the Interface Software packages, together with Wordstar, form as complete and comprehensive a collection as most could require. Interface Software discs can be set up to boot directly into the package — thus avoiding the more complicated "manual" initiation via the system software.

Looking at the machine from an educational vantage point, there are advantages and disadvantages. It feels solid and having CP/M for its operating system allows the widest range of system software. Also the optional floating point processor must make it a good bet for a micro number cruncher. However, the lack of graphics cannot be inexpensively overcome — there's no bus into which to slot a graphics board and a full graphics terminal would be necessary to provide such a facility. Also the lack of a bus structure would prevent some educationists from customising their hardware, although the latest Altos glossy does describe a prototype board.

Documention

Since the hardware and software come from several sources, the documentation is varied. The ACS 8000 Operating Manual is reasonably accessible — the text within it is coherent and there's a detailed table of contents (but no index). The pages are numbered, although the numbers don't appear in the table of contents; a full set of circuit diagrams is included.

But there's no User's Guide for CP/M 2.0. Instead, the operator is expected to make himself familiar with the main features of CP/M 1.4 via the corresponding User's Manual, and then "transfer" by means of the "CP/M 2.0 User's Guide for CP/M 1.4 Owners". This is extremely inconvenient for new users and not as helpful as it sounds for ex 1.4 users, since two manuals have to be accessed and cross referenced in order to understand the system. I hope that Digital Research are planning a CP/M 2.0 User's Guide.

The manual for BASIC 80 version 5.1 has not shown any signs of improvement over the 5.0 manual — in fact if anything it's got worse as there are now two pages of 5.1 additions at the front of a 5.0 manual.

However, I was impressed with Interface Software Ltd.'s manuals for application software. These don't ask the user to become familiarised with system manuals as they contain step by step details for using any necessary system utilities. As well as eliminating the need to go about finding information from other manuals, the application software manuals contain descriptions of the systems, equipment requirements and capacities, detailed instructions for using the programs and sample runs using test data supplied with the software. The tables of contents are paginated and detailed.

I have to admit that I found it easier to use Wordstar's menus than to go by their comprehensive manual. For most practical purposes the information contained in these menus is sufficiently detailed for the user to achieve any required effect.

Expansion

The minimum system comes with 32K but this can be upgraded to 64K with the plugging in of a few chips. (The review machine arrived as a 48K version but was expanded to 64K in a matter of minutes). Also, as previously mentioned, the machine's desk has room for extra drives — adding them should be straightforward. There are sockets on the board for the DMA controller and the arithmetic chip.

To expand the system from a single to a multiuser, the one board computer must be replaced with another (double size) board. According to the literature, the largest system (ACS 8000-6, with DMA as standard) can handle up to four users and two printers. This can run under either M/PM or AMEX, Altos' own operating system which can still run CP/M programs. A fully expanded four user system can have 208K RAM on board — AMEX takes 16K and each user gets 48K.

Logitek business systems

All Logitek Business Systems come complete with an Adds Regent 25 VDU, Texas 810 Matrix printer and all the business and software listed above — as well as CP/M and BASIC.

Prices

Logitek sells a wide range of computers and business systems based on the Altos range of computers. Below is a representative sample of their range.

Altos CPU with single floppy capacity ½ Mbyte	
32K	£2398
48K	£2569
64K	£2713
Altos CPU with twin floppies capacity 1 Mbyte	
32K	£3083
48K	£3240
64K	£3398
Additional Disc and Tape Drives	
Single capacity ½ Mbyte	£1028
Twin capacity 1 Mbyte	£1370
Winchester 14.5 Mbyte	£2450
Winchester 29 Mbyte	£3250
Tape backup 17.5 Mbyte	£240C
Peripherals	
Texas 810 with options	£1650
NEC Spinwriter	£2195
Adds Regent 25	£ 675
System Software	
CP/M + Altos Utilities	£ 85
AMEX (Altos Multiuser executive)	£150
BASIC 80 Interpreter	£215
BASIC 80 Compiler	£215
CBASIC	£ 85
Fortran 80	£245
Cobol 80	£375
UCSD Pascal	£125
Z80 Macro Assembler	£ 85
Business Software	
Nominal Ledger	£295
Purchase Ledger	£295
Sales Ledger	£245
Mailing List	£295
Stock Control	£395
Payroll (forthcoming)	£295
Word Processor	£255

Single User Systems	
F1-48K Altos CPU with 1 Mbyte floppies	£ 8900
F2 — as above but 64K	£ 9060
H1 — System F2 + 14.5 Mbyte hard disc	£12,135
H2 — As H1 but 29 Mbyte hard disc	£12,960
Multi User Systems	
MU2-112K with 1 Mbyte floppies and 14.5 Mbyte hard disc plus another terminal	£13,795
MU2A — as MU2 but 29 Mbyte hard disc	£14,615
MU4 — 208K with 1 Mbyte floppies and 14.5 Mbyte hard disc plus three more terminals	£16,065
MU4A-As MU4 but 29 Mbyte hard discs	£16,885

The Logitek Business System prices include installation and hence are more expensive than the component parts.

Conclusion

As well as examining the software provided and running the disc and benchmarks, the review machine underwent extensive use as a word processor. Both this article and Chapter 9 of *The Complete Pascal* were typed (and subsequently revised) using Wordstar. I soon came to trust the reliability of the system.

Since the Altos range of computers are single board systems, any potential user is locked into Altos hardware. Fortunately, the Altos single user system runs CP/M while the multiuser systems run operating systems that are upward compatible with CP/M. And even though potential users are not tied into one supplier for software, Logitek have made every effort to hold customers by selling at reasonable prices a range of business software tailored to the Altos range of hardware.

BENCHMARKS	
BM1	1.4 secs.
BM2	4.3 "
BM3	11.3 "
BM4	11.3 "
BM5	12.0 "
BM6	21.2 "
BM7	34.9 "
BM8	2.7 "
DISC TESTS:	
D1	0.9 secs.
D2	6.3 "
D3	33.5 "
D4	6.3 "
D5	31.9 "

TECHNICAL DATA	
CPU	Z80A 4MHz
Memory	32K to 64K dynamic RAM
Keyboard	Adds Regent 25
Screen	
Cassette	N/A
Disc Drives	2 drives, 8" double density single sided
Printer	Texas 810
Bus	N/A
Ports	2 serial, 2 parallel
System Software	CP/M and Altos utilities, UCSD Pascal
Languages	BASIC 80, CBASIC, UCSD Pascal, Fortran 80 Cobol 80, 8080 Assembler

AT A GLANCE	
FIRST IMPRESSIONS	
Looks	***
Setting Up	****
Ease of Use	****
HIGH LEVEL LANGUAGES	
BASIC	****
Cobol	**
Fortran	***
Pascal	**
System Software	***
PACKAGES	
Business	****
Education	**
Home	***
PERFORMANCE	
Processor	****
Cassette	N/A
Disc	***
Peripherals	***
EXPANSION	
Memory	***
Cassettes	N/A
Discs	****
Bus	N/A
COMPATIBILITY	
Hardware	**
Software	****
DOCUMENTATION	***
VALUE FOR MONEY	***

***** excellent
**** very good
*** good
** fair
* poor

BENCHMARKS ROUND-UP

Here follows all the timings for all the machines tested since the September 1979 issue. For the sake of completeness, others have been included that date back to the days of "the old regime". Timings from this month's Benchtests do NOT appear in the list.

Machine	BM1	BM2	BM3	BM4	BM5	BM6	BM7	BM8
ABC 80	1.1	2.3	11.1	12.1	12.6	17.7	23.9	13.6
ACT 800	.9	4.6	8.5	9.4	10.1	14.9	23.4	5.6
Apple II	1.3	8.5	16.0	17.8	19.1	28.6	44.8	10.7
Challenger C2 4P	1.4	7.8	15.0	16.5	17.8	27.0	39.5	7.5
Challenger C3 S1								
CP/M	2.3	7.9	21.0	21.0	22.5	37.5	59.6	9.9
65D	1.7	13.1	21.6	23.7	29.2	39.6	58.3	17.6
Compucolor II	2.0	10.9	22.4	23.9	25.7	38.7	55.2	10.2
Cromemco System Three								
Short reals	1.7	4.6	14.9	17.8	19.4	30.2	41.9	22.9
long reals	1.9	5.7	16.4	19.7	21.3	32.4	44.1	22.9
Heath WH89								
EBHB	4.1	17.0	35.0	38.8	44.0	75.8	113.0	11.0
MBASIC	2.5	9.2	25.8	26.0	27.0	46.6	73.2	13.0
Micromation Z Plus								
Interpreter	1.4	4.4	11.2	11.3	11.5	21.2	34.9	3.9
Compiler	.6	.5	3.6	1.8	1.8	4.7	13.5	4.9
Panasonic JD 700	2.8	9.1	24.6	24.7	26.2	43.9	69.7	11.8
PET	1.7	9.9	18.4	20.4	21.0	32.5	50.9	12.3
Sharp MZ-80K	1.4	9.4	16.3	22.5	25.4	36.8	51.1	10.2
Sinclair ZX80	1.5	4.7	9.2	8.9	12.7	25.9	39.2	—
Sorcerer	1.8	10.0	20.7	22.2	24.3	37.6	53.7	9.6
TRS 80 Level I	2.5	18.0	34.5	39.0	45.0	67.0	109.0	—
TRS 80 Level II	2.7	11.6	28.0	28.5	31.3	51.9	81.0	11.7
Video Genie	2.7	11.6	28.0	28.5	31.3	51.9	81.0	11.7

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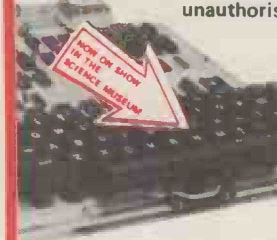

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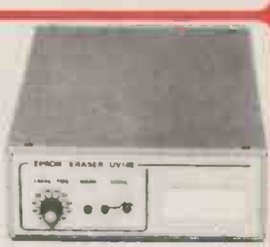

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BENCH TEST

HP-85

Hewlett Packard are much renowned for their high quality electronic equipment, with a range that stretches from television waveform monitors through pocket calculators to computers. The HP 85 (or Capricorn) is their long awaited entry into the small computer market and has many "plus" features — and some surprising omissions. Has it been worth the wait?

by Guy Kewney

Hardware

As is to be expected from HP, the machine is superbly engineered and similar in design concept to the PET. The processor, power supply, keyboard, screen, loudspeaker, tape drive and printer are contained in a unit about the same size as an Apple; although reasonably light in weight HP's excellent carrying case would be a worthwhile investment.

The CRT screen is a minuscule 5" with a paltry 32 characters per line and 20 lines to the screen. The CRT uses its own dedicated memory and can store up to four screenfulls that "roll-away" out of sight at the top of the screen but can easily "roll-back" at the touch of a key. However, the limit of 32 characters is rather low and this must give rise to serious misgivings as to the machine's business potential. In addition to these four screens, there's an additional graphics screen that is comparable to the Apple Hi-Res graphics. Actually it's 255 horizontal dots by 191 vertical dots thus giving the same apparent resolution in both axes.

Several commands are available to manipulate the dots, such as DRAW 40,30 which draws a line from whereever the "spot" happens to be to point 40 on the X-axis and point 30 on the Y-axis. These points are referenced to the edges of the screen and if your chosen points are off the screen then tough luck as it will attempt to draw a line there anyway. The absolute movement of the DRAW instruction is affected by the dimensions set by the SCALE statement that effectively tells the computer what scale you are using on the screen, be it 40 points in each direction or 40,000. DRAW 40,30 will have more effect with a coarse SCALE such as 40 by 40 than with a finer scale of 40,000. A similar command is IDRAW but this draws relative to the last plotted point on the screen. For example, 130,—40 will add 30 to the last plotted point's X co-ordinate and subtract 40 from the Y co-ordinate. It then draws a line from where the last point is to these newly calculated co-ordinates. MOVE and IMOVE are identical to DRAW and IDRAW except that the "pen" moves to the new specified location but without drawing a line behind it.

BPLOT enables you to draw pictures but the actual operation, like the Apple SHAPE table, is a bit awkward and cumbersome. Care has to be exercised when BPLOTTING lest the BPLOT data "interferes" with existing screen data to produce a meaningless scribble. Mixed text and graphics is possible with the LABEL command. The snag is that, while you can put messages onto the graphics screen by saying LABEL "WHAT KIND OF PARAMETER IS THAT?" getting them off again requires care. If you know exactly where the PEN was when the LABEL started, you can go there again, reverse the PEN and reLABEL and it will vanish. If you know approximately where the LABEL was and it was near the bottom of the screen, you can specify a detailed GCLEAR from a certain Y level down and clear only that much of the screen. GCLEAR, by itself, will clear the graphics screen but I couldn't find an easy way to clear the text screens under program control. A nice feature is the ability to dump the entire contents of the screen — both text and graphics — to the 32 character thermal printer under the action of the COPY key. LDIR is a beautiful command that defines in what direction the label will be printed and also re-orientates the attitude of the letters — straight up will print ABC .

Comparison with the Apple graphics is inevitable and both have their good and bad points. The HP 85 has total lack of direct cursor control under program command. With the Apple you can type a list of prompts down the left-hand side of the screen — move the text window to the middle of the screen and clear the remaining half ready to accept data from the keyboard. Not so with HP85 — it will take blood, sweat and possibly even tears to program it to reach a similar result. Most graphic routines that I have seen get round this problem by re-writing the screen everytime — just like a VDU on the end of a bit of wire — which in a 32K BASIC is a bit of a drop-off.

Eventually, the HP85 will come with a disc based operating system but currently there is a very good tape operating system driving the 3M mini cartridge. This features fast and slow tape movement under program control and a sliding tab that prevents accidental erasure. It's much more efficient than the humble cassette in locating and loading data and makes the PET tape system look even more pathetic. Data files are either sequential or random in access and to avoid unnecessary tape movement, the last 22 items from the catalogue are kept in RAM for immediate access — which is good. The loading routine will look for the first available space on the tape big enough to take the program. . . a very economical system. The 98 series of HP machines uses an identical drive but the two tape formats are different. However, a man from HP said that "a binary program is available to convert between the two". Another strong point of the tape system is its security checking. For example, it's possible to protect a program to the level that an unauthorised user cannot load it, or even see it in the catalogue! The weak point of the tape system is in the error protection — it's too good. One example that one would love to ignore is the tape flaw detection. This involves a light which shines onto the tape. If a piece of brown oxide flakes off, the tape becomes transparent and the computer thinks that it has reached the end of the tape — and stops the drive. I wrote fifteen programs, but in the process of amendment, damaged, number two. Thereafter, all thirteen programs that followed were lost for ever. It was small consolation to hear the HP man explain that a bit of black ink on the backing would solve the problem!

The keyboard is excellent and supplies the full ASCII set and also a comprehensive numeric pad. There are other single function keys such as RUN, PAUSE, LOAD, COPY, TEST, STORE, CLEAR and GRAPH although the idiot that put the SCRATCH key where it is needs burying in a deep hole. . . it's very easy to accidentally SCRATCH instead of ENDLINE (Carriage Return to you) and hence erase that program that you spent two hours typing in. Another part of the keyboard that deserves special mention is the idea of programmable or user-defined keys. Under the screen are keys that can be made to control the user's program without the necessity to hit return everytime. At the bottom of the screen, the program can display the labels, like "THINKS" bubbles, that it has assigned to each key — such as STOP, YES, NO etc. This simplifies operation for the unsophisticated user no end. In conjunction with the editing keys, the cursor forms a very powerful on-screen editor that features both character and line editing; however, there's the drawback that the cursor deletes any underscoring of letters as it progresses along the line.

The HP85 is built around Hewlett Packard's own custom built chip set and includes an 8 bit CPU, dynamic RAM and I/O controller. As a consequence, the chip count on the CPU board is reduced considerably to only 16 ICs! The disadvantage with this is that no-one outside HP knows the instruction set and no programming is available in either machine code or assembler — which is a potential disaster particularly if you want to write some very tightly controlled timing loops for some outside peripheral. True, there is a real time clock with a resolution in mSecs but in practical terms, the unknown and variable time delays introduced by the other BASIC program statements tend to make this clock perhaps not quite as useful as it otherwise might be. I feel this lack of any machine code programming to be a serious oversight on the part of HP.

Photography by Francis Chapman

BASIC INSTRUCTIONS

Statements: ASSIGN, BEEP, CHAIN, CLEAR, COM,
CRT IS, CREATE, DATA, DEFAULT OFF/ON, DEF FN, DEG, DIM, DISP,
DISP USING, END, FN END, FOR. .TO. .STEP, .NEXT, GOSUB, GOTO, GRAD, IF. .THEN. .
ELSE, IMAGE, INPUT, INTEGER, KEY LABEL, LET, LOAD BIN, NORMAL, OFF/ON ERROR. . .
GOTO, or GOSUB, OFF KEY/ON KEY, ON TIMER. . .GOTO or GOSUB, OPTION BASE
PAUSE, PRINT, PRINT USING, PRINTER IS, PURGE, RAD, RANDOMIZE, READ,
REAL, REM, RENAME, RESTORE, RETURN, SHORT, STOP, STORE BIN, TRACE,
TRACE ALL, TRACE VAR, SETTIME, WAIT

GRAPHICS STATEMENTS

ALPHA, BPLOT, DRAW, GCLEAR, GRAPH, IDRAW, IMOVE, LABEL,
LDIR, MOVE, PEN, PENUP, PLOT, SCALE, XAXIS, YAXIS.

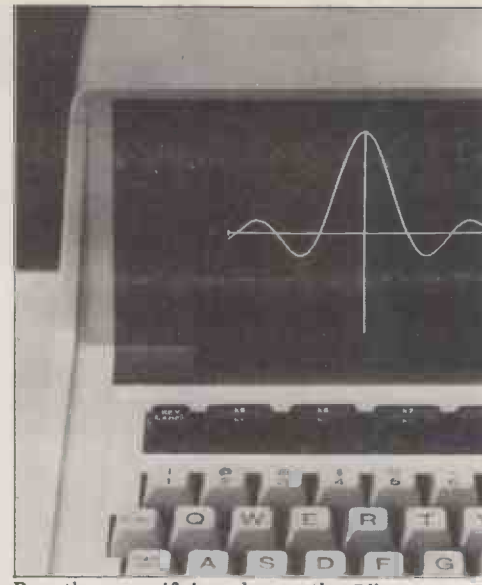
BASIC FUNCTIONS

ABS(X), ACS(X), ASN(X), ATN(X), ATN2(Y,X), CEIL(X), CHR$(X), COS(X),
COT(X), CSC(X), DATE, DTR(X), EPS, ERRL, ERRN, EXP(X), FLOOR(X),
FP(X), INF, INT(X), IP(X), LEN(S$) (note that it *is* S$), LGT(X), LOG(X),
MAX(X,Y), MIN(X,Y), NUM (S$), PI, POS(S1$,S2$), RMD(X,Y), RND, RTD(X),
SEC(X), SGN(X), SQR(X), SIN(X), TAB(N), TAN(X), TIME, UPC$(S$), VAL(S$), VAL$(X).

HP85 SYSTEM COMMANDS

Non programmable:
AUTO, CONT, DELETE, INIT, LOAD, REN, RUN, SCRATCH, STORE, UNSECURE.
All except REN and UNSECURE are single key commands.

Programmable:
CAT, COPY, CTAPE, ERASETAPE, FLIP, LIST, PLIST, PRINT ALL, REWIND,
SECURE. Only COPY, LIST/PLIST and REWIND are single keystrokes.



Pass the magnifying glass — the 5" "micro" screen plus user defined keys.

Software

The BASIC comes in a 32K ROM with floating point, 12 digit precision and is claimed to "meet and exceed the ANSI standard". Let's get one thing straight, the ANSI standard is not a competition but an attempt to standardise on available BASIC commands and thus save you and me a lot of time laboriously rewriting programs from one machine to another. So any claim to "exceed" the standard is so much hot air. Nevertheless, as can be seen from the list of statements, the BASIC is very comprehensive and has many features not normally found in personal computers. All the software is upwardly compatible in that HP say, providing state ments are limited to one per line, then the more advanced 98 series will be able to understand about 95% of the HP 85's BASIC repertoire. Notice, however, the surprising omission of PEEK, POKE USR and CALL — all confirmation of the lack of machine code support. As can be seen from the Benchmarks, the HP85 is respectably fast if not the fastest.

TECHNICAL DATA

CPU:	Hewlett Packard custom-designed chip, in NMOS
Memory:	16K bytes standard; add-on 16 Kbyte modules planned.
Keboard:	IBM typewriter standard, plus programmable function keys, plus numeric calculator pad, plus system function keys.
Screen:	Five-inch, with 32 characters per line, 20 lines per screen
Tape:	Cassette-width, cartridge drive integral, 195 Kbytes per cartridge, 29-second rewind, 650 bytes/second transfer rate, 60inches/second search, error-correcting
Printer:	Integral thermal printer, identical character set as screen, same size — permits totally accurate screen copies of print and graphics. Speed: two lines per second.
Bus:	Will support the HP-IB eventually.
Peripherals:	To be announced; will attach to HB-1B or other interfaces.
System software:	Tape operating system with high security options to prevent accidental or deliberate access to important data.
Language:	Only BASIC, with sophisticated graphics extensions, no Peek or Poke.
Power supply:	UK standard, safe, inaccessible, integral.
Cooling:	Convection

Firmware support is achieved by making the bottom 8K of the BASIC ROM "transparent" and user firmware packages up to 8K in size can be accessed at this location instead — the idea being, I guess, for HP to issue a stream of plug-in packages.

Another aspect of HP BASIC is that it's very friendly while the program is being entered and the comparison with other micro's in terms of writing and editing programs is astonishing. If, for example, you try to enter a faulty BASIC statement, the old statement with the same number is not deleted thereby giving you the chance to correct your mistakes or leave the old line alone.

Comprehensive error checking and reporting is another good feature although one annoying error was overflow. Try loading a long program (there's one supplied with the HP85 called COMPZR which plays tunes, using the BEEP instruction. It will load a data file called MUSIC and thereafter, if not carefully handled, will play over 600 notes from Rossini's William Tell overture with heartrending accuracy and total lack of sensitivity). Unfortunately, the William Tell notes seem to take up all available memory because, when I attempted to change a section of the tune, I got the OVF message — overflow of memory. Once the machine signals OVF the only thing that can be done to start the program again is RESET. However, you can't clear the OVF problem by pressing RESET! The program will run until you try to delete the overflowing data when the OVF will be signalled again. Presumably the system software looks down the data block for an "end of block" code which doesn't exist because it was never entered, or so it seems. The same thing happens again if you try to write a new block of data over the old block. I hardly need to point out that this problem could easily be solved by a simple POKE instruction but. . . you have to SCRATCH, LOAD the program and LOAD the data and hope that this time the problem solves itself. It can be a time consuming procedure.

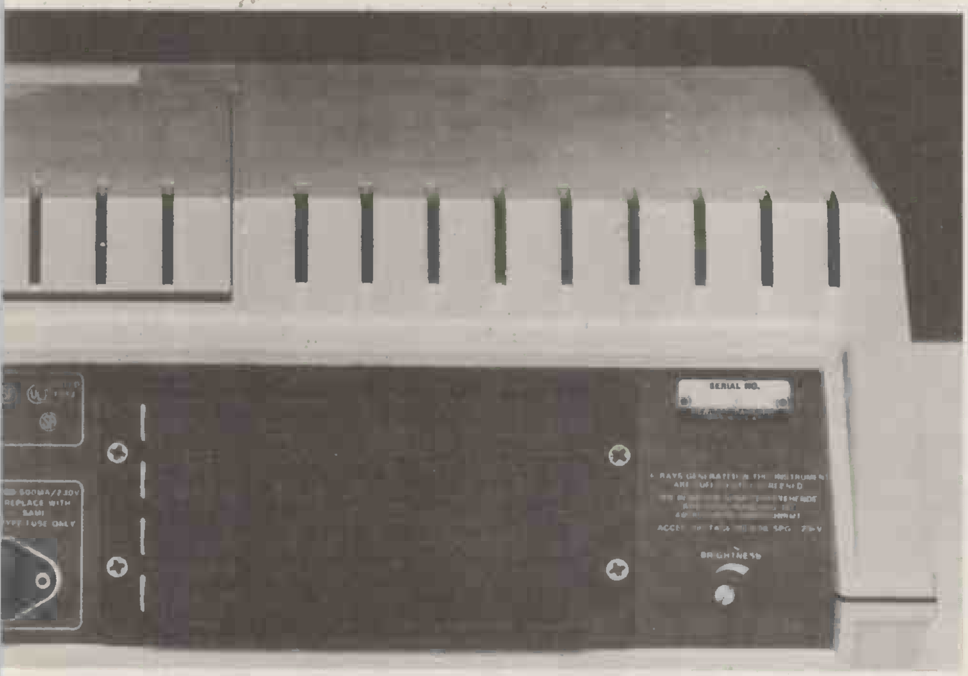
Documentation

The biggest thing going for the HP85 is the manual. The quality will come as no surprise to anybody who has ever bought an HP calculator before. Any reference to keys is accompanied by a clear diagram of the key to assist recognition and when any output is derived, then that output as produced by the machine is printed; there are no discrepancies, or at least very few. The manual is also the best "Teach Yourself BASIC" book that I have ever met although it needs the machine to make it work.

Expansion

Theoretically, it should be possible to design one's own interface boards but in practice this will be difficult with

Have case will travel — HP's neat extra that makes carrying that little bit easier.



HP's no-nonsense back panel — showing the four expansion sockets.

the HP85 as little information regarding the exact nature of the hardware is available. This means relying just about exclusively on HP for any add-on boards, of which there are four promised for June. They are an IEEE-488 or HP-IB, ASCII parallel, RS232 serial and BCD board and all will come presumably with appropriate software in ROM. It just seems a bit crazy that HP didn't include the HP-IB as a standard fitting from the outset — after all, they invented it! All of these boards plug into four expansion sockets at the rear of the machine.

The standard machine comes, perhaps surprisingly, with only 16K of RAM of which 14.5K is available to the user. This RAM can be expanded by plugging a further 16K in to one of the rear sockets. The big question mark, however, is the lack of hardware information — would you send your car back to the factory to have the oil changed because the bonnet was welded shut?

Potential

HP sees the 85 as being aimed at "the scientific, technical and professional user" who is prepared to pay a price premium for good mathematical and graphic features; clearly the HP85 meets these objectives, albeit at an excessively high price. The business user would do better looking elsewhere at a machine that had been designed with him in mind — that screen really is tiny.

Conclusion

The HP85 cannot be compared sensibly with most classes of personal computer . . . its market is so completely different. It has been designed specifically for one area — the scientific — and in that particular sphere it excels. Nonetheless, there are annoying gaps in the manufacturer's understanding of the market, perhaps reflecting the fact that the HP85 comes from the *calculator* side of HP. The most irritating of these gaps is the absence of any access to machine code instructions and the most puzzling, the omission of the Hewlett Packard Interface Bus. If more attention had been paid to this and perhaps the needs of the business user — say a larger screen and an RS232 socket at the rear for a printer — then the HP85 could be described as an excellent all-rounder. In the final analysis, the machine is overpriced for the hardware content but almost redeems itself by producing superb documentation that is virtually 100% error free.

PCW acknowledges the assistance given by Mike Dennis in producing the final draft of this Benchtest.

PRICES (excluding VAT)

Basic System	£1950
Additional 16K RAM	£ 237
Applications packages	£ 57

HP85 Benchmarks (in seconds)

1	1.8
2	3.8
3	16.3
4	16.5
5	17.7
6	30.0
7	44.8
8	12.7

At a glance

FIRST IMPRESSIONS	
Looks	*****
Setting up	*****
Ease of use	*****
HIGH LEVEL LANGUAGES	
BASIC	***
Graphics BASIC	****
System software	*****
PACKAGES	
Games	****
Mathematics	****
Business	**
PERFORMANCE	
Processor	****
Tape	****
Diskette	to come
Printer	****
Video	***
EXPANDABILITY	
Memory	to come
Diskette	to come
HB-IB	to come
Printer	possibly to come
Other interfaces	to come
COMPATIBILITY	
Hardware	*
Software	**
DOCUMENTATION	
System	*****
Processor	*
Software	******(!)
VALUE FOR MONEY	**

*****	excellent
****	v. good
***	good
**	fair
*	poor

POWERING~UP THE POST

With the concept of electronic mail rapidly approaching popular fruition it's timely that David Hebditch should have turned momentarily from his endless discussions with the Post Office to produce this two part costing evaluation on "the state of the art".

PART 1: ECONOMICS AND EMBRYONICS

For many companies wishing to transmit messages between their own various locations, the use of the dial-up telephone system could yield big savings over both the Post and Telex. For example, a 3000 character inter-office memo could be sent long-distance over the telephone for as little as 6p compared with 12p by first-class post and 57p by telex. Both the speed and the accuracy of transmission are also significantly improved, especially when compared with the mail.

In performing these calculations, these are the assumptions made:

1. A message of 3000 characters (or about 600 words). This is probably longer than the average but does tend to favour the postal service where the charge is fixed (up to a certain number of characters — which cannot easily be calculated because it depends upon the weight of the paper you use)!
2. That the call made would be a long-distance one. Again, this biases the study in favour of the post (which is distance-independent) and against the telephone and telex networks (which have distance-structured tariffs).
3. I've made two calculations for telex. The first assumes that the message be entered directly on the keyboard by the operator at a sustained rate of 3 ch/s. In the second case, I assume the message to be prepunched into paper tape and then transmitted at the full line rate of 6.6 ch/s.
4. The calculations for transmission between microcomputers on the public telephone network were performed three times, once for each tariff time-band:

— Peak	0900 — 1300
— Standard	0800 — 0900
	1300 — 1800
— off Peak	1800 — 0800

The results of the study are summarized in the table below. Clearly, the use of the public telephone network is much cheaper than telex. Also, transmission on the speech network after 6.00pm is much cheaper than first class mail. The scale of the difference becomes even more marked if one assumes that only a local call is required for the transmission; in this case, the message costs *one half of a penny* compared with 12p for the first class post!

The major reason for the telephone being cheaper than telex is the difference in speed; 30 ch/s compared with 6.6 ch/s respectively. Also, Telex doesn't have a low off-peak rate.

But what are the other costs involved? A telex machine with paper tape facilities currently rents from the Post Office for £592 p.a. (£632 p.a. for a console model). Telex machines have no secondary applications (except as ugly paper weights). If you already own a microcomputer (for data and/or word processing) the cost of enhancing it for communication purposes may well be minuscule. Many machines (e.g. the Rair Black Box, the Cromemco range and the North Star Horizon) all come equipped with spare V-Series (RS-232) ports as standard. On other machines, the cost of a serial communications adaptor might range from between £50 and £200.

A modem is then required to convert between digital and analogue signalling. These range in price from £75 p.a. to £250 outright purchase. Clearly, the use of the public telephone network for outside business hours message transmission is only going to take-off if calls can be originated and received automatically.

Comparison of Transmission Costs

	Transmit Time (secs)	Rate	Cost per message	Transmit Time (mins)	Cost per message	
First Class Post	—	—	—	12 hrs (?)	12p	POST
Telex @ 3 ch/s	1,000	2.5p per 20s	125p	17 mins	125p	TELEX
Telex @ 6.6 ch/s	455	2.5p	57p	8 mins	57p	
Micro @ Peak	100	3.5p per 10s	35p	2 mins	35p	MICROS VIA PUBLIC TELEPHONE NETWORK
Micro @ Standard	100	3.5p per 15s	24p	2 mins	24p	
Micro @ Off-peak	100	3.5p per 60s	6p	2 mins	6p	

PART 2: WHICH MODEM?

Modems must be the most boring pieces of equipment in the marketplace (unless you are another modem, I suppose). We use the telephone network for data transmission because it's there; we have no choice about it. But digital signals are not suitable for transmission on telephone lines and have to be converted to an analogue form within the speech frequency band carried by the Post Office. Obviously, at the receiving end, the signals need to be converted back to digital form. All this is the job of the *modem* (short for modulator-demodulator).

The functionality of modems is very limited; they work one bit at a time in each direction and know nothing about things called "characters". This review of available modems is purposely restricted to those devices which are most applicable to the home and small business environments. In other words, they are cheap and simple to use. I've also limited the list to those modems with which either I or my associates have had some practical experience. Having said that, if I'm doing any company an injustice by not including them in the list, if they'd care to write in I'll give them a mention in the upcoming "Network Notes" column.

First of all, what does one look for in a modem? The following notes correspond to the columns in the comparison table.

1. Modems can be directly connected to the telephone line (via a junction-box or jack plug) or, alternatively, they can transmit and receive signals via a telephone handset.
2. The UK Post Office will not "assume" transmission on the public telephone network at speeds greater than 200 bit/s. In spite of that, 300 bit/s seems to have worked reliably enough for some years. You can get 1200 bit/s modems but they are more expensive (as you would expect). Acoustically coupled modems which work at 1200 bit/s have also been around for a while, but the reliability of these is questionable. I would certainly have to use one for a sustained period before being convinced of their practicability.
3. Most of the modems and couplers included in the list are designed for use at 300 bit/s (CCITT V21 Specification). This is a full duplex arrangment (simultaneous both way transmission). Transmission takes place on different carrier frequencies for each direction. . . . .a "calling modem" sends on Channel 1 and receives on Channel 2. Clearly, the connected modem cannot do the same — it must receive on Channel 1 and transmit on Channel 2. Three techniques are employed to achieve this:

a) The modem is constructed to receive on Channel 1 only.
b) The modem can be switched (manually) to transmit *or* receive on Channel 1.
c) The modem normally transmits on Channel 1 but will switch to Channel 2 if it hears a carrier frequency on Channel 1 (the Post Office Modem does this).

For home and business applications, there seems to be a clear need for the ability to switch between channels to become standard.

4. The Post Office has chosen (until recently) to exercise its monopoly privilege over the provision of units that will automatically dial calls on the public telephone network. The Post Office device for dialling calls under computer control is called a "DEC 1". It's bigger than a PET and is reputed to have valves and cogs inside. There's no reason at all why auto-dial cannot be built into every modem (just as it is in the Prestel 1200/75 modem).
5. Auto-answer *is* usually incorporated in modems but these have to be hard-wired, thus restricting the choice.
6. On the hard-wired modems, it's sometimes possible to get simple loop test facilities. I've found these to be invaluable in development work, but they are also recommended for operational working for times when you need to isolate a fault.

Most of the modems in the comparison table are, unfortunately, acoustic couplers. The majority do a fine job but the coupler is an expedient solution to the requirement to transmit on the public network. Originally, couplers were designed for use in situations where the terminal was itinerant. I would suggest that today, only a small minority of couplers are employed in such applications. They are popular now because they provide a handy way of getting started in data communications — one that doesn't involve the Post Office.

Over the past ten years or so, I've regularly used a variety of acoustic couplers. Mostly I've stayed with the Anderson-Jacobson ADC212 in its fine polished wooden case and the less-elegant but more compact Minimodem 3001C. The latter is made by Modular Technology and resembles a tank landing craft in Post Office red (if you can imagine that).

If you have a reasonably quiet office you should be all right. But I've found that in acoustically and electrically noisy environments (especially exhibitions) such couplers can become totally unusable. That, however, is the exception; under normal circumstances there should be no problems. Unquestionably though, you should use a hardwired modem whenever possible. At the present time there are only two suppliers who can meet this requirement. . . the Post Office and Modular Technology.

For many years the Post Office only offered 300 bit/s working on the public network with its Modem No. 2. You cannot purchase these — they rent for £130 per annum. A more recent alternative is the Modem 13; it's provided as an integral unit and forms the base of a regular telephone set. Costing £75 per annum, it's powered from the telephone line itself but will only transmit on Channel 1 — which is an obvious limitation. I've used both these modems extensively and have had no trouble from the point of view of reliability. I've also used Modular Technology's Minimodem 3C and 3A (the C standing for a call modem and the A for the answer model). These cost £225 and £250 respectively but that's a one time purchase price. Again the equipment is very reliable. . . indeed I cannot remember ever having a fault on Modular Technology equipment.

One advantage of using the Minimodem unit is that each device includes a display of the various interface lead levels. This is a very encouraging facility because it enables you to see exactly when the device is transmitting and receiving or has lost carrier — or whatever the problem might be. The modems also include local and remote test facilities which enable you to carry out various simple routines for locating possible faults in your link up. The 3C and 3A modems also include a Quality Indicator lamp which is a useful facility when working on the variable public network. The Post Office modems do not include such facilities.

The major disadvantage with the Minimodems is that, at present, there is no facility to switch one model between call and answer functions; by the time you are reading this, however, Modular Technology should have announced a completely new range of acoustic couplers and hard wired modems. These are as yet un-named (as you will see from the entries in the comparison chart) but they carry a very impressive specification. For example, they are both switchable between call and answer operation and in addition to the usual standard V-Series interface,

Honeysett

"It's not very encouraging I'm afraid Mr Nisbett
I fed your symptoms into the computer and it died"

they also offer a 20 MA interface and din type connectors for the attachment of cassette tape units. The hardwired modem includes an auto-answer facility (as does the present 3A) and an optional auto-dial capability.

In view of what I said earlier, the auto dial arrangment can only be used on inhouse PABX networks or in countries where the telecommunications authority is a little less paranoid than ours about such attachments. For an estimated price of around £300 it would seem to be an excellent modem for domestic and small business purposes. Modular Technology will continue to sell their low cost (£160) calling coupler.

The other suppliers on the list, namely Peripheral Hardware Ltd., K&N Electronics and Transdata Ltd., all supply high quality and reliable modems although my personal experience of these is not as extensive as it has been with the other units mentioned above. I certainly look forward to an opportunity of trying out a Peripheral Hardware Sendata 1080 acoustic coupler which works at 1200 bit/s. If I manage to get my hands on it I'll report the results in Network Notes.

Supplier/Product	Hardwired (HW) Acoustic (AC)	Speed (Bit/s)	Call	Answer	C/A Switch	Auto Dial	Auto Answer	Test	Price	Notes
Anderson-Jacobson										
ADC 211	AC	300	✓	x	x	x	x	x	£193	Includes complete enclosure for handset
ADC 212	AC	300	✓	x	x	x	x	x	£255	
K & N Electronics Ltd										
AC 3500M	AC	300	✓	x	x	x	x	x	£212	
Modular Technology Minimodem Range										
3001C	AC	300	✓	x	x	x	x	x	£160	
3001A	AC	300	x	✓	x	x	x	x	£160	Includes V-Series 20 mA & Cassette Interfaces
3C	HW	300	✓	x	x	x	x	✓	£225	
3A	HW	300	x	✓	x	x	✓	✓	£250	
New Range (1)	AC	300	✓	✓	✓	x	x	✓	c.£220	
(2)	HW	300	✓	✓	✓	✓	✓	✓	c.£300	
Peripheral Hardware Ltd										
Sendata 1080	AC	1200 (+ 75 return channels)	✓	✓	x	x	x	x	£345	Includes complete enclosure for handset
Post Office										
Modem 13	HW	300	✓	x	x	x	x	x	£75pa	Rental only
Modem 2	HW	300	✓	✓	✓	✓ (extra)	✓	x	£130pa	
Transdata Ltd										
Acoustic Modem 307	AC	300	✓	x	x	x	x	x	£185	

VIEWDATA
AND THE INFORMATION AGE

PART 2:~THEORY INTO PRACTICE

by Dr. Adrian Stokes

Last month I described the background to viewdata and Teletext and included instruction on the basic mechanics of how to use them. Here, in part two, I'll be considering tasks to which they can be put — with particular reference to the use of microcomputers as videotex receivers (and vice versa). I'll be looking too at possible future uses for such systems.

Although I've described how to find your way around the viewdatabase, the mechanical ability to meander around a fairly large database doesn't imply any ability for finding useful information.

The basic structure of the viewdatabase is a tree and can only be searched with a simple search strategy, compared to the complex strategies allowed in most information retrieval systems. For example, to find an Italian restaurant in North London in a conventional information retrieval system would require a search of the type:

FIND (RESTAURANT) AND (ITALIAN) AND (NORTH LONDON)

whereas, in a viewdata system, no connectives are allowed and the user has to choose the search path carefully. In the above case, a reasonable choice is:

Entertainment = > Eating Out = > Italian Restaurant = > North London.

It might, however, have been just as reasonable to start the search by geography, looking for entertainment in North London, and then deciding what type of entertainment was required. Therefore, the Information Provider should ideally include multiple routes to the same data.

Given that this has been done (and it leads to significant problems if cross-linkages are required to other IP's data), to what tasks can viewdata be put?

The different usages can be divided into four major areas — residential, public, business and specialised. Viewdata was always intended to be aimed at the general public rather than at business users and the Post Office are predicting that, within three years, the ratio of domestic to business receivers will be about five to one (with a projected total, in 1983, of three million sets). In this market, one major role of viewdata will be as a first line of reference. Even though the viewdatabases are reasonably large, there is no way in which they can be extended to hold even a small fraction of the information which might be required. For example, a user who wanted to find out about microcomputers would probably be able to get a list of (most of) the micros available at present and might even be able to get some details of configurations available; but he'd almost certainly not be able to get hold of machine code listings, purely because of the amount of data involved.

This is one type of data likely to be available. A second is transient information, again provided that the volume of data is not too high. For example, railway timetables are noticeably subject to change at frequent intervals and printed timetables can easily be made incorrect; these could be stored on viewdata and updated as regularly as needed.

If data changes even more rapidly — take share prices for example — viewdata is perhaps not the ideal medium. This is where Teletext is more attractive since not only can its data be changed within seconds, but also the revised version is automatically disseminated to customers whereas, with viewdata, the updated frames have to be called for.

The fact that viewdata can be used as the first line of reference implies that the user might want access to the full reference; so one obvious place to have a viewdata terminal would be in a library or other public place. And there is likely to be a growing market for "coin-in-the-slot" viewdata terminals; already there has been a six-month experiment with half a dozen such facilities (made by Cherry Leisure).

The third area for viewdata is in business applications. In the case of large companies, there's likely to be relatively small use of viewdata since they'll quite probably have their own dedicated systems — although they might use viewdata for communicating with either the general public (advertising), with distributors or with other companies. However, in the case of small businesses, viewdata might provide the ideal solution for maintaining information since the investment is very much lower than for a dedicated system and can be increased in small steps. Also, the information can be accessed from remote locations if required.

Finally, there are specialised uses of the system. Teletext was originally proposed as a means of sub-titling television programmes for deaf people but there are now many other ways in which viewdata and Teletext can be used to help the disabled. Indeed for the deaf, viewdata has been adapted so that they may communicate via the telephone — using the system's interactive capabilities. The screen is divided in two, half being dedicated to each customer with the centre line being used for system messages. Also, a nice touch, each user's typing comes out in a different colour. Of course, there would be no need to go through viewdata at all, except for the fact that the send and receive channels of the modems operate at different speeds. Obviously ordinary keypads cannot be used — one needs the full alphanumeric range (as used by the IPs for editing frames).

Viewdata can also be very helpful to physically disabled people. One simple use is to be able to order (and pay for) goods without leaving home. But another, perhaps more important use, is the provision of generally helpful information and there is an experiment in progress at the moment to provide a Prestel database on the problems of disability.

There are in fact lots of other specialised uses, many of which are only just beginning to be realised as a result of the research that's going on now in this area.

Telesoftware

A viewdata adaptor consists of, among other things, a processor and memory — so does a computer! In fact, if the processor wasn't too restricted in what it can do and if there were more memory, then the viewdata adaptor would make for quite a respectable microcomputer with, of course, its own (usually colour) display. In addition, it has communications capabilities.

This is the basis of telesoftware, the idea that the hardware at the user's end can be enhanced, thus providing him with a micro as well as a viewdata receiver. From there, an obvious step is to keep most of the software on the viewdatabase (since there is no reason why the data on the viewdatabase need be textual) and retrieve it when needed. Similarly, programs can be kept on Teletext and loaded as required.

Of course, there are problems. First, what language should be used? There are a number of common languages around and although one obvious solution might be to use machine code, there are enough different processors about to make this impractical, particularly for Teletext where storage is limited. Perhaps the best idea is to use a standard language such as ANSI Minimal BASIC which, though not particularly efficient, should work on most machines.

In addition, what programs should be retained? On Teletext, due to the limited storage (although the problem is not quite as bad as I have implied in this case), it's likely that the programs to be stored would be standard ones, e.g. a calculator simulator, a mortgage calculation etc. On the other hand, not only could viewdata hold a large library of programs (possibly in different machine codes), it could, because of its interactive nature, allow the user to write his own programs.

One problem that arises with proprietary software is the question of cost. The most that can be charged for a frame on Prestel is 50p and, for his money, the user can keep a copy of the program forever. In order to overcome this, some work has been done in the field of self-destructive programs so that you can rent a program, only for it to become inaccessible either after a fixed period of time or a certain number of uses.

In this section, I have implied that Telesoftware is not on the market yet and, to some extent, this is so in that it's not generally available. However, the IBA has been conducting regular experiments in this area and one software company, CAP Microsoft, has been carrying out texts with the implementation of MicroCOBOL via Telesoftware.

Of course, to make significant use of Telesoftware, the receiver ought to be enhanced by means of a printer — and backing store, such as cassette tape or discs. Once these are available, not only will the receiver run Telesoftware, its use as a viewdata set will be greatly enhanced.

Intelligent terminals

The first "enhanced viewdata receivers" were, in fact, micros which interfaced between the receiver and the line. There are now quite a few of these on the market and, forgetting those which can be used as stand-alone viewdata systems (such as GEC's), the prices vary from about £1500 up to nearly £10,000. In the lower price range are such machines as the Telemachus TM-1, the TECS (Technalogics Expandable Computer System) and the Jasmin Electronics machine. At these prices, the storage is obviously limited and consists of RAM with no backing storage (although this can be added). At the upper end of the market, the Telemachus TM-3 is based on a PDP-11/03 with twin 8" floppy discs — obviously an extremely powerful system.

Although these machines can be used as stand-alone micros, their intended use (and what the customer is paying for) is as an intelligent viewdata terminal, enabling pages to be obtained from a viewdatabase and stored locally (or created locally), edited as required (with far more facilities than the minimal ones provided by the Post Office on Prestel) and then transmitted to the viewdatabase. The number of frames which can be held locally vary from about three up to 200 per disc for the TM-3.

Home computers as viewdata terminals

What of the user who already has a micro and wants to use it as an intelligent viewdata terminal? Already, coming onto the market there are packages that enable micros to be modified for this purpose. For example, "Appletel" was recently announced in PCW (Feb 80). This is a package which converts an Apple II into an intelligent editing terminal, allowing storage of up to 60 frames per disc. At present, the display is only monochrome and a separate Post Office Datel 600 modem is required; future developments, however, include an integral modem with autodialler and a colour display.

Further packages for other machines are coming onto the market, especially for S-100 bus machines and there will be regular updates to this article on this topic. In fact, if any reader has experience of any such packages, I'd be pleased to hear from them.

The future

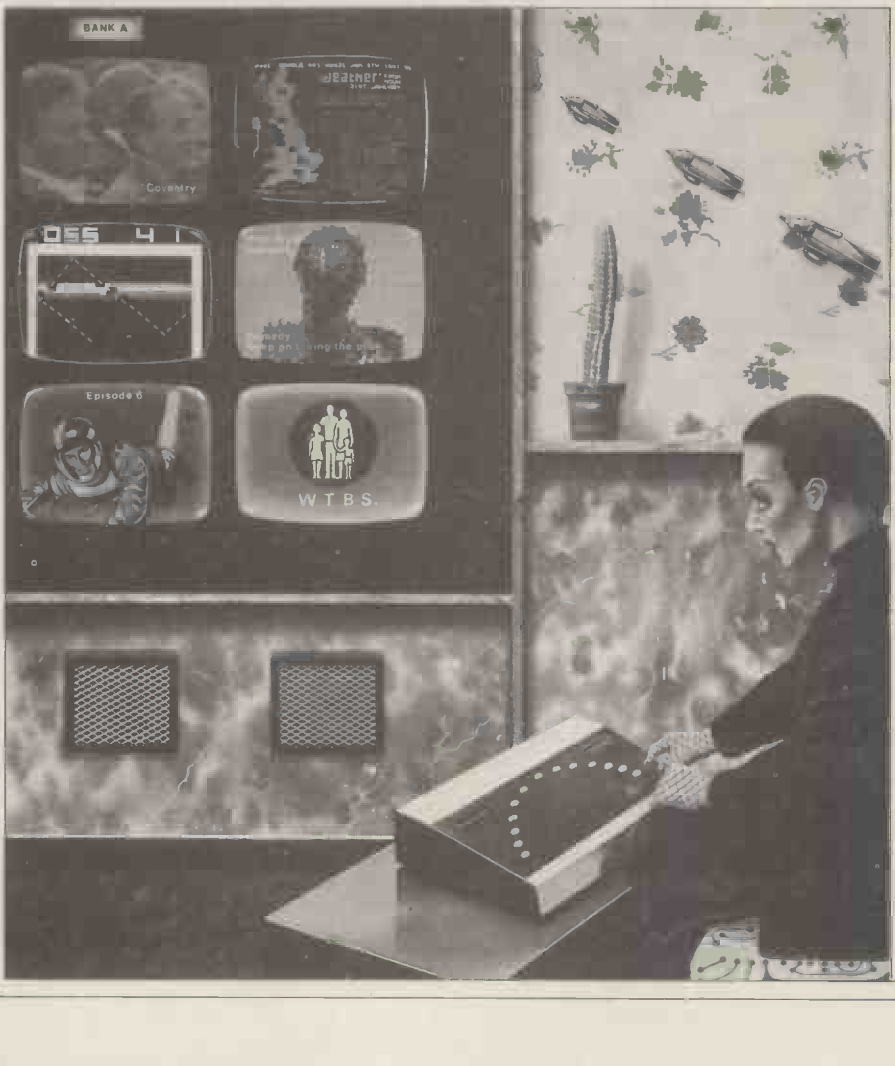
It's obvious that there is a significant future for viewdata and Teletext, even if perhaps not quite what was envisaged ten years ago. Such ideas as transmitting daily newspapers via these systems are technically feasible but impractical at present when one considers the volume of data involved. However, use of viewdata for "electronic mail" has far-reaching implications including the whole question of the Post Office monopoly.

The PO has already relaxed its monopoly significantly because of Prestel (for example, by allowing television sets with integral modems to be connected to the telephone system) and further changes are inevitable. Also, there are problems over the Post Office's role as a common carrier. Already, for reasons of demand, it has had to suspend this role — it hasn't been able to give Prestel facilities to everyone who has asked.

A further problem which has raised considerable interest recently is that of frame content on Prestel. The ones in question described various pornography shops in Soho (and were called, most appropriately, "Rupert Streetwalker"). They were removed after complaints from an MP (and replaced by frames telling you how to complain if you were offended by material on Prestel). The Post Office has no more responsibility (nor control) over content than it does over the content of mail but this could lead to some interesting situations.

The introduction of "new" technology raises many new questions. For example, there was much discussion last year over the VAT rate for the information content of frames. When the Finance Act 1972 excluded books etc. from VAT, viewdata was not considered and hence not mentioned; eventually Customs and Excise agreed that the information content should be zero rated.

Viewdata is an area where there is bound to be considerable growth over the foreseeable future, particularly when coupled with home micros and, although it may not so far have lived up to all its expectations, during the next five years or so we should increasingly be able to witness the impact of this Information Age.



ACORN ATOM

The elegant injection moulded plastic case houses a full size professional keyboard and a hardware/software combination of extraordinary power and versatility; in the minimum price configuration the kit of parts provided allows BASIC *and* ASSEMBLER, graphics and sound output, direct cassette and T.V. interface and much more. Sockets and connectors allow for expansion *within* the case to allow features normally associated with computers costing ten times as much.

Every kit is sent with assembly instructions and a beginners guide to Atom BASIC, ASSEMBLER and operating system.

The basic unit in kit form costs **£120** plus VAT and postage, total £143.00. Prices and details of ready built units and accessories on request. Delivery in beginning of May.

- Fast 32-bit Integer BASIC
- Floating point math routines (10 digit)
- Mnemonic Assembler
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- 192 Graphics characters
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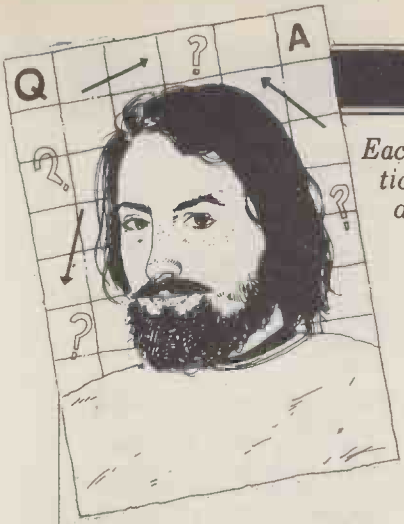
ACORN COMPUTER

Acorn Computer Ltd.,
4a Market Hill,
Cambridge, CB2 3NJ
Tel. (0223) 312772

See page 76 for complete list of approved dealers.



COMPUTER ANSWERS

Each month Sheridan Williams and his panel of consultants answer readers questions. Topics may be hardware — from kits to mainframes, or software — from differential equations and statistics to file handling or sorting; the choice is yours. Send your questions direct to Sheridan Williams at 35 St Julians Road, St. Albans Herts.

Growing pains

I am considering buying discs for my Commodore PET. I have been told that there are alternatives to the PET discs . . . are they worth considering and if so, why?
B. Abbott, Nottingham

It's very unusual to find someone asking this sort of question; in my experience most people would just go out and buy PET discs for their system. Why on earth people are prepared to spend hundreds of pounds without seeking advice I don't know.

One of the important considerations in choosing a suitable disc system is its ease of use, by that I mean its operating system. I find the PET disc system a pain to operate and simple everyday tasks like a disc directory are far more difficult to obtain than they should be. I think the main reason for the difficulty is that the PET disc thinks it is a "printer".

One of the best alternatives to the PET disc is the Computhink disc; it comes with its own operating system which supports a very comprehensive set of commands. These commands allow direct access files which although possible on the PET discs, are incredibly tedious to implement. The Computhink discs are available in two forms: 200K per disc (single sided), and 400K per disc (double sided) . . . thus with the two drives you can have 800K on line!

Many people consider that double siders tend to be unreliable, mainly because of the heads banging together as they access the disc; the Computhink discs have the heads slightly offset and seem no less reliable than single sided disc drives. The PET disc drives are available only in a 170K version — which is single sided. Prices compare quite favourably too; around £810 for PET discs and cable; and £895 for single density Computhink discs; remember though that you get 15% greater capacity on the Computhink for an extra cost of only 10%. The double sided 400K Computhink discs will cost around £1150. Neither disc system uses any of the main store on a 32K PET so there are no worries there.

The only advantage that I can see for the PET discs is that they are "intelligent", which is to say they have their own processor on board. In plain English this means that the PET discs can be getting on with one job while the PET itself is tackling another. The next point worth considering when buying discs is the availability of software. It seems that my approval of the Computhink discs is backed up by Petsoft who can supply most of their software on both systems. Before anyone asks, I have used both systems and am totally unconnected with Computhink; I'm just making recommendations based on my personal experience. The Computhink disc operating system is not perfect by any means, but it's far easier to use than the PET system.
S.W.

Printing to a price

Can you recommend a good, cheap printer for our school's Research Machines 380Z. Our budget won't extend much past £500 so this makes a Teletype 33 out of the question.
D. Thomas, Bath

The Teletype 33 does have a keyboard, paper tape reader and punch — all very useful for preparing programs and data off-line. They can be obtained in a refurbished condition, but as you say, they are still outside your budget.

One of the best value-for-money printers on the market must be the Anadex; it's a fairly fast (110 c.p.s.), bi-directional matrix printer and can be used on the 380Z with only a single modification (you have to connect the busy signal from the printer to the 380Z . . . a very simple thing to do). The Anadex has both serial and parallel inputs and can be used very easily and with little trouble on virtually any micro. It supports 110-9600 baud input, together with others that control double sized characters and form feed. Amazingly enough, I've seen many people using the Anadex who have not yet found out that it can print double sized characters. You need to send the ASCII character 14 to switch on the double sized facility, and ASCII character 15 to switch it off. Example on the 380Z:

```
LPRINT CHR$(14); 'Large';
       CHR$(15); 'Chars'
```

Printing ASCII code 12 will activate a form-feed.

The ANADEX is compact, fast, robust, versatile, and cheap, and I can certainly recommend it.
S.W.

Call for CAL

Can you give me any information on existing CAL packages, including where they may be obtained. Ideally I'd like to know what is available and what machines they run on.
J.H. Ruston, Wimbledon

As a computer is a general purpose tool, we need to tailor it to suit individual requirements. If the computer is to assist learning in a particular subject area there should be good, well tested packages available. This whole subject comes under the term "Computer Assisted Learning" (CAL).

At present it's difficult to provide a single CAL package for any topic because there is too large a variety of hardware and systems software on which to run it (different versions of BASIC for example). There are dozens of micros and mainframes, each one with its own sub varieties. A package designed to run on the old 8K PET might not run on a larger PET that makes frequent use of PEEK and POKE. If we try and use a standard subset of BASIC we are up against the problem that we cannot use graphics, files and machine code routines — all of which make the package more impressive and useful. For this reason, and the fact that there is not much profit to be made, the availability of CAL material is severely limited.

I suggest that you keep in touch with material available by reading PCW, "Computer Education" (from North Staffordshire Polytechnic, Blackheath Lane, Stafford, ST18 0AD), "Educational Computing" (30-31 Islington Green, London N1 8BJ) and by joining MUSE (Oundle School Oundle, Peterborough, PE8 4AQ).

Find out if your local education area has a policy towards computers in schools and colleges. If it has then it should have developed some CAL material of its own; in the Hertfordshire area for example there is the Advisory Unit for Computer Based Education. There ought to be equivalent organisations in all areas — but there aren't, which is an absolute disgrace.

Material currently available can be obtained from Edward Arnold Ltd, Woodlands Park Avenue, Woodlands Park, Maidenhead, Berks SL6 5BS; information about what they supply can be obtained from the Educational Computing Section, Chelsea College, Pulton Place, London SW6 5PR. These two work in collaboration and can supply BASIC programs on paper tape or, in some cases, cassette for the 380Z, in the subject areas of Biology, Physics, Economics, Chemistry, and Geography.

Other bodies that may be able to help are Council for Educational Technology, 3 Devonshire Street, London W1N 2BA. Petsoft have one or two educational programs for the PET. Qwertysoft 20 Worcester Road, Newton Hall, Durham, have several programs written by teachers for the PET and TRS 80. There is the Central Program Exchange at Wolverhampton Polytechnic which has BASIC programs available and MUSE have a fairly good library for the SWTP and 380Z micros. For those using the 380Z there are programs available from F. Donovan 35 St Julians Road, St Albans, Herts AL1 2AZ (an address that may not be too unfamiliar with some of you).

Finally, I am always interested to hear of any material available from any source and in any language; I'll keep you posted of anything good that comes my way.
S.W.

PET to printer problems

Some time ago my school purchased a PET, and through the good offices of a local company we acquired two printers. The first was an 8B CREED, the second a terminal printer with keyboard, tape reader and punch facilities. Our problem is to know how to connect these printers to our machine.
A. Mawdsley, Manchester

Your terminal printer probably has an RS232 or "current loop" interface. These use a seven bit ASCII code, sent serially along a pair of wires, sandwiched between parity, start and stop bits. In an RS232 interface each bit is expressed by a positive or a negative voltage; in a current loop interface, by a current or no current.

The PET IEEE 488 port is an eight bit parallel one, so the data must be converted to a serial format, and to the voltage or current level that is compatible with the terminal. Most interfaces use a UART (Universal Asynchronous Receiver Transmitter) chip and they are readily available from most Commodore dealers at around £89 for a uni-directional and £149 for a bi-directional interface.

With a paper tape reader/punch and keyboard a bi-directional one would be useful. The CREED teleprinter is a bit more tricky. This uses a 5-bit Murray code which again is serial, although not an ASCII code. The data from the PET must be converted to the right format, either by hardware (expensive) or by software in the computer (fiddly). Don't forget either that the teleprinter will have to be switched between letter and figure modes. If you browse through copies of PCW you will find a number of companies who specialise in producing interfaces for the PET. They may be able to supply one to suit your needs.

If any readers have made an interface for the CREED and can let me know, I will gladly pass on the information.
M. Wratten
(Mr Mawdsley may well find it interesting to read "Hard copy at a soft price" p.77 this month — Ed.).

The forgotton interface

I am the owner of a Compukit UK101 (6502 cpu) and a TI 58 calculator. Please could you inform me if it would be possible to interface the two, allowing extensive number-crunching on the computer with intrinsic functions of the calculator — and if so, how?
M. Buckley, Norwich.

I found your question particularly interesting, not least because it brings to the fore the idea of the "Systems Approach". This is one of the main foundations of professional computing, yet so far it has rarely been mentioned in personal computer magazines. As you may know, professional computer staff tend to work within one of three groups of activity: operators, programmers or systems analysts. The task of the latter is to consider each problem in its entirety, and decide the best approach to take . . . which may not involve computers at all!

Just as many recent articles have (rightly I think) exhorted us "not to rush into coding" when writing a program, so the "Systems Approach" would advise us "not to rush to use a computer" when first considering how to tackle a problem. Perhaps it's because systems analysts are not so directly computing orientated that this topic has received little attention in personal computing circles. More likely, however, it's that having to combine the tasks of programming and operating — and in our leisure hours at that — is quite enough, and there isn't time to consider the Systems Approach. (*Not to be confused with "operating systems"!*)

Supposing we take the Systems Approach to the problem of interfacing your UK101 & TI-58? We may well be surprised to find that this quickly yields an easy, cheap and reliable solution. There is a near perfect interface available and at no cost whatsoever . . . yourself! Write your program so that when "number-crunching" is needed the screen displays "NOW CRUNCH THIS" (or some similar message) the nature of the operation, and the numbers in question. This should be followed by an INPUT statement so that the answer can be entered back to the computer via the keyboard. Key the numbers and operation into the TI-58; key the answer back into the UK101 . . . and proceed!

Now, I know this is not the answer you had in mind — or were hoping for — but I do think that the Systems approach should more often be borne in mind.

In fact electrically interfacing the UK101 to the TI-58 is far from easy, for the calculator is not designed to accept an electrical input. Therefore you would either have to build an electro-mechanical device to enable the computer to literally press the keys of the calculator, or else remove the keyboard of your TI-58 to make an electrical connection to the Texas chip. Neither approach is beyond the hobbyist who is really skilled in electronic construction and measurement.

If you would like to know more about the possibility of connecting your UK101 directly to the calculator chip, then you will find the article "Sinclairly Yours" in the February 1979 issue of PCW very helpful. This describes interfacing a Sinclair Cambridge Programmable calculator to an MPU, and as well as discussing techniques, it also explains how to overcome some of the other problems that are likely to arise — such as incompatability between the supply voltages for the computer and the calculator. I don't know of anyone who has taken the other approach of constructing an electro-mechanical "key-presser", but I'd be delighted to hear from any reader who has tried to build something of the sort.

(Then of course you still have the problem of reading the calculator display! — Ed).

Holding on

On the ITT 2020 a single character can be fetched from the keyboard as soon as a key is depressed — either by means of the GET statement, or by PEEKing the keyboard buffer. The character so obtained remains in the keyboard buffer until another key is depressed. Is there any way of detecting the lifting of the finger from a key? This would have applications in interactive programs such as one for an electronic organ.
D.C. Leedham, Enfield, Middlesex.

I'm afraid not. Most keyboards generate a strobe pulse once when any key is pressed and it is the edge of the strobe pulse that is used by any following circuitry. The ITT 2020 is no exception. What you require is a constant output while the key is pressed and that is only feasible with a custom built keyboard.
M. Dennis

Cursor damage?

I am considering the purchase of a NASCOM1 and wonder whether the VDU's cursor would damage a television screen.
G.M. Taylor, Leeds

It's undoubtedly true that the high intensity of the characters on a VDU screen can cause deterioration of the phosphor on a cathode ray tube, as witnessed by the screens of industrial terminals which have seen heavy use. However, for domestic purposes where you will be using the computer on and off and not continuously there should be little problem. It's advisable you keep the contrast and brightness to the minimum visible display, and blank the screen when not in use. Other than that I wouldn't worry.
M. Wratten

Adding to the ABC~80

I really have problems. My ABC-80 is working so well that I would like to put on floppies, printer etc. What should I do if I don't want the Pertec floppy which Luxor sell, or the Centronics printer either? You see I don't understand about interfaces. How is the IEEE 488 and RS232 bus? Can I just buy a Shugart or Macro and put it on?

Also the last three letters of the Norwegian alphabet don't occur in yours. How can I get an English made printer to print the before mentioned characters. And last, if I succeed in putting another floppy than the Pertec on my ABC-80, can I use software from other firms than Luxor?
Eivind Trana, Bergen, Norway

I'm afraid that your queries are difficult to answer specifically. Why don't you want to use the Luxor disc drives (which according to Sue Eisenbach's review are BASF not Pertec)? My advice is to stick to the Luxor drive unless you are prepared for an awful lot of extra work at ALL levels of hardware and software. As far as the printer is concerned I would suggest that you approach some printer manufacturers directly in Norway. Alternatively, maybe an IBM Selectric could be fitted with the appropriate golfball.
M. Dennis

Students choice

Because I'm a student I'll have to buy a kit microcomputer very soon. Which one shall I buy? Shall it be an S-100 bus system with a little bit from this and a little part from that or should I stick to kits like the Nascom. Also can I upgrade a Nascom 1 to a Nascom 2?
Reidar Otto Johnsen, Tromsdalen, Norway

S-100 is fine for ready-to-run business systems and a lot of computer shops plug them hard — purely and simply because they are complete and well made. However, they are expensive for the enthusiast and a single-board computer would be much cheaper than an equivalent S-100 system.

Which single-board computer? Well, if you want to program with equal ease in machine code and BASIC then without a shadow of a doubt buy a Nascom 2. If you only want to program in BASIC then the other two may be suitable. You should be aware that the Nascom 2 does have a few more BASIC commands available but only you can decide whether they are worth the extra cost or not.

Don't forget that you have to add the cost of a power supply for the Nascom (approx. £30) and you can't upgrade a Nascom 1 to a Nascom 2.
M. Dennis

Brain~racking

I am fully aware of the vast selection of personal computers available. I am now in a position to purchase

one for myself and can probably afford as much as the top end of the range of PETs or the new Sharp MZ80K. I have been racking my brain about the right choice; to add to the confusion, having read a lot about Superboards as well I find it difficult to see the advantage of, say, a PET over a Superboard — providing you own a TV as I do. Will it be wise to pay £750 when £250 will buy something as good and probably more expandable?
S.W. Hepburn, Bisley, Surrey

Your question is difficult to answer as you don't state exactly what you expect of your computer. If by expandability you mean a large range of ready-made "add-ons" that are currently available, then none of the computers that you mention fall into this category. You should look instead at either the Apple or ITT 2020 which are about the same price as the top-end PET.

The single board computers such as the Ohio, Compukit UK101 and the Nascoms are, at the moment, limited in their upward growth. There is simply no well-defined path to follow. The long promised additions seldom seem to materialise. As you can afford £750 then I suggest that you take a closer look at the Apple/ITT2020; buy one with only 16K and get the extra memory as and when you require it — it simply plugs in. Try, too, to treat yourself to a floppy disc as soon as possible. I don't think that you will regret the decision. Remember, make 1980 the year of the Apple!!
M. Dennis

380Z Basic access

How do I access the keyboard directly in BASIC on a Research Machines 380Z? What I require is a function similar to the Commodore PET's GET command where the keyboard is scanned and the character returned (or a zero if no key is depressed). The INPUT statement is no good to me because I require truly interactive routines such as reaction times.
Anon.

This is a common question so I'm answering it here for the benefit of all 380Z users. As most users will know, the 380Z is available in two machine types — the C4100 and the C100. It doesn't matter which version of BASIC you are using and neither does it matter how much store is available. The subroutine below will store in CH the ASCII code of the key pressed and CH will be zero if no key is pressed.

```
1000 CH=PEEK(K9)AND127
1010 IF CH=0 THEN 1040
1020 POKE P9,195
1030 IF CH=26 THEN STOP
(CHR$(26) is CONTROL Z)
```

This subroutine could be used as follows:

```
10 K9=4092: P9=16403: REM
   C4100
20 K9=64508: P9=65301:
   REM C100
(Delete 20 or 30 as appropriate)
30 PRINT "PRESS ANY KEY"
40 GOSUB 1000: IF CH=0
   THEN 40
50 PRINT "YOU HAVE
   PRESSED"; CHR$(CH)
60 GOTO 30
```

I have many programs available that use this technique, and those interested are welcome to write directly to me.
S.W.

"I thought we'd be the last people to be replaced by the silicon chip."

Honeysett

THE 5th WEST COAST COMPUTER FAIRE

San Francisco boasts many attractions — Golden Gate bridge, Fisherman's Wharf, Chinatown and the cable cars to name but a few. Last weekend, however, the biggest attraction for 20,000 computer buffs was the Fifth West Coast Computer Faire. David Tebbutt reports from the show.

San Francisco, that delightful city at the top end of "Silicon Gulch" was chosen as the location for the Fifth West Coast Computer Faire. It's an event that has the reputation of being something of an enthusiast's show, packed to the gills with computer freaks and full of pioneering spirit. It has the distinction of being the place where many very successful products and companies achieve their first public showing; it's also highly likely that it's the place where quite a few of them appear in public for the last time!

The show is staged by Jim Warren, an ex-roller skating instructor. To be fair to Jim, he's also very knowledgeable about computers; he was once editor of *Dr Dobb's Journal* and currently he's working on a sort of Ceefax/Oracle of the radio waves, a project that's due to be announced later this year. He was to be seen frequently (and fleetingly) buzzing in and out of the stands on his skates.

Over 200 companies filled the two halls and, in addition, there was a full, three stream conference programme. People who should know told me that this year's effort placed less emphasis on hardware and far more on end user products — a trend which is happening all over the place as the hobbyists find themselves diluted by business, education and home users. Around 20,000 people attended and the overall impression I gained was that it was lively, interesting and worthwhile.

Conference capers

I managed to attend a few of the sessions and of those the best was undoubtedly that given by Hal Chamberlin of MTU; he was describing the various ways of producing computer music. He's an unassuming young man with shoulder length hair, the sort you might meet in any programming department. But unlike such programmers, Hal is something of a world authority on the digital representation of music. He gave a fascinating lecture with demonstrations which convinced me that we are only at the very beginning of the development of the computer's potential as a music machine. Hal's own very successful company, which he runs with David Cox, produces the hardware and software necessary to make the finest music ever heard on a micro — more about their products later in the report.

Another memorable talk was given by Don Perry Dunlap, who chose as his topic "Is Electronic Technology Making Mankind An Endangered Species?". With a title like that, you'd perhaps expect the hall to be full — but then maybe people knew what was coming.

The hall was plunged into darkness . . . a carousel projector was checked . . . the cassette player was checked . . . and the show began. At first there was just spooky music. This turned into the "2001" theme and then, reaching the climax of the first crescendo, Don Perry Dunlap squeezed the remote control of the carousel projector. A blinding rectangle of white light appeared on the screen! He pressed it again — another white rectangle. The music continued. Don Perry Dunlap pressed, and pressed, and pressed but all to no avail. The slides had, presumably, been mounted on the "wrong" side of the projector . . . The music died and so, slowly, did Don Perry Dunlap. More in hope than expectation he continued to squeeze the remote control until, finally, he realised the game was up — modern technology had pulled the rug from under him. The lights came on and everyone waited expectantly, wondering how he would continue. Up to then he had had our sympathy, but not for long. He proceeded to read his speech — jokes and all — from a copy of the conference proceedings. Being near the door I sneaked out.

The whole world seemed to turn up to see Adam Osborne present his white elephant awards (despite the name these are a genuine attempt to grant recognition to significant achievements). Unfortunately, I find Mr. Osborne's style irritating; there is something very dictatorial in his manner, but then he usually has something sensible to say. He gave one award jointly to Zilog and Intel for their 8002 and 8089 products and the other to the writers of the Visicalc program. He noted that the latter award was in recognition of "the beauty of design and timeliness of the product". There's nothing wrong with what Adam says, except maybe his tendency to repeat the same old jokes; what jars is the way he says it.

So what, I hear you ask, is a white elephant award? Well, it's a North Star board containing a suitably inscribed brass plate plus a chip mounted for each recipient; each chip is, in turn, surmounted by a microscopic white elephant. Before leaving the presentation I asked a pretty young delegate why she had attended the session. She replied: "I didn't understand a word of what he said but, wow, that voice!" (Rumour has it that the young lady in question was subsequently invited to go yachting by the man himself).

And, while on the subject of sailing with Adam Osborne, I simply have to tell you the misfortune that struck our very own Guy Kewney just a day or two before the show. Seeking the pleasures of the sea, the two of them (having decided that it would be a good idea to use the engine for pottering around San Francisco Bay) carefully stowed the sails, upped anchor and motored off. After a while it became apparent that the yacht wasn't making too much progress — in fact it was proceeding at approximately walking pace even on full throttle. Guy held on to the rudder while Adam went below to investigate and, not knowing quite where to go, our "newshound" steered into the middle of the bay. Eventually Adam re-emerged with the news that the gears (or something) had stripped and that they would have to unstow the carefully stowed sails; the job done, Guy was again given the tiller while Adam went below to fix a drink. This time Guy headed in the general direction of the harbour entrance and just as he was starting to feel apprehensive about getting back again, Adam reappeared to take over the helm. A few deft course adjustments later they were stranded on a mud-bank! And technology wasn't finished yet!

Adam, attempting to catch the harbourmaster's ear via the radio waves, managed to disintegrate an important button on the radio; thus the two of them were reduced to frantic waving at passing boats. It's all true. . . it must be, Guy told me.

Stories from the Show

Ipex International Inc. presented the answer to every editor's prayer — an attachment which can convert the common-or-garden Selectric typewriter into a computer printer. It doesn't alter the appearance of the typewriter because it fits neatly inside, into existing screw holes. It comprises a solenoid assembly (which pulls the appropriate bail bars depending on the letter required), a control unit which can contain the power supply as well as being able to decode the computer's ASCII into the ball select code and, for the S100 user, a card which fits directly into your computer. If you choose the S100 option then the control unit comes minus the power supply. By the way, yes, it does work on the UK power supply. In the USA this ESCON SELECTRIC Interface System costs from $495. Those interested should contact 16140, Valerio Street, Van Nuys, CA 91405, USA.

Another very interesting product was one made by Nestar . . . called the Cluster-shared microcomputer system. Using this system it's possible to have up to 65 Apple computers working together in a network. All machines have access to central storage — up to 33 Mbytes of it — thus enabling each machine to work by itself or with others, sharing the same files and communicating. A system was running at the show on which one screen displayed a list of names for whom messages were held in the central system. Anyone seeing their name on the list could walk up to another terminal on the Clusterbus, type in their name (as spelt on the list) and have one or more memos displayed to them. Guy Kewney and I made frequent and good use of this system. Contact Nestar Systems Inc., 430, Sherman Avenue, Palo Alto, CA 94306 for further information. (Any buyers . . . please contact me for a possible future PCW case study).

The inhabitants of Menlo Park have the good fortune to count Ramon Zamora and Bob Albrecht among their neighbours. Ramon and Bob, with help from their friends, have set up a project called "Computertown USA!". It's an attempt to introduce the community, mainly the kids, to the joys of computing. The picture shown here was taken in the Menlo Park library where a number of PETs and a TRS-80 have been installed, at no charge. Children spend an hour or so being taught how to use the machines and once they can prove themselves able they are given a badge that proclaims "my computer likes me". This gives them the authority to attend the library at any time and also qualifies them to help other children less able than themselves. They are not allowed to ask the librarians for help, only the organisers of Computertown USA! — or other children. Although all of the programs used are games, they are educational ones and they give the children a grasp of fairly advanced mathematics — for example, the complex problems involved when manoeuvring in deep space. More about this enterprising idea in a future issue of PCW — probably via an *Interrupt from America*.

I talked to a college professor from Canada about Computer Aided Instruction and he told me a true story about his own experience in Vancouver. The day came when some of his colleagues decided to evaluate these new-fangled computer things as teaching aids. Well, what do you think the demonstration packages were designed to teach? Wait for it . . . the use of slide rules and logarithms! It's so awful it's hardly even funny.

Gary Kildall, the man who brought us CP/M and MP/M, is launching PL/1 worldwide on April 15th. I took a picure of him so that you'd all know what he looks like — unfortunately the gremlins got at it and it didn't come out; sorry Gary.

Infoworld is a great bi-weekly newspaper for the microcomputing community. Published in the heart of Silicon Valley, its writers are really in touch with things as they happen. The cost is $35 per year ($18 per half year) airmail. Write to Infoworld, 530 Lytton Avenue, Palo Alto, CA 94301. (By the way, it used to be called the *Intelligent Machines Journal*). The publisher is John Craig — the same John Craig that used to edit *Creative Computing*. If there are any dealers out there who'd be interested in selling this or any other magazine from the USA I suggest they contact me at PCW for pointing in the right direction.

Back to Hal Chamberlin and MTU. Professionally thorough and a company to watch, they are reputed to produce the best documentation in the business. They specialise in 6502 products — things like AIM, KIM and SYM floppy disc controllers, visible memory for the PET (with light pen facility) and the excellent four voice sound system mentioned earlier. One day this firm will produce a music compiler to save all the tedious coding of waveform tables and the like. All you'll need to do is feed in the music, dictate the instrument definition and away it will go to compile your music for you. IJJ in Marlborough are their UK agents.

Another exciting product was the Minimover-5. . . a five-jointed, computer controlled arm. It can handle weights up to 8 ounces (even when fully extended), operates within a sphere of 17.5" radius and travels at between 2 and 6 inches per second, depending on the weight being carried. The jaws open to a maximum of 3 inches with a squeezing pressure of between 0 and 3lbas. I saw the arm being driven by a TRS-80, for which a package exists. It will cost around $1700 plus freight, $30 for the software and $19 for a reference and application manual. Contact: Microbot, 1259 El Camino Real, Suite 200, Menlo Park, CA 94025.

Eric Bakalinsky dreamt up the well-known phrase or saying "Dr. Dobb's Journal of Computer Calisthenics and Orthodontia". He describes himself as an "Interior designer and willing co-pilot for flights of fancy". He also pressed us to publish his phone number, (415) DAFODIL, where he awaits calls from "beautiful women who'd like to join him for chocolate moussee".

Sharp has produced a hand-held computer which can be programmed in BASIC and here's a picture to prove it. The machine fits into a cradle which in turn connects to a miniature cassette recorder. In America it retails for around $300 for the 400 byte version or around $450 for the 1424 byte version. Amazing! What's more, Sharp UK are actively considering marketing it in Britain.

The stringy floppy was as much in evidence as it was at the Las Vegas show. Next month we'll be bringing you a user's report. . . in the meantime those interested could write to Exatron, 3555, Ryder Street, Santa Clara, CA 95051. For those who don't know, a stringy floppy is a cassette drive which powers a continuous loop cassette (of tape length between 5 and 75 feet). The tape is pulled from the centre of a capstain which revolves as the tape is unwound; at the same time the other end of the tape is rewound on to the outside of the same reel. It's used as a mass storage device and far outstrips the performance of a normal cassette drive both, in terms of speed and also because it's possible to access data randomly, without any need to rewind the tape. Maximum tape capacity is 2.88 million a flux change is one bit — you work it out from there, but don't forget the control bits). It's fast, cutting program loading time down from minutes to seconds (e.g. 4K in 6 secs).

Ken Cohn collects Apple programs the way some people collect matchbox labels. He's got over 3600, some of which he's never tried. Is this a record? He belongs to ADAMII (standing for Arizona Desert Apple Menagerie) — what else can I say?

I have to report that Suzanne Rodriguez — editor of Dr Dobbs Journal — is lovely. I took some pictures of her, too, but they didn't come out either — sorry fellas!

Something no enthusiast should be without — A Periodical Guide for Computerists. It lists articles, book reviews, letters and editorials by subject from all the popular computer, radio and electronics magazines — including PCW, of course. The 1979 issue will cost $5.95 surface ($7.15 air) while 1976, 77 and 78 cost $5.00 surface ($6.00 air). Write to E Berg Publications, 622 East Third, Kimbell, NE 69145 for further information.

John Craig and Hal Chamberlin both reckon that PCW has got a head start over other foreign computer publications in that it's written in a language that they can understand. Such taste and discrimination!

The Atari graphics are super but the word is we may have to wait until the end of the year before the international version is ready — and that means us folks.

Another lovely lady was manning the Syntauri music exhibit. She had a piano type keyboard interfaced to the Apple — through which she was playing some pretty good music. She was able to fiddle around with various parameters at the Apple keyboard thus varying the nature of the notes produced. The sound was nowhere near as good as Hal's but that keyboard interface was *so* tempting. For further information contact Ellen Lapham, Vaille Associates, 3506, Waverley Street, Palo Alto, CA 94306.

One thing is pretty clear to me and that is that there's as much opportunity in software for us here in the UK as for anyone else. The Canadian chap I talked about earlier had unravelled the innards of the SYM and had been able to define a lot of new BASIC instructions — making the language really powerful. He hawked his ideas around the show and ended up with a company accepting his ideas and giving him a new machine to enable him to develop them still further. That could have been one of us. I'm sure software is the one area where we can really show the world that Britain is a good match for anyone. Another example is the man who computerised the Luscher colour test. He was running one of the most popular stands at the show, giving personality evaluations based on colour preferences. Another man I bumped into has already proved how good we are. His company, Microfocus, has set up an office in Santa Clara to sell its products in the USA. Their CIS Cobol is the only microcomputer Cobol to have been certified by the US government. Among the big deals they have pulled off are one from Intel and another from Texas Instruments. The company is Microfocus of 58, Acacia Rd., St. John's Wood, London, NW8 6AG. Three cheers for them — if you've got something on the boil that you'd like to show at the next Computer Faire, it will be held on the 3rd — 5th April 1981. Address all enquiries to Computer Faire, 333 Swett Road, Woodside, CA 94062. Don't try to go there, as I did, because all you'll find is one of those American letter boxes on a stick. The building is being constructed. If you want to phone them the number is (415) 851 7075.

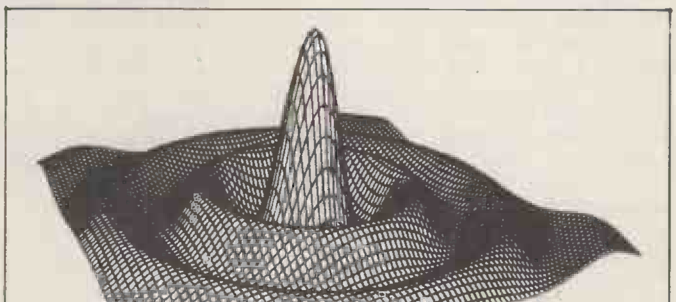
Here's a very quick round of the various magazines that caught my eye. (Remember, dealers, if you want to sell them, liaise with me and I may be able to help). *Compute* magazine specialises in the 6502 — uses, products, packages etc. PET, Atari, Apple and single boards all catered for. $22.50 in US funds drawn on a US bank to Compute, PO Box 5119, Greensboro, NC 27403. 104 pages — good and glossy.

Interested in robots? *Robotics Age*, issued 4 times yearly, is aimed at professional, student and hobbyist. Send $15 or $16(air) per annum to Robotics Publishing Corporation, 3410 Marquart, Suite 203, Houston, Texas 77027.

There's a non profit program exchange and they publish 9 times per annum. Get your Apple group to contact them at A.P.P.L.E, 517 11th Avenue E., Seattle, WA 98102. In the USA the one time Apple-cation (ugh!) fee is $25 and the 1980 sub is $15.

Dr. "Lux" Luxenberg is the man who runs *SYM-Physis*, the SYM 1 user's group bi-monthly publication. It looks good to me, full of hard information to the equivalent of 20 pages of single spaced typing. As "Lux" says in his introduction ". . .that's a lot of software and documentation for the money". They are quite independent of Synertek. Send a cheque for $12.50, payable in US Dollars to SYM Users' Group, PO Box 315, Chico, CA 95927.

Finally, my favourite quote from the show. A company mentioned earlier (and who shall remain nameless) tell me that they are being extremely cautious — they want to hold their growth down to 400% this year!



How about this for a bit of plotting? The machine that did it can handle paper 8½" wide by up to 11" long and plot in an area of 8" by 10". In America it costs from $755 (for Apple II) plus the cost of the software package at $60. It can be hooked up to a TRS-80 or an S100 system and packs of 4 pens cost $7.50. Contact Strobe Inc., 897-5A Independence Avenue, Mountain View, CA 94043.

INFORMATION RETRIEVAL AND DATABASES

Mike Knight of Mike Rose Micros sifts through all available documentation to present this month's selected report.

If you were to ask the "man in the street" what his impressions of a computer were, his response would probably be prejudiced by the films he had seen or the TV programs which he watched regularly. How many times has Dr Who been saved by K9? Could Blake really triumph over the Federation without ORAC or ZEN? Even Wonder Woman uses the services of a computer which can instantly tap into any other. Almost daily on our screens, instant responses are given to large numbers of world savers by friendly computers who can call upon enormous banks of data. Of course, a businessman with a microcomputer is not normally expected to save the world. He may, however, wish to run his company more efficiently and to do this he certainly needs to be able to tap the information available within it.

Over the past few months I have reviewed a large number of packages covering most of the functions normally found in any business i.e. Stock Control, Sales Ledger, Purchase Ledger, Payroll and Word Processing. In some cases, particularly in accounting, linkages are provided between the packages. But almost without exception these linkages simply mean that a user of the system can move from one business function to another without resubmitting the basic data entered into the first. In this months "Systems" I am, therefore, going to look at packages which may enable the businessman to use his computer, not just as a workhorse within the various functions of his company, but as a databank of information which he may call upon as needed.

Objectives

The major objective of any Databank is to be able to easily store information on, and retrieve information from it with a minimum of "system" control data and no duplication of "live" data — while fully meeting the needs of the application currently being processed.

In my opinion none of the packages reviewed this month fully meet this objective; almost all, however, would provide the business or professional user with a very useful tool with which to save large amounts of time and effort in the creation and access of their files of information.

Tasks and volumes

I am not going to compare each of the packages this month since there are no common objectives. I'll give instead some indication of the facilities available within each package, in the evaluation section.

Evaluations

ANALYST

This package, written by Structured Systems Group Inc. of California, USA, is marketed in this country by Terodec (Microsystems) Ltd of Yateley, Hants (0252 874790). The package is designed to run on any Z80 or 8080 using CP/M with 48K, one disc, printer (80 column min) and a VDU, amounting in all to approximately £3000. Costing £180 it consists of four program segments linked by a menu, written in CBASIC. The manual supplied is reasonably comprehensive but little thought seems to have been given to the small number of examples presented.

The major illustration is of an attorney at law which, even if the American wordage is understood, is not likely (apart from the legal profession) to fill most small business users with confidence. However, even if the illustrations are comprehended, I have some doubts whether the jargon, used extensively throughout, would be. If this communication problem could be overcome I'm sure that the package would be useful to many small businesses. Bought together with the minimum hardware, an installation service is provided for £150; training is provided at £75 per day and maintenance support costs 14% of the retail cost per annum.

The functions available in this package are: define a data file, create or modify a data file, define a report, print a report. Data may be selected by use of up to ten range or match conditions.

AUTO INDEX

Written by CAP-CPP of London (01-404 0911), Auto Index is available from their dealers throughout the country. The package is written in MicroCobol and consists of twelve programs linked by menu. It was introduced in the spring of 1979 and there are so far approximately 50 users. The list price from CAP is £500 but there may be some variation in amounts charged by various dealers. The minimum hardware required is a 64K disc system with a 132 ch printer costing between £5000 and £6000.

A user manual is supplied but it's not for the beginner. Firstly, jargon is used throughout, with no accompanying definitions; secondly, although many examples are used the language is, to say the least, unusual. This is a great pity because, if the manual were rewritten in English with the first time business user in mind, it would enhance what I am sure is a fine product. In fact, the sales literature supplied is very good and will undoubtedly attract many small businessmen.

Back up for the package varies according to the dealer who supplies it, but all of them are supported by CAP. The package allows for the following functions; defining the database, building and updating the database, enquiries, maintaining the database and loading/unloading the database. Records are defined as key, attribute or text data and selection from the database can be made from all of the key and attribute portions of the record.

CROMEMCO DATA BASE MANAGEMENT

This package was written by Cromemco Inc. of California, USA and is available from Computerland in Manchester (061 236 4737) or any of the Cromemco dealers around the country. The package costs £59 and the minimum hardware required is a 64K dual drive Cromemco System 2 costing £2095. First introduced in 1978, the package is written in 16K extended BASIC and consists of approximately 12 programs which are linked, invisible to the user, by a menu.

A user manual is supplied which has obviously been written with the first time user in mind. All jargon where used is explained in laymans terms and each operation is illustrated with examples.

COSTS

Package	Software	Min Hardware	Total
Analyst	£180	£3000	£3180
Auto Index	£500(+)	£5000(+)	£5500(+)
Cromemco Data Base Management	£59	£2095	£2154
Data Base Management	£32.50	£500	£532.50
DMS	£170	£1800	£1970
Locate	varies	£3000	
Petaid	£45-300	£605-1495	£650-1795
Pagemate	£325	£1495	£1820
Protext	£38.50	£1200	£1238.50

Support during and after installation varies from dealer to dealer but in most cases if the package was supplied together with the hardware, it would be installed and maintained on the same basis, ie. three months warranty and 12% of the total purchase price per annum thereafter. Training on the package would normally be provided free in the dealer's showroom.

The operations available in this package are as follows: create a new database, examine a system layout, enter new data, create sort files, display change and delete records, enquiry, modify the master, change master file and drive assignment and print mailing lists. Selection is done by simple matching criteria.

DATABASE MANAGEMENT
This product was written by Hubert S Howe and is available from A J Harding (Molimerx) Bexhill-on-Sea, Sussex (0424 220391) or any of their countrywide dealers. It's designed to run on a 16K TRS 80 with cassette, costing approximately £500. A disc version is also available for a 48K TRS-80. The package costs £32.50 and if necessary can be customised. A user manual is supplied which gives a simple overview both of the system and of databases in general. A full telephone backup service is provided during installation although no actual training is available.

Maintenance arrangements depend on the dealer concerned but if necessary the program listing could be supplied. The commands available in the package are as follows: add records to the file, change records, delete records, find an item, justified or format printing, list the file on the VDU, print the file, sort the file, total the items in any numeric field and write the file to cassette or disc. Selection is done by single field matching.

DMS
Written by Compsoft Ltd. of Guildford, Surrey (0483 39665) DMS is available direct from them or from any of their dealers throughout the south of England. The package consists of two programs written in Microsoft BASIC which are never co-resident but are complementary. The package was introduced in July 1979 and to date has about 46 users.

The minimum configuration is a 32K PET with dual disc drives, costing £1800; the package itself costs £170 for the full version or £95 for each of two smaller versions which are available. The documentation supplied is excellent, a first time user would not only understand but would enjoy reading the first section. If he's daring he might go past the warning issued when the technical section is entered and even there he could probably get well stuck in before realising his mistake. As my secretary said on reading it: "Thank goodness some microcomputer people are real humans!" (You may not have realised that I have three heads and am coloured green.)

As regards support, any bugs found are corrected free of charge together with any enhancements made to the package. The system is split into three main sections, namely creation of file description, creation and update of individual records and selection and reporting of stored information. Selection is done by matching to preset constants or by any logical comparison of fields or partial fields.

LOCATE
This system was written by Loveden Computer Services Ltd of Grantham, Lincs (0476 72000) and is available directly from them. The package is written in BASIC and costs vary since it all depends on the amount of personalisation required. It's designed to run on a minimum 24K plus disc configuration although 32K is preferred; the cost of the minimum hardware is approximately £3000. Part of the customisation service is the provision of personalised operating instructions and if necessary that would include telephone backup and training. The facilities available within the package are access, display, change, create and print.

PETAID
Stage One Computers of Bournemouth (0202 23570) wrote this package and it's available direct from them or from any one of their countrywide dealers. It can be supplied in five different versions, namely sequential tape, sequential disc, random disc, sequential/random disc and indexed sequential disc — costing £45, £130, £180, £220, £300 and £250 respectively — together with an associated utility Extract & Sort costing £75.

The prime use of the package is as a formatted access file management system which will allow the user to create, maintain, examine, and print random access files on PET floppy discs. The package is supplied with a user manual which tends to concentrate on system operation although it does illustrate the instructions with simple examples. The system is designed for the user with no programming experience, yet no attempt has been made to introduce the package in simple English. Computer jargon is used extensively throughout the introduction and while my experience leads me to believe the package would be beneficial to many business users, I have some doubts as to whether they would appreciate it from the description given. However, since there are 300 users of the system, presumably they either went straight to the operating sections relying on a previous demonstration for an overview, or were already knowledgeable about computers.

The minimum hardware required for the package is an 8K PET with two tape drives costing £605 for the tape version and £1495 for the 16K minimum dual disc configuration. Training is offered at £75 per day and maintenance, including updates, costs £100 per annum for written answers to queries submitted on special report forms.

The facilities available within the package are as follows: create a new screen format or file, create a new file with an existing format, insert amend delete and display records, search and display selected records, and search and print selected records. Selection is done by matching a field or part of a field using any logical function.

PAGEMATE
A product written by Computhink, California, USA and available from ACT Petsoft Ltd., Newbury, Berks (0635 201131) and Birmingham (021 455 8686) or from any of their Computhink dealers (approximately 150) throughout the country.

The package consists of six programs linked by menu and it costs £325. A manual is supplied which explains the organisation and access to the database; it doesn't, however, give the first time user enough help in creating anything other than the simplest of databases. Petsoft seem to have recognised this since they organise regular courses on the use of the package. With training I believe most businessmen would find it very useful.

The options available are editing, sorting, copying, statistics, listing and diskcopy. Selection criteria are by matching field(s) using any normal logical function.

PROTEXT
Nigel Dibben wrote this one and it's available from A J Harding (Molimerx), Bexhill-on-Sea, Sussex (0424 220391) or any of their countrywide dealers. It's written in BASIC and costs £38.50. The minimum hardware is a 32K TRS 80 with disc backing store costing approximately £1200. It comes supplied with a manual which is definitely not for the faint hearted. To be fair, A J Harding does warn that the package is not intended for the beginner. A great pity this because the facilities available look just what a small businessman might need and I'm sure that eventually both the software and the manual will be modified for "normal" humans. In the meantime perhaps business users might consider this package when they are fully acquainted with both the machine and programming — until then, be warned.

An installation backup service is provided and maintenance support thereafter depends on the dealer concerned. The facilities available in this package are creation/amendment of datafile structure, creation/amendment of data file, display, print and include, print and exclude. The selection is done by field, partial field or floating field matching using any normal logical criteria.

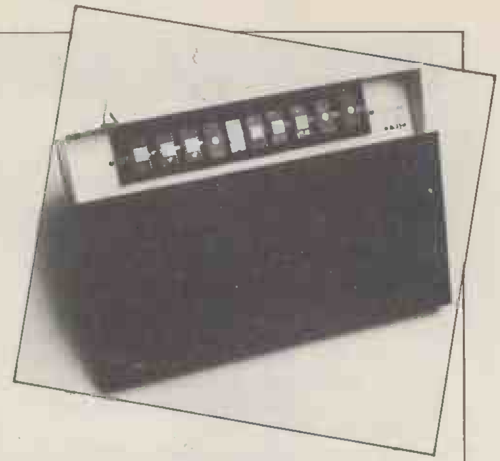
Post script

One other package which I have not had a chance to review is Visicalc, available from Microsense Computers Ltd. Hemel Hempstead (0442 41191). This runs on a 32K Apple armed with at least one Disc II drive. Among the functions available are sum values in list, minimum value in list, maximum value in list and average value in list.

CHECKOUT

by John Moore

MICRODATA UV8 EPROM ERASER



Microdata Computers Ltd is a recently formed company based in Hayes, Middlesex, and the UV8 eraser is their first product on the market. Already a good seller I decided to take a look at it to see what you get for your money.

The UV8 sells for £97 plus VAT, can erase up to 14 EPROMS at a time, and does so in the surprisingly short time of 8 minutes. The secret lies in driving the UV tube from a high frequency (16 kHz) inverter instead of directly from the 50 Hz mains. This keeps the tube, an 11¼ inch Sylvania germicidal type, continuously ignited instead of letting it flicker at 100 Hz because of the reignition every time the mains voltage passes through zero. The result is a much higher intensity than you would normally expect. Microdata tell me they have consulted the tube manufacturers and they confirm there will be no reduction in tube life running it like this. In fact, as the heater is not used, the tube could well last longer than when conventionally driven.

My own home built eraser uses a tube of twice the wattage and takes typically at least 10 minutes to erase a 2708. The UV8 is claimed to take 4 to 7 minutes, and my first tests on a Motorola 2708 showed that complete erasure of all 1024 locations could be achieved in 2 minutes 35 seconds when positioned at the centre of the tube, or 4 minutes 20 seconds at one end. These times are undoubtedly fast by any standards. They also confirm my findings with my own eraser that the output of UV tubes varies considerably along the length. When four National Semiconductor ICs were tried they took rather longer, between 3½ and 9 minutes. However these were quite old ICs that may have become "sticky": incidentally did you know that some PROMs can go like this if they have been cycled many times? I once had a 2708 that even after two or three dozen consecutive programming runs (with no erasure in between) still had about 3 bits stuck high. I tried the standard cure of baking in an oven for 40 minutes at 400 deg F (the same as for bread!) and this worked wonders. It may be possible that ageing can lengthen the erasure time as well. If a situation like this should arise it's catered for by a switch on the eraser that doubles the exposure time to 16 minutes.

Although the erasure time of the UV8 is internally preset to a nominal 8 minutes, the model under test actually ran for anything from 9 minutes 44 seconds when cold to 8 minutes 34 seconds when hot. This variation arises because the timing is derived by division from an RC oscillator that uses ordinary standard temperature sensitive components; however the variation is not usually critical. In any event there is a 100k pot in the circuit which could no doubt be adjusted if necessary to bring the time down a bit.

The case and lid of the eraser are made of good thick aluminium and are very nicely finished. The whole device occupies a bench space of only 7 by 14 inches. There's 4½ feet of 3 core mains lead which is fused at 1 amp and properly earthed inside the case. Surprisingly the exposed live line inside the box passes within only 3/16 inch of the chassis at one point. This is not good practice, but everything seems secure in this area so it doesn't appear dangerous.

When power is applied the circuit automatically resets to prevent the UV light coming on. The PROMs are insert-

Cont. on Page 128

HARD COPY AT A SOFT PRICE

One of the most trying tasks in this world is programming a micro-computer while having no facilities for hard copy. Apart from the problem of not being able to print computer art (?), listings or program output cannot be produced and you have no record at all of what was done during the day. In this article, Tim Steele shows the practicalities of "making" a cheap output printer from a "common or garden" teleprinter.

If you know the "right" shops the transformation *could* cost you as little as £10; a more realistic figure, however, would be £20 — £50. This compares extremely favourably with the so-called "quick" or "screen" printers available and, to my mind, produces better output. As an added bonus, certain machines provide the facility to punch input (programs, etc.) into paper tape off-line while your computer is thinking about something else, and then to run the corrected and (you hope) error-free paper tape into the micro.

Teleprinters come in all shapes and sizes, and you can buy anything from a machine that would sink the Titanic to a small, lightweight, civilised machine not much larger than an electric typewriter. Beware of scrap machines: if you see any rust, blackening or corrosion, steer well clear! If you're thinking of buying one second-hand, try and get it plugged in — at least see if the motor runs — or failing that, turn the governor (the black drum with white stripes on it) *in the direction of the white arrow only.* If there is any binding or jamming, don't buy it. If you turn the governor the other way, you will lock the thing solid, and possibly break it. Be careful when transporting the machine, it may be heavy, but it's also delicate! Fig. 1 shows some of the more common models available and their prices; they are all made by Creed.

Fig. 1

Machine	Tape Reader	Tape Punch	Price
7B		X	£5 — £25
7E		X	£5 — £30
54		X	£5 — £30
75	X	X	£30 — £100
444	XX	XX	£50 — £150
X = Available Option	XX = Installed always		
Meaning of Suffixes			
/RP — Includes tape punch	/RO — No Key Board		

You can also buy a paper tape reader, the Creed 6S6 or 6S6/M for £5 — £10. The suffix /M means that a solenoid is fitted for remote control of tape start and stop. The reader is electrically identical to the keyboard contacts. (See later.)

Most machines are coded with the standard teleprinter code, but some use a special computer code because they were used as computer terminals. It doesn't matter greatly which type of machine you use; the computer-coded variety are easier to write software drivers for, but the teleprinter-coded machines are to be preferred for their compatibility with standard 5-track punched tapes and the Amateur Radio teleprinter transmissions (if that's a field that interests you).

Once bought, commissioning the teleprinter will of course take a little time, and it pays to plan everything before you start. If you want to be really thorough, buy the Teleprinter Handbook (from the Radio Society of Great Britain, 35 Doughty Street, London) and clean and adjust the machine in accordance with the instructions. This is not essential, and if you fully understand the technical gobbledygook they use you are well on the way to becoming a teleprinter repairman anyway.

The teleprinter works by using the movements of a solenoid (known as the magnet) to set up five two-state latches; these determine which character is to be printed. The magnet has two positions — "mark" and "space". To move the solenoid lever from side to side, a current is passed through it one way for "mark" and the other way for "space". To ensure the magnet moves quickly enough, a high voltage (80V) is used and resistors are placed in series to limit the current to 20 mA. The keyboard is an SPDT switch which produces the character when a key is pressed. A typical character is shown in Fig. 4.

It can be seen from this that the character consists of a start pulse, five character elements that are mark or space, and a stop pulse 1½ units long. The extra length is to give the mechanism time to come to rest. After this, the next character can begin. Since the maximum number of characters is 32, a shift key has to

Fig. 2

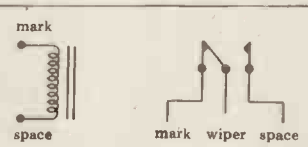


Fig. 3

MACHINE	Magnet		Keyboard			"J" Bell	Comments
	m	w	m	wiper	s		
7B	5	3	6	7	8	4 Earth	Prints one character behind
7E	7	9	1	2	3	31 32	
54	7	9	1	2	3	10 11	
75	J	G	Obtain wiring diagram from Creed.			K L	Keyboard wiring complex
444	9	32	13	2	3	27 31	Tape reader M — 1, wiper — 12, S — 3

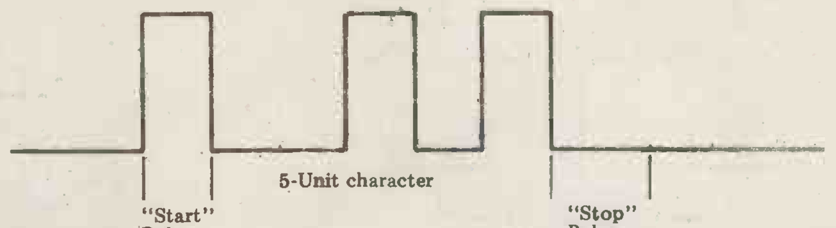
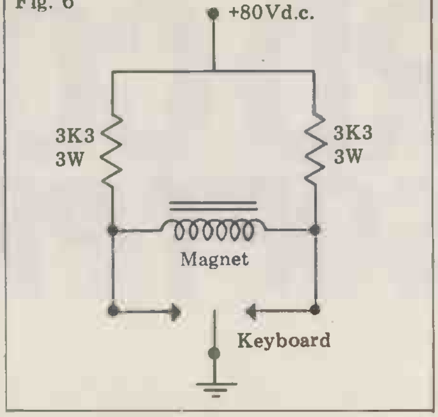


Fig. 4

CODE	Letters	Figures
		Fig. 5
MMSSS	A	—*
MSSMM	B	?
SMMMS	C	:
MSSMS	D	WRU?
MSSSS	E	3
MSMMS	F	%*
SMSMM	G	@*
SSMSM	H	£*
SMMSS	I	8
MMSMS	J	BELL*
MMMS	K	(
SMSSM	L	)
SSMMM	M	.
SSMMS	N	,
SSSMM	O	9
SMMSM	P	0
MMMSM	Q	1
SMSMS	R	4
MSMSS	S	'
SSSSM	T	5
MMMSS	U	7
SMMMM	V	=
MMSSMM	W	2
MSMMM	X	/
MSMSM	Y	6
MSSSM	Z	+
SSSMS	CAR RET	CAR RET
MMSMM	FIGS	FIGS
MMMMM	LTRS	LTRS
SMSSS	LINE FEED	LINE FEED
SSMSS	SPACE	SPACE
SSSSS	ALL SPACE	ALL SPACE

Fig. 6



be used to determine whether "letter" or "figures" shift is selected. Once having sent "letters" or "figures", the machine stays in that shift until another shift character is sent — a little practice will make this clear. The complete code is reproduced in Fig. 5.

So, assuming that you have the machine in your workshop and you have checked it turns over freely, connect the mains to the motor. If the teleprinter makes a noise like a machine-gun, find the solenoid arm (RHS of machine at front) and push it to its other position. The sound is perfectly normal and does not indicate any damage being done. If it makes loud screaming noises, or goes off bang, blame whoever you bought it from! Now try waggling the solenoid lever from side to side — the machine should print gibberish (assuming you have put paper in). If this test does not work, refer to the Teleprinter Handbook or your scrap merchant. Now press a key (if the machine has a "HERE IS" key, press that instead) and check that the machine makes buzzing noises.

Having done this, you will probably want to see if it types properly. To do this, hook up the circuit of Fig. 5. If you wish to adjust the speed of the machine, find the black drum on the end of the motor (if the machine has one) and adjust the screw on the rim (first switch the machine off and on again afterwards) until a piece of white paper or tape stuck across a diameter of the disc appears stationary in neon light. Then turn the screw 7½ turns in the "—" direction. This sets the teleprinter up for 45.45 Baud.

All that is left now is to interface the machine to your micro. To type into the micro from the keyboard, the circuit shown in Fig. 7 will suffice. This will send the input high for "mark" and low for "space". Fig. 8 is a flow diagram of a suitable keyboard input routine. Outputting to the printer is slightly harder; I suggest using the circuit of Fig. 9 for this — although other circuits will do as well. Fig. 10 provides a flow diagram of a suitable output routine.

Having wired up your teleprinter,

Fig. 7

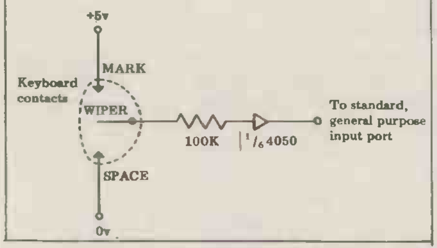


Fig 8a

Subroutine INCH

N.B.
0 = SPACE
1 = MARK
LSF = Letter shift flag
1 = Figures
0 = Letters

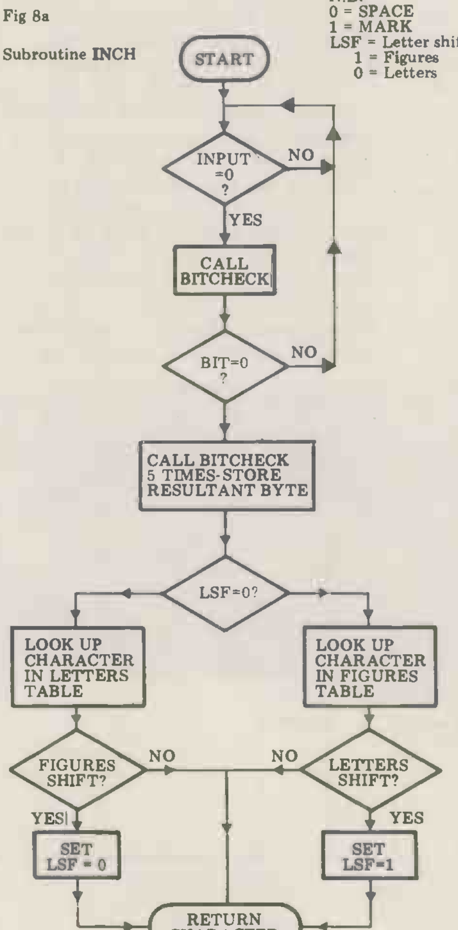


Fig. 8b

Subroutine BITCHECK

N.B.
K_0 depends on your micro's speed

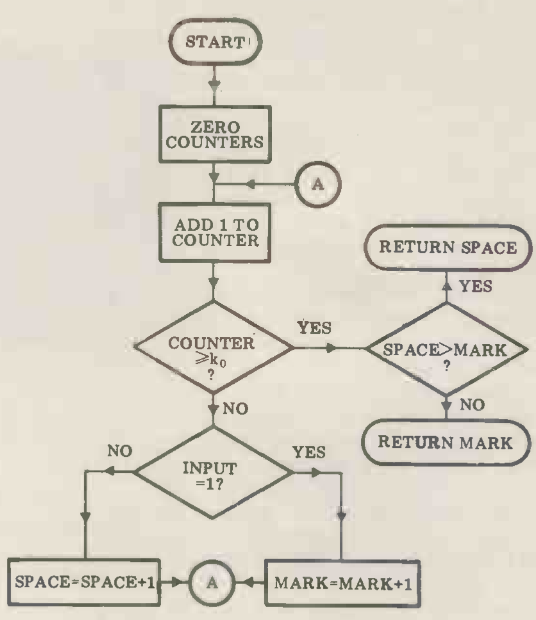
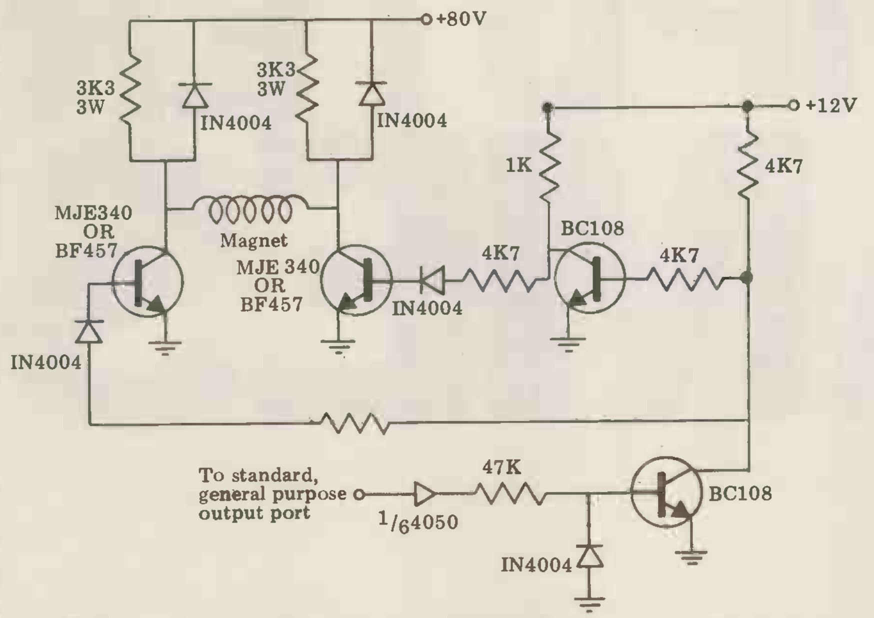


Fig. 9



you are ready to start writing programs. The first thing you may want to do is produce listings on the printer. You can do this using the same LIST routine as your monitor software by shifting the routine somewhere else in memory, correcting the branches and substituting the OUTCH routine for its own.

When you use INCH to input from the keyboard, try to bear these points in mind:-

1 Don't leave it longer than 30 milliseconds before calling INCH again or you may lose characters.

2 Don't forget to call OUTCH after inputting a character so that the character is echoed back to the printer.

Also, you might like to write your input routine so that on pressing "CAR RET" the user gets "CAR RET", "LINE FEED",")" — (as a prompt).

Fig. 10a

Subroutine OUTCH

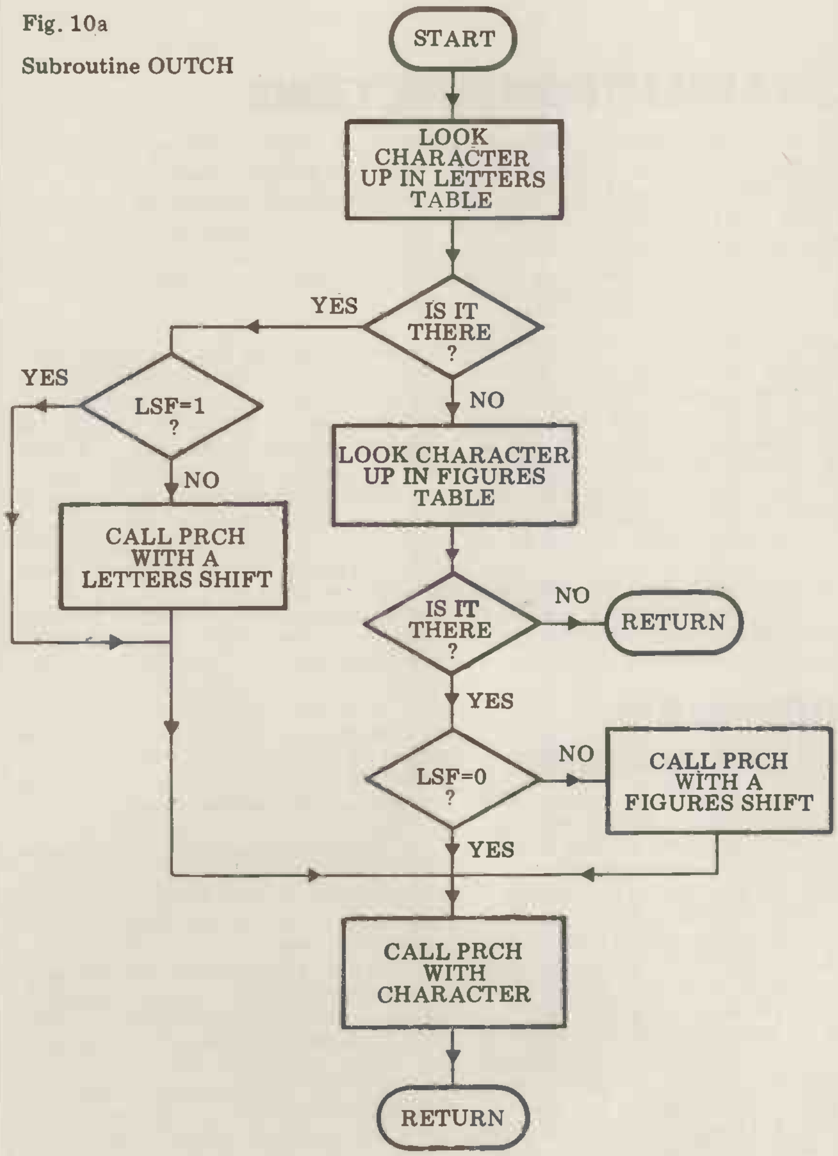
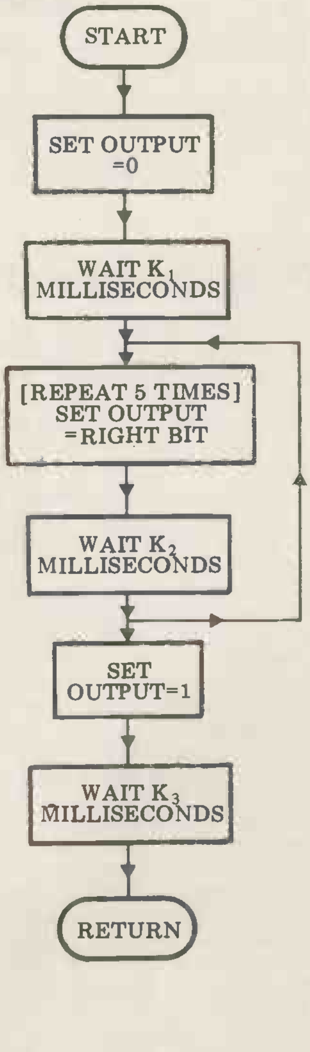
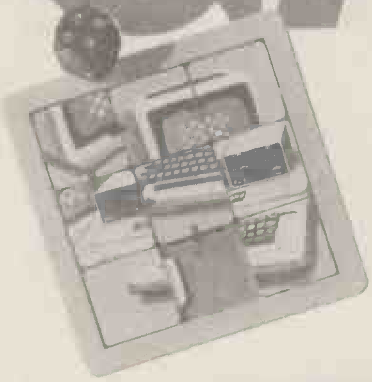


Fig. 10b

Subroutine PRCH



COMPUTER GAMES



MORE COMPLEX EVALUATION FUNCTIONS

Those readers who have followed the previous articles should now have a good understanding of the principles of tree searching. The concept of the evaluation function has already been introduced (sometimes called the scoring function), but up to now only simple functions have been considered. In this article David Levy will look at those for more complex games and the reader will also be shown how to devise his own. David considers, too, some simple methods of learning, and illustrates a method that allows the program to improve its own evaluation function.

How good is good?

Show a chess master a position from a game of chess and he will most likely make some comment about which side has the advantage. He might say: "White is slightly better," or "Black has a clear advantage", or "White is winning". Press him further and he will tell you why it is that White is slightly better: perhaps the reason will be simple, such as White has an extra knight . . . or maybe it will be more subtle, such as Black having the inferior pawn structure (or, even more specifically, a pair of "doubled pawns").

In the language of chess players all of the master's comments will mean something. But when we write a chess program we have to put some numerical value on advantages such as an extra knight or a superior pawn structure, and the accuracy with which we can do this is one of the principal factors in determining the strength of our program. The result of our efforts to quantify various forms of advantage is a device called an evaluation function, and for all interesting games the evaluation function is part of the key to successful programming.

In an earlier article I suggested a simple evaluation function for noughts and crosses, the justification for which lies in the fact that only rows, columns or diagonals with moves by one player only (and not his opponent) are of any real interest. Once a row has one move by each player, that row is of no further use to either of them. I did not get this evaluation function from a World Champion noughts and crosses player, I made it up by taking a brief look at the underlying structure of the game. Alas, chess, checkers, backgammon, etc., etc., are all far too complex for such a simple approach to be possible. We must therefore rely, for our evaluation function, on the advice of experts, either spoken or in books.

There are three stages in building a useful evaluation function for a complex game, and I shall illustrate these stages by using chess as my example.

Identifying the important features

In order to be able to tell a good position from a bad one, it is first necessary to know what features to look for. If you know nothing about chess, and you and I both look at the same position, I will be able to make a fairly accurate assessment of which side has the advantage and by how much, simply because I know what to look for. You will be looking at the same thing but will not understand what you see. But suppose I were to tell you that the most important thing in chess is material — how many pieces each player has on the board, and that the player with the most pieces usually wins. Then you can count the pieces, and if White has 16 pieces but Black has only 8 you will hazard a guess that White is doing quite well, and in general you will be correct. I could further advise you that the pieces have different values: that a queen is worth 9 pawns, a rook 5, a bishop or knight 3, and that the king was beyond normal values. Then you could look at a position and fairly easily tell which side, if any, was ahead on material. You may know nothing else about chess but at least you can make a meaningful, first order estimate of which side is ahead and by how much.

If it were possible for a chess program to search a tree 200-ply deep, an evaluation function with material as its only feature would almost certainly be sufficient to enable the program to play better than Bobby Fischer. But such is the nature of the game that a 20-ply search is not yet realistic, let alone 200-ply, so our evaluation function must have more features.

In order to discover which features of the game are important, you may do one or both of two things. You may read some books on the subject, in the search for general advice (heuristics), and you may ask someone who is expert in the game. In answer to your question "What else is important in chess, apart from material?", you may well receive the reply "Control of the central squares". On investigating further you discover that pieces in the centre can move to, or attack, more squares than pieces on an edge or in a corner. And pieces that attack central squares may eventually be able to move to a central square, so attacking central squares is a useful thing to do.

Further questioning, and/or reading, will reveal that if your pieces are getting in each other's way they will not be able to do very much, whereas if they have plenty of scope to move they will be more likely to help you improve your position; thus it is important for your pieces to have as many moves as possible.

Everyone knows that the king is the most important piece in chess, so obviously one should look after one's own king. Expert advice will tell you to keep it away from the centre of the board until the final stage of the game has been reached; castle during the opening stage so as to put your king nearer a corner, where it will be safer than on its original square; and don't rashly advance the pawns in front of it once you have castled. You can learn all this from any decent book on the game.

A fifth feature, whose importance is often underestimated is pawn-structure. Good chess players know that "isolated pawns", that is pawns which do not have any supporting pawns on adjacent columns, are weak, because if the opponent attacks them they can only be defended with something more valuable than a pawn, and it is always best to use your less valuable pieces for defence. Also, it is usually a disadvantage to have "doubled" pawns, i.e. two of your own pawns, one in front of the other, since they will not be able to defend each other and the front one will block its colleague's path.

To summarise this stage of function building: Read some good books on the game and try to get advice from a strong player. You need to know which features in a position are important, and you need to understand why they are important so that you can measure roughly how much of each feature is present in a position.

Quantifying the features

I have already explained how to measure the material situation in a chess position. The scale of values: queen=9, rook=5, bishop=knight=3, pawn=1 is a very useful guide. Some programmers find that giving the bishop a value between 3 and 3½ leads to a more accurate assessment, but it is useful to work with integer values since integer arithmetic is faster than floating point. So if you do decide to use non-integer values, scale everything up so that the final calculations are all integer.

These values of 9, 5, 3 and 1 are known to work well, though there is no logical explanation as to why they are better than some other set of values. It has simply been shown, throughout the modern history of chess, that a knight is worth roughly three pawns, but that a player with four pawns is better off than a player with a knight, while the man with only two pawns will probably lose to the man with the knight.

Features other than material are not so easy to quantify. This is probably because the material count is something that can be performed quickly by anyone who can add, while a count of (say) the number of squares that your pieces attack is not an easy matter for a human player to accomplish when thinking ahead. Because human players do not use any method of quantifying centre control, mobility, etc., when playing games against each other, there exists no well-tested set of values for these features. We must therefore devise our own.

In an earlier article I gave a simple evaluation function for solving the 8-puzzle. Since the object of the exercise is to move tiles from their present location to some target location, it seems logical to measure the merit of a configuration by summing the straight line distances that the tiles need to be moved before they will all be on target. Similarly, for any feature in any other game, we look for a logical explanation of why that feature is important, and this will often lead us to a possible method of quantifying the feature. In chess, as we have discovered, control of central squares is important because from the centre of the board a piece exerts more influence (i.e. it attacks more squares) than it does from an edge or corner square. So to determine the relative values of the squares, from the point of view of centre control, we should, perhaps, count how many moves can be made by each piece, on each square, when the remainder of the board is empty. Of course the remainder of the board is never empty, and sometimes it is very cluttered, but this approach does have a logical foundation and provides us with a first order measure of central square values. A detailed discussion of this method can be found in Jack Good's paper, to which I refer in the bibliography.

Let us assume that we decide to assign square values as follows: each of the four central squares counts 4, those next nearest the centre count 3, the next group 2 and those on the edge of the

1	1	1	1	1	1	1	1
1	2	2	2	2	2	2	1
1	2	3	3	3	3	2	1
1	2	3	4	4	3	2	1
1	2	3	4	4	3	2	1
1	2	3	3	3	3	2	1
1	2	2	2	2	2	2	1
1	1	1	1	1	1	1	1

board count 1. We might then count the total centre control for a player by summing the square values on which his pieces stand, or by summing the values of all the squares that his pieces attack. This may sound like a rather ad hoc statement, but the quantification of features is something of a trial and error process. Since you are a computer programmer you must have a logical mind, so apply some logic to the feature in question and you will come up with a quantification that will serve as a useful model.

How easy or difficult it is to quantify a feature varies enormously. To take some more examples from chess: mobility (the freedom of movement of the pieces) may be measured simply by counting how many moves each player has at his disposal. In fact mobility is the second most important feature in chess, and if you plot (White's mobility — Black's mobility) throughout a master game, you will almost certainly discover that whoever wins the game has a lead in mobility throughout much of its duration. The two key elements of pawn-structure, isolated pawns and doubled pawns, are also easy to measure — we can simply count them.

But what about king safety? This is not so easy because there are so many aspects of the position to take into consideration. The king is usually safest when it hides behind a few of its own pawns, but when these pawns advance they offer considerably less protection. A king is normally much safer near a corner of the board, but not if the opponent has many of his pieces trained on that particular corner. It is usually advisable to castle early in chess, to put the king into safety, but if queens are exchanged during the first few moves it may be better to leave the king nearer the centre, since it will be relatively safe during the middle-game and better placed for the end-game. With so many factors to take into consideration, the quantification of a feature such as king safety can be rather prone to error, but some attempt to do so is essential, so don't be put off if you encounter difficulties of this sort.

Weighting the features

Having decided which features to include in your evaluation function, and worked out a suitable method of quantifying each of them, you must then decide which of them are the most important, and assign some numerical weighting to each, to indicate its importance relative to the other features.

Let us suppose that we are writing a chess program and that we have decided to employ only two features in our evaluation function, material and mobility. We quantify material using the scale of values given above (9,5,3,3,1) and we measure mobility by counting how many moves each side can make from a given position. Let us denote the material difference (program's material — opponent's material) by Ma, and the mobility difference (program's mobility — opponent's mobility) by Mo. If we were to compute a score for a chess position simply by adding Ma and Mo, the result would be unrealistic. The reason for this is that one unit of material (in our case one pawn) is not of equal value to one unit of mobility (a move). A pawn is more valuable than a move (other things being equal) and so we must weight the material feature accordingly, multiplying Ma by some numerical weighting WMa. If we set WMa at 3, we are telling the program that one pawn is equivalent to three extra moves, so if it sees an opportunity to increase its mobility scores by 4, the program would be willing to sacrifice a pawn to do so.

The best method of arriving at a good set of weightings for an evaluation function is to start with values that seem to be in the right range, and then improve these values in the light of the program's performance. With our two featured chess function, if we were to play a number of games we would almost certainly discover that with WMa set at

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3, the program would not be sufficiently careful about its own pieces, and that as WMa was increased to 5 or 6 the program's performance would also improve. The task becomes more difficult and more time consuming when using a multi-feature function. I would recommend building up your function slowly, starting with two features and getting their weightings adjusted satisfactorily, then adding a third feature and adjusting its weighting while keeping the other two constant, then add your fourth feature, and then add new ones in descending order of importance. As you add each new feature you should carry out some experiments, if you have sufficient memory, by playing the new version of the program against the previous one. You may discover that the addition of a particular feature, while giving a more accurate position assessment, results in such an increase in computation that the program can search only a much smaller tree and the end result is weaker play.

Making your program learn

You will have gathered from the previous paragraph that it is often a very time consuming and difficult matter to reach an optimal set of weightings for your evaluation function. One way to help overcome this is to make the program learn from its experience and improve its own evaluation function!

A simple example is the case of our two featured chess function:

WMa x Ma + Mo

We could modify our program so that it was able to play against itself, using two different values of WMa in each of the two "versions" of the program. If we start out in total ignorance, we could make WMa=1 in version 1, and WMa=100 in version 2. We then set the program to play a large number of games against itself, in half of which version 1 would be White and in the other half it would be Black. At the end of the series we would discover that version 1 had lost almost all, if not all, of the games. (I have already explained that one pawn is worth much more than one move.) We then set WMa to be 2 in version 1 (or we could reduce WMa in version 2) and keep the other value constant. After another series of games we would find that version 1 still lost very heavily, but possibly not quite so heavily as in the first series. If WMa was kept at 100 in version 2, we would discover that as the value of WMa reached 3 in version 1, version 1 would start to win a few games; when it reached 4 or 5 its results would improve considerably, and by the time WMa was 6 it would possibly be outscoring the version with WMa=100, because although material is more important than mobility there are situations in which the sacrifice of a pawn or two can advantageously increase a player's mobility, and WMa=100 will never recognise those situations.

This process of adjusting the weighting in accordance with the program's results can, of course, be fully automated, so you could switch on at night, go to sleep for a week, and when you woke up your program would be playing like a Grandmaster. But with more than two features in the evaluation function this type of learning process can be difficult to operate — the self-learning reaches a local peak in the n-dimensional surface representing the various possible weightings and their results (n is the number of features), and it becomes difficult to climb out of the local peak in the search for a global peak. A method of overcoming this problem was discovered by Arthur Samuel, author of a famous draughts (checkers) program, but more about that in a moment. First I would like to describe a simple method of learning called "Boxes", which can be applied to equally simple games with surprisingly effective results.

Boxes

Boxes is a method of decision taking that allows for a certain amount of program learning. A task (such as making the best move in a game) is split up into a number of sub-tasks (such as making a move in a particular game position) and a box is assigned to each sub-task. Inside the box is the information that is used by the program to guide its decision, and this information can be updated in the light of the program's experience.

Boxes was originally tested on the game of noughts and crosses. Donald Michie has calculated that there are 288 essentially different positions with which the player moving first may at some time be confronted. To each of these 288 positions is assigned one box (matchboxes were used) and inside each box there are a number of beads. The beads each have a number on them, the numbers indicating vacant elements in the noughts and crosses array (i.e. places in which the box "program" can make its next move). If one box corresponds to a situation in which elements 1, 2 and 3 are vacant, then that box will start out life with an equal number of "1 beads", "2 beads" and "3 beads".

When this box is opened (i.e. when the "program" has to make a move from the configuration corresponding to that box), a bead is drawn out at random, and the move is made according to the number on that bead. The bead is then replaced but the "program" makes a note of the fact that this box was used, and that the bead chosen was (say) numbered 2. When the game is over, the boxes which were opened during the game are referred to again. If the "program" won the game, then each box used during the game has one bead added to it, the number on the new bead corresponding to the move made from that box. If the game was a draw the contents of the box remain unchanged, but if the game was lost then one bead is removed from each box in order to reduce the probability that the same move will be played again should that situation ever arise in a future game.

The interested reader is referred to the paper (1968) by Michie and Chambers, which is mentioned in the bibliography. The authors describe how the boxes method, with some modification, learned so well that it could win at noughts and crosses between 75% and 87% of the time when it had played a series of 1,000 games against a program which played first in every game and always moved at random. Of course methods such as this are far too simple to be able to cope with games of the complexity of chess or bridge, but it is interesting to see how effective a learning mechanism it can be in a simple environment.

Samuel's draughts program

Probably the most famous game playing program up to the late 1960s was the draughts (checkers) program written by Arthur Samuel of IBM. I shall be discussing Samuel's work in some detail in a future article so here I shall restrict myself to a description of two methods of learning which the program employed.

The simpler of the two methods is called rote learning. Each time the program conducts a tree search from a position (the root of the tree), it provides an evaluation of this position based on the results of the look-ahead search. This evaluation is therefore more accurate than the evaluation which would be achieved by applying the evaluation function directly to the root position. Thus the evaluation of the root position is stored, together with the position itself, and when the program next encounters the same position, but as a terminal node, instead of applying the evaluation function to the terminal node it looks up the stored evaluation. The process is relatively fast, since the positions can be hash coded and stored in such a way as to make retrieval easy; it results in more accurate play because the evaluation taken from the store is more reliable than a superficial evaluation. The obvious disadvantage of this method, from the micro-user's point of view, is the large memory required to make effective use of the rote learning process. (By the time that the program reached the peak of its playing ability, quite a high proportion of all reasonable draughts positions were in its store, and the program played at or near championship level).

A more generalised approach to learning was Samuel's method for the self-modification of the weightings in the evaluation function. Samuel used the argument that if an evaluation function was ideal, the score obtained by applying the function directly to a position would be the same as the score obtained as a result of a look-ahead search *from* that position. The fact that the two scores are often different was employed in the following way.

Let us assume that our evaluation function has three features, A, B and C, and that the features are weighted with WA, WB, and WC respectively, so that the whole function is expressed as:

(A x WA)+(B x WB)+(C x WC)=score

where A, B and C are the quantities present of each feature. We shall denote the backed-up score for a root position by S_b, and the score which was backed-up to that same position during the previous tree search (two ply ago) as S_p. Note that, if the tree search is normally n-ply, the score S_b will be the result of an n-ply search, whereas the score S_p, although arrived at during an n-ply search, is only the result of a search to depth n-2. S_b is therefore a more reliable score than S_p.

Samuel computed, for each such pair of values, the difference, which he called delta. If S_b—S_p (i.e. delta) was positive, then he argued that S_p was in error and terms in the evaluation function which contributed positively should have been given more weight, while features which contributed negatively should have been given less weight. Whenever delta was negative he used the converse argument that features which contributed negatively should have been given more weight, and those which contributed positively should have been weighted less.

Samuel kept note of the correlation existing between the signs of the individual feature contributions (i.e. the signs of A, B and C) and the sign of delta, and he updated these correlation coefficients after every move of a game. He then selected the feature with the largest correlation coefficient (other than material advantage, which is always the most important feature), and he set the weighting for this feature at a presribed maximum value, with the weightings of the other features adjusted in accordance with their correlation coefficients. In fact Samuel set all the weightings to be integer powers of 2, so that if the ratio of two correlation coefficients lay between n and n+1 then the ratio of their feature weightings would be 2^n. (If a correlation calculation gave rise to a negative sign, the sign associated with the weighting itself would be reversed.)

The obvious advantage of Samuel's generalized learning method is that it can be implemented on a microcomputer with little difficulty, because it is not necessary to store an enormous number of board positions. When your program makes a move from the root of the tree, you need only store all the 2-ply positions in the relevant part of the tree together with their backed-up scores. (In chess this would normally be in the region of 36 positions, in checkers probably less than 10). A problem arises when the alpha-beta algorithm prunes off the branch actually selected by the program's opponent, since the relevant 2-ply position will not have been stored, but it is reasonable to argue that this will only happen when the opponent makes a mistake (or a move which the program thinks is a mistake), so such instances could be ignored. More accurately, if the program's opponent makes an unexpected move, before computing its reply move the program could first re-examine the relevant part of the tree from the previous root position, searching along the path represented by the opponent's move. This refinement would permit the program to take into consideration the S_b and S_p comparison for positions which, in the first instance, had been pruned away.

Task for the month

Write a noughts and crosses program, using an evaluation function in which the features are:

c_3: The number of cross' "3-rows" (i.e. the number of rows containing 3 crosses).

c_2: The number of cross' 2-rows (2 crosses and an empty space).

c_1: The number of cross' 1-rows (1 cross and two empty spaces).

n_3, n_2 and n_1: Corresponding features for noughts.

Your program should perform a 3-ply exhaustive search (without alpha-beta pruning) and the evaluation function should start with all weightings equal. Modify your exhaustive search noughts and crosses program ("Task of the Month" in article 3) so that it can act as a sparring partner for the present program, and set the two programs playing each other. After every move of every game, the 3-ply search program should modify its weightings using Samuel's method. After each game, print out (or display, if you have no printer) the result of the game and the new weightings in the evaluation function. Observe how the 3-ply program improves its performance.

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CALCULATOR CORNER EXTRA

PUTTING SOME THOUGHT INTO CALCULATORS

"Noughts and Crosses" is not one of the world's more intellectually demanding games to play; to program a computer to play it is more challenging, but it's now so thoroughly worked out that David Levy, in his excellent series on games, sets "noughts and crosses" programs as homework exercises for the reader!

So why, you'll be asking, are we publishing a noughts and crosses program? This example, written by Peter Brooks (a medical researcher from Oxford), is interesting for three reasons.

1. It's written for a programmable calculator (the increasingly popular Casio FX502P) and despite using less than 256 bytes and 18 memories, it nevertheless plays an "intelligent" game. This must surely make it one of the most compact strategic games programs around.

2. The programs structure will repay study, as it makes ingenious use of data-packing, indirect addressing and subroutine calling to achieve its brevity. It shouldn't be too hard to translate into other calculator dialects, or into machine code/assembler for Mk 14, Acorn and the like, or to incorporate it into a more sophisticated game program (3D for instance).

3. The way the program has been documented is exemplary. Would that all the programs we receive, whether in BASIC or whatever, were as comprehensively explained as this one.

Move scoring

The opponent's moves are given a weighted value of 4 against the calculator's move value of 1. Because of the method used by the program of testing for a calculator win (it checks to see if the move made was in response to a match with a comparison value for a possible win line — i.e., a line in which one position is empty, and the other two positions are held by the calculator — rather than making the move and then searching again to find out whether a winning line has been made), the opponent's move value is low enough to prevent a line of two opponent's moves and one empty position adding up to a two-digit number, but large enough to enable a distinction between lines with only one position occupied (by the opponent) and lines with two positions occupied (both by the calculator). The full list of values given by different line positions can be found in the table below.

It can be seen from the above that the only positions worth considering are

Occupied by Calculator	Occupied by Opponent	Total line Value
0	0	0
0	1	4
0	2	8
0	3	12 (this position not tested for)
1	0	1
2	0	2
3	0	3 (this position not tested for)
1	1	5
2	1	6 (this position not tested for)
1	2	9 (this position not tested for)

those in which the calculator already has one or two moves; those in which the opponent has one or two moves; those in which neither player has any moves; and those in which both players have one move each, leaving one position empty. After some trial and error, the preferable (or one of the preferable) sequences to test was discovered to be 2, 8, 4, 1, 5, 0 (with the possibility of interchanging the last two numbers). Originally it appeared that a good rule of thumb for the strategy sequence was 2, 8, 1, 4, 5, 0, but more often than not the calculator forced a win upon the opponent (i.e., if all the opponents did was to block calculator winning lines, and not attempt to create their own winning lines, they would win because the sequence of moves made by the calculator would result in the creation of opponent winning lines by default. If you don't believe me, try the exchanging 1 and 4 in the instruction ".28415 Min .1 Min .F" in the program, and playing a few games).

The strategy therefore is to search for the following:

- 2 : winning line for calculator — move to win
- 8 : winning line for opponent — move to block
- 4 : one move made by opponent — move to disrupt possible opponent strategy.
- 1 : one move made by calculator — move to create possible winning line
- 5 : two out of three positions occupied by opponent and calculator — move into position left
- 0 : empty line — move into centre position of the line.

In tactics terms, the priority is: Win/Block/Disrupt/Possible win/Complete disrupted line/Begin line. The number is entered as a fraction in the program because fewer steps are required to extract the values one at a time from the sequence; e.g., .28415 x 10 = 2.8415; the fractional part is already in the correct position for storing back in the working memory, and the integer part is easily separated from the whole number and stored in the comparison memory ready for testing.

Move making

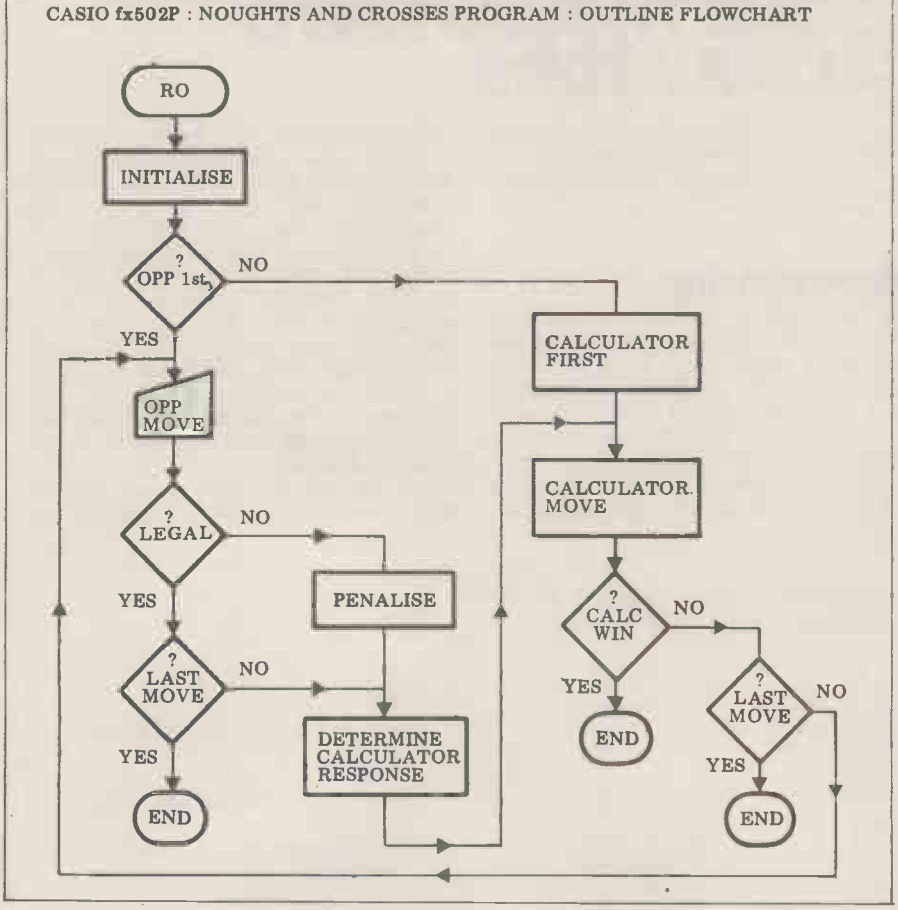
Once a subroutine returns and the total score for the particular line matches the value tested for, the program jumps to a section that determines which position the calculator will move into according to a rule of thumb.

The rule is to move into the centre position of the line if unoccupied, and to the end positions (whichever is unoccupied) if occupied. Again the positions are stored as a fraction to enable easy operation to extract the moves in the right sequence.

The decision as to which line to search first (i.e., 1-2-3, 4-5-6, 7-8-9, etc) was purely arbitrary; the only drawback is that, because the program only searches until the number returned by the subroutine matches the strategy value, other possible matches are not searched for, so the calculator will, quite frequently, ignore positions which are, tactically, highly advantageous to it. That will apply especially to positions where one move can create two winning lines — the opponent can only block one of them, and so the calculator would automatically win. This might perhaps give the opponent a better game; certainly it's not difficult to draw. But it also opens up possibilities for experimentation with the program for those seeing the effect of different strategies (which might help underline some of the points in David Levy's series on Computer Games). Juggling with the section on subroutine calling could conceivably remove redundant searching; the only limit to the experiments would be the user's imagination.

The subroutines are called, incidentally, in reverse numerical order; that is, P8 first — the reason for this is, again, that fewer steps are involved.

CASIO fx502P : NOUGHTS AND CROSSES PROGRAM : OUTLINE FLOWCHART



Symbols used in the program listing

After seeing the difficulties experienced by the magazine over correct printing of certain symbols in listings, I have attempted to avoid, wherever possible, the use of symbols which could be misinterpreted. I have therefore chosen to use standard computer symbols in two cases: the asterisk "*" in place of the multiplication sign (to avoid confusion with X), and the oblique "/" in place of the division sign (to avoid confusion with the minus sign). I could not think of a viable alternative to the decimal point (except perhaps dp or D, but that could still lead to problems) so it has been left in the lap of the gods (!). I have also included all INV second function statements for clarity if not brevity.

Input~output protocol: Summary

1. Initialise: press PO
2. If Opponent is to move first go to (3) Otherwise calculator moves first: press EXE, move displays
3. Key move using layout of numbers 1 — 9 on keypad: press EXE; calculator's response appears after about 9 seconds
4. Further opponent's moves entered as in (3)
5. If calculator wins, flashes winning move alternating with '2'
6. If game drawn, last move made is flashed, alternating with '9'
7. Sequence of moves made in a game may be recalled (before re-initialisation) using MR .4
8. Attempted entry of illegal moves will cause opponent to lose the chance to move, the sequence record will show that the opponent attempted to cheat, and the calculator takes the move instead.
9. Display format:

M.123456789ON

where M = calculator's move; 123456789 = board positions, with '1' for calculator's position, '2' for opponent's; N = number of moves made so far.

10. While the HLT status indicator is visible, a game is in progress, and moves may be entered whenever the display settles.

Input~output protocol

1. To start a game press PO. The HLT status indicator will appear, and the display will show zero.
2. Decide whether the calculator or the opponent is to move first. If the opponent is to move first, go to (3). If the

calculator is to move first, press EXE and the display will show the first move thus:

5.000010000^{01}

where 5 is the move position .000010000 is the entire board position, numbered 1 to 9, giving '0' for empty box, '1' for the calculator's move, and '2' for the opponent's move, and the exponent shows the number of moves made so far.

3. The opponent must decide on his/her move within 15 minutes (!), otherwise the calculator will automatically switch off, preventing further moves in the game in progress, and a new game will have to be initiated.

Use the numeric keypad to enter the move, with the noughts and crosses board corresponding to the same layout of the keypad (i.e. to move into the top left hand box, key '7', etc).

Cont. on P. 127

PROGRAM MEMORY : TITLE AND LABEL ALLOCATIONS

P0	Main program — initialisation — calculator's random first move generation — test for entry of opponent's move
Label 0	Execution of calculator's move — update move counter — update board positions — update move sequence record — refresh game strategy in working memory — check for calculator's win — check for end of game — display current move, current board, current move count
Label 1	Opponent's response — take absolute integer of opponent's entered move — test for illegal entry; penalise if illegal, update move sequence record, and give move to calculator
Label 2	— if move legal, accept and execute opponent's move — update move counter — update board positions — update move sequence record
Label 3	— check for end of game
Label 4	— initialise search for calculator's response
Label 5	— indirectly call subroutines P1 to P8 until condition satisfied
Label 6	— recall move sequence stored by last subroutine called. Find the empty position and begin response.
Label 7	— initialise end of game loop: prepare current move, board positions, and move count; put into Y — register. Recall reason for end of game and put into X — register.
Label 8	End of game loop — exchange X with Y register, prepare display format, pause to display, loop to beginning of label 8
Label 9	Penalty for attempting to cheat — set current move memory to zero and update move sequence record. This will cause a zero to be included as an indication that the opponent attempted to cheat (except for an illegal move on the opponent taking the first move in a game) without affecting the board or current move count

PROGRAM MEMORY : TITLE AND LABEL ALLOCATIONS

P1	Subroutine for bottom row total
P2	Subroutine for middle row total
P3	Subroutine for top row total
P4	Subroutine for left column total
P5	Subroutine for centre column total
P6	Subroutine for right column total
P7	Subroutine for first diagonal total
P8	Subroutine for second diagonal total
P9	Subroutine for move sequence record

DATA MEMORY ALLOCATIONS

Memory	Content
0	Move position; Subroutine call; Indirect operations
1	Board position: bottom left
2	Board position: bottom centre
3	Board position: bottom right
4	Board position: middle left
5	Board position: middle centre
6	Board position: middle right
7	Board position: top left
8	Board position: top centre
9	Board position: top right
.0	Move sequence from subroutine
.1	Game strategy : refresher memory
.2	Current board positions ready for display
.3	Ongoing move counter
.4	Ongoing move sequence record
.5	10 (a constant)
.6	Unused
.7	Unused
.8	Unused
.9	Unused
F	Comparison memory for game strategy, wins, endgame
.F	Game strategy: working memory

CASIO fx502P : LISTING AND RATIONALE FOR NOUGHTS AND CROSSES PROGRAM

P0	INV MAC	Clear all memories
	10 Min .5	Store constant
	.28415 Min .1 Min .F	Store game strategy
	INV RAN#	Generate pseudo-random number
	*9 Min F	Multiply by 9 (store 9)
	+ 1 = INV INT	Add 1, take integer part
	Min 0	Store in move memory. This is the calculator's first random move, ready to begin a fresh game
	AC HLT	Clear display and stop
	INV x = 0	Was there an input ?
	GO TO 0	No. The calculator is to move first
	GO TO 1	Yes. The opponent is to move first
LBL 0		
	1 INV IND Min 0	Calculator's move. Store 1 for calculator in memory 0
	M+ .3	Increment move counter by 1
	MR 0	Recall move position
	INV 10^x	Take antilog
	INV 1/x	Take reciprocal
	M+ .2	Add to board contents memory
	GSB P9	Store move in sequence record
	MR .1 Min .F	Refresh game strategy working memory
	2 INV x = F	Was the condition before the calculator's move a check for calculator's win?
	GO TO 7	Yes, and the winning move was made. Go to end of game loop
	9 Min F	Store end of game (draw) check value
	MR .3 INV x ⩾ F	Was it the last possible move?
	GO TO 7	Yes. Go to end of game loop
	INV 10^x	No. Take antilog of move count
	*(MR 0 + MR .2) =	Multiply by (move made plus current board position)
	INV RND 0	Prepare to display to zero decimal place
	HLT	Stop and display move made, current board positions, and current move count
LBL 1		
	INV ABS INV INT	Opponent's move; take absolute integer of move value
	INV x = 0	Was move entry zero?
	GO TO 9	Yes. Illegal move. Penalise opponent
	Min 0 — MR .5 =	Store move, and subtract 10
	INV x ⩾ 0	Is remainder equal to or greater than zero? (i.e., the move value is 10 or greater)
	GO TO 9	Yes. Illegal move. Penalise opponent
	INV IND MR 0	Recall contents of memory addressed by memory 0
	INV x = 0	Are contents zero?
	GO TO 2	Yes. Move permitted. Go to opponent's move label
	GO TO 9	No. Illegal move. Penalise opponent
LBL 2		
	4 INV IND Min 0	Opponent's move. Store 4 for opponent in memory addressed by memory 0
	1 M+ .3	Increment move counter by 1
	MR 0	Recall move position
	INV 10^x / 2 =	Take (antilog of move divided by 2)
	INV 1/x	Take reciprocal
	M+ .2	Add to board contents memory
	GSB P9	Store move in sequence record
LBL 3		
	MR .3 INV x ⩾ F	Recall move counter (9 is still stored in F) and check for last possible move
	GO TO 7	Yes, it was the last possible move. Go to end of game loop
LBL 4		
	MR .F	No, it wasn't the last possible move. Recall game strategy
	* MR .5 — INV INT	Multiply by 10 and take integer
	Min F	Store integer in F
	= Min .F	Subtract integer from (10 times strategy) and store remaining strategy back in .F
	8 Min 0	Set memory 0 to 8 ready for subroutine calls
LBL 5		
	INV IND GSB 0 =	Call subroutines addressed by memory 0
	INV x = F	Does value returned match contents of memory F ?
	GO TO 6	Yes. Row/column/diagonal in which calculator's move is to be made has been found. Go to label for deciding which position is to be used
	INV DSZ	No. Decrement memory 0. Is value in 0 zero ?
	GO TO 5	No. . Go to beginning of label to try next subroutine
	GO TO 4	Yes. Go to label 4 and try next value in game strategy
LBL 6		
	MR .0	Recall the row/column/diagonal sequence stored by the subroutine which caused a jump to this label
	* MR .5 — INV INT	Multiply by 10 and take integer
	Min 0	Store integer in memory 0
	= Min .0	Subtract integer from (10 times move sequence) and store remainder of sequence back in memory .0
	INV IND MR 0	Recall contents of memory addressed by memory 0
	INV x = 0	Are contents zero ?
	GO TO 0	Yes. Go to label 0 to make calculator's move
	GO TO 6	No. try next in move sequence
LBL 7		
	MR .3	End of game loop. Recall move counter
	INV 10^x	Take antilog
	*(MR 0 + MR .2) =	Multiply by (move made plus current board position)
	INV x↔y	Put result in Y register
	MR F	Recall contents of memory F (contains the value whose matching caused the jump to this label)
LBL 8		
	INV x↔y	Exchange contents of X and Y registers
	INV RND 0	Prepare to display contents of X register to zero decimal place
	INV PAUSE	Pause to display
	GO TO 8	Go to display contents of Y register
LBL 9		
	0 Min 0	Prepare to penalise opponent for attempting illegal move. Store zero in move memory
	GSB P9	Add zero to move sequence record to show that opponent cheated
	GO TO 4	Award move to calculator
P1	.213 Min .0	Store .213 in memory .0; this is the move sequence for the bottom row which will determine which moves the calculator looks at first if the move is to occur in this row. All such sequences give priority to the centre position, followed by the end positions, for each row/column/diagonal
	MR 1 + MR 2 + MR 3	Total value of all moves in the bottom row. The other subroutines follow the same pattern
P2	.546 Min .0	
	MR 4 + MR 5 + MR 6	
P3	.879 Min .0	
	MR 7 + MR 8 + MR 9	
P4	.417 Min .0	
	MR 1 + MR 4 + MR 7	
P5	.528 Min .0	
	MR 2 + MR 5 + MR 8	
P6	.639 Min .0	
	MR 3 + MR 6 + MR 9	
P7	.519 Min .0	
	MR 1 + MR 5 + MR 9	
P8	.537 Min .0	
	MR 3 + MR 5 + MR 7	
P9	MR .4	Recall move sequence made so far
	* MR .5 + MR 0 =	Multiply by 10 and add value from memory 0
	Min .4	Store updated sequence in memory .4

WAVE~MAKING ON A NASCOM 1

Don Finlay of the City University describes a synthesis program which adds fundamental and six harmonics — for use in acoustics demonstrations or in music.

Fourier analysis...

In principle, any repetitive waveform may be analysed into an infinite series of sinewaves. For instance, a squarewave contains a fundamental, a third harmonic which is one third as large as the fundamental, a fifth harmonic one fifth as large, and so on through all the odd harmonics up to infinity, as given by the expression

$$f(x)=\frac{4}{\pi}(\sin x + \frac{\sin 3x}{3} + \frac{\sin 5x}{5} + \ldots)$$

where x = wt, an angle which increases constantly with time t.

The mathematical process for determining the magnitudes and relative phases of the components of any given waveform is generally referred to as Fourier analysis. As with so many mathematical operations, computers are now used to speed the process and display a graph showing harmonic amplitude with frequency. Microprocessors can be used, with algorithms based on the Fast Fourier Transform (1) although they are limited in accuracy and speed. Dedicated instruments in the form of spectrum analysers are more efficient at dealing with continuously varying signals, but are very expensive.

...and synthesis

A process which is generally easier is the inverse of analysis, i.e. synthesis. If we know what harmonic content we need in a given waveform, we can synthesise that waveform by generating and adding together these harmonics. This was the principle of the Hammond organ from its introduction, some 50 years ago: a series of mechanically driven "tonewheels" provided all the frequencies needed for the notes of the scale and their harmonics. Nowadays, sinewaves for synthesis are usually generated electronically, including digitally.

This program enables the owner of a Nascom 1, with a small amount of added memory, to generate a 256-byte waveform table using 2nd, 3rd, 4th, 5th, 6th and 8th harmonics of a sinewave fundamental. The 7th is not used because it is "discordant". The sinewave table is assumed to be already entered into memory, in 2's complement form, in locations 1000H to 10FFH, and the new waveform table is calculated and entered automatically into locations OEOOH to OEFFH. From the latter locations, samples can be taken to play a tune, as I described in December 1979 (2).

The method

Data for the harmonic weightings are entered into locations 1100H to 1106H. These are the relative amplitudes of the required fundamental and six harmonics, in ascending order. The principle of the program is that the first 8-bit sample in the sinewave table is multiplied by the 8-bit weighting of the fundamental, and the 16-bit result stored in locations 110FH and 1110H. Next, a sample one place further on in the table is multiplied by the 2nd harmonic weighting and the result added to the previously stored result. For the nth harmonic, the weighting is multiplied by a sample n places further on in the sine table, and added in. Finally, the sum of all these products is taken from the store and divided by the total weights, so that the result fits within 8 bits again, forming the first new sample. This is repeated, with appropriate pointer increments, for each of the 256 samples required.

It would be possible for the sum to exceed 16 bits if too large a sum of weights were used; for this reason, the total of the weights must not exceed FFH. If the operator disobeys this, an error message is displayed and the program does not run.

Pointers are needed for the new sample (location 1107H) and for the fundamental and each harmonic (1108H to 110EH). The sum of the weights is stored in 1111H, and the 256 samples to be calculated are counted by decrementing from an initial zero stored in 1112H. The pointers must be initialised; if all are initialised to zero, then the resulting waveform consists of sinewaves all starting from zero. If any pointer is set to 40H, then a 90° phase shift is introduced, giving a cosine wave; 80H gives phase inversion and COH gives 270° phase shift. Any phase angle can be allowed for, within the 256-bit resolution for a full cycle.

Execution starts at 1113H. The seven weights are first added and the result tested for excess, as indicated by the labels in the program listing. At label FT8, the pointer for the fundamental, which corresponds to a rank of pipes whose largest is 8 ft long, is loaded into register HL and the corresponding sample is fetched from the address now pointed to by HL and loaded into the E register. The weighting for this sample is fetched from 1100H and loaded into register C. Subroutine MULT is then called; this multiplies the weight and the sample and adds them into temporary store 110FH, 1110H, which is initially set to zero. Since the sample may be 2's complement negative and is stored as an 8-bit number, it's tested and if necessary converted to 16-bit negative by putting FFH into the D register, which holds the more significant byte, with the less significant in E. Normal multiplication to a 16-bit result can then take place.

Similar procedure is followed for the harmonics. Labels FT4, FT2 and FT1 refer to octave-related harmonics in imaginery 4 ft, 2 ft and 1 ft pipes. NASARD indicates the 3rd harmonic, TIERCE the 5th, and LARIGO the 6th; these names come from the builders of pipe (and electronic) organs.

At the end of the FT1 section, the sum of all the harmonic products for one new sample is in store and must be divided by the sum of the weights. Again the number may be negative, so a test is made at label SIGN and if the MSB is high then a jump is made to COMP. This routine complements before and after calling an ordinary subroutine DIV which does long division.

TABLE 1

	HARMONIC							
	Fund.	2nd	3rd	4th	5th	6th	8th	
1100H	8	8	0	0	0	0	0	(0)
1108H	0	40H	0	0	0	0	0	(0)
1110H	(0)	(0)	(0)					

Locations of weights and phases which must be entered before running a program. Initial values shown are for a waveform with only fundamental and 2nd harmonic, with the second harmonic phase-shifted by 90°. Terms in brackets are pointers and temporary stores which are always pre-set to zero.

Running the program

To make use of the program, it's loaded, together with the sine table, into locatons 1000H to 1243H. The sine table is at 1000H to 10FFH; weights, pointers, temporary store and count at 1100H to 1112H; and the program from 1113H to 1243H. Decisions must be made about the weights and phases required. Table 1 makes it easy to keep track of the requirements; it's arranged so that weights and corresponding angles are in columns. As an example, a simple waveform with equal fundamental and 2nd harmonic amplitudes but with the phase of the 2nd harmonic shifted 90° is entered. Executing from 1113H causes the new waveform table to be calculated and entered in about a second (there are 256 sequences each of which includes seven multiplications, seven 16-bit additions and a division).

To see the waveform, a simple program can be devised to output all samples in page 0E consecutively and continuously to a digital to analogue converter, and thence to an oscilloscope. The accompanying photographs were taken using such a program, and the example quoted appears in No. 7.

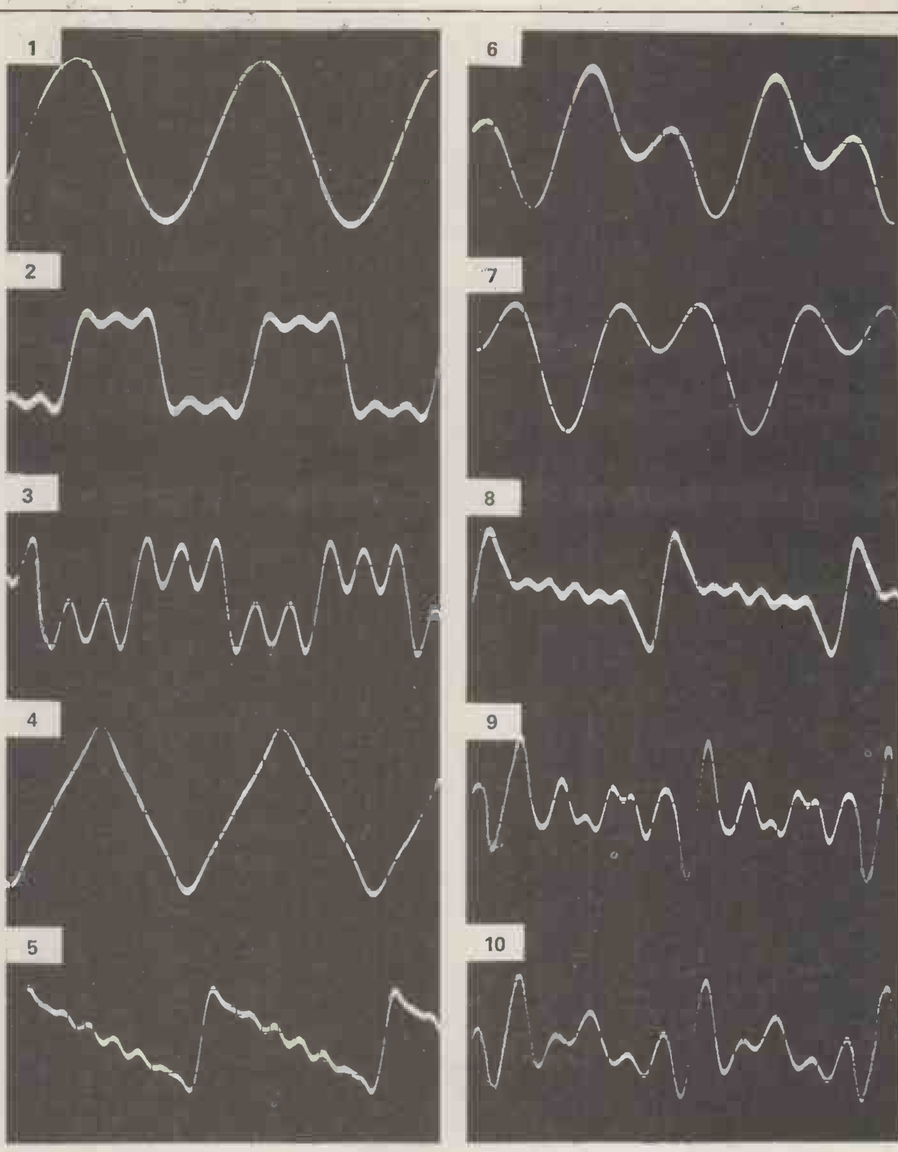
Alternatively, the waveform can be used in my tune-playing programme[2]. To use this program, a further execution from EF79H is needed. However, I found it necessary to shift the frequency and duration data from the area of memory just below 1000H, as the stack operations always corrupted the top of this. This is simply achieved by changing the contents of memory location 0DA0H from 0F to 12, and copying the data, 1E bytes, from a starting address 0FCBH to 12CBH.

Sources of information for waveform synthesis include mathematic texts dealing with Fourier; *The Dictionary of Hammond Organ Stops* by Stephens Irwin (Chappell & Co, 1968); and various numbers of *Computer Music Journal* [3] (available from LP Enterprises, 313 Kingston Road, Ilford, Essex 1G1 1PJ). The Hammond book gives a series of numbers for each voice, representing the amplitude of each harmonic, but these are weighted to give roughly equal increase in loudness for each increment of the setting 0 to 8, i.e. they are logarithmic. A way of interpreting them in this program would be to regard each of the Hammond numbers as a power of $\sqrt{2}$, giving a 3dB increase at each step, or double the amplitude for each 2 steps. Hence the numbers would be converted as follows:

Hammond	Program weight
1	2
2	3
3	4
4	6
5	8
6	11 = 0BH
7	16 = 10H
8	22 = 16H

Many pieces of music arranged for electronic organ have a similar numbering system to the Hammond, and these conversions could be used on them.

The *Computer Music Journal* articles emphasise how inadequate is this synthesis in imitating musical instruments, since each harmonic grows and decays at its own individual rate, and may also



Some demonstration waveforms, obtained by pre-setting the harmonic weighting factors and phases as shown. All other locations between 1100H and 1112H are pre-set to zero. Executing from 1113H enters the waveform table into page 0E, using samples already stored in page 10. A further, simple programme is used to step through page 0E continuously, and output each step to a digital-to-analogue converter. The two flutes can be used to demonstrate the similarity of sound, although the phase of the second harmonic is shifted 90° in the second one. The oboe phase shift was inserted in error!

	WEIGHTS							PHASE
Address	1100	1101	1102	1103	1104	1105	1106	1108 to 110E
1. Sinewave	Any	0	0	0	0	0	0	All 0
2. Squarewave	F	0	5	0	3	0	0	All 0
3. Clarinet	7	0	3	0	5	0	0	All 0
4. Triangle	DD	0	19	0	9	0	0	(110A) ← 80H
5. Ramp	50	28	1B	14	10	0D	0A	All 0
6. Flute	8	8	0	0	0	0	0	All 0
7. Flute	8	8	0	0	0	0	0	(1109) ← 40H
8. Trumpet	C	C	C	9	4	3	3	All 0
9. String	1	3	1	7	5	2	2	All 0
10. Oboe	4	3	5	4	6	1	0	(1109) ← 40H

```
0000'                  0001          ORG 1113H
1113   0607            0002 WGTS     LD B,7
1115   210011          0003          LD HL, 1100H
1118   7D              0004          LD A,L
1119   86              0005 SUM      ADD A,(HL)
111A   3808            0006          JR C, EXCESS
111C   2C              0007          INC L
111D   10FA            0008          DJNZ SUM
111F   321111          0009          LD (1111H),A
1122   1821            0010          JR FT8
1124   EF              0011 EXCESS   RST 28H
```

vary in frequency. In synthesisers, a limited provision is made for this. Perhaps it could be the next step in the development of Nascom-based sound — although some of the waveforms I have generated are not bad imitations of steady, organ-like tones.

References

1. William D. Stanley and Steven J Peterson: "Fast Fourier Transforms on Your Home Computer" (The Byte Book of Computer Music, pp.97-103, Byte Publications Inc. 1979).
2. Don Finlay: "Words and Music by Nascom" (Personal Computer World, Dec. 1979 pp.61-65).
3. James A. Moorer and John Grey: "Lexicon of Analysed Tones" (Computer Music Journal Vol.1 No.2 pp.39-45, violin tones; Vol.1 No.3 pp.12-29, clarinet and oboe tones; Vol.2 No.2 pp 23-31, trumpet tones).

Acknowledgements are due to The City University, as before, for equipment and finance; and to Stan Butler for his invaluable help in photographing the waveforms.

```
1125  45584345     0012        DEFM 'EXCESS
      53532057                 WEIGHTS;
      45494748                 RE-ASSIGN
      54533B20
      52452D41
      53534947
      CE
113E  00           0013        DEFB 0
113F  CD4002       0014        CALL 0240H
1142  C38602       0015        JP 0286H
1145  3A0811       0016 FT8    LD A,(1108H)
1148  6F           0017        LD L,A
1149  2610         0018        LD H,10H
114B  5E           0019        LD E,(HL)
114C  2C           0020        INC L
114D  7D           0021        LD A,L
114E  320811       0022        LD (1108H),A
1151  3A0011       0023        LD A,(1100H)
1154  4F           0024        LD C,A
1155  CD0212       0025        CALL MULT
1158  3A0911       0026 FT4    LD A,(1109H)
115B  6F           0027        LD L,A
115C  2610         0028        LD H,10H
115E  5E           0029        LD E,(HL)
115F  2C           0030        INC L
1160  2C           0031        INC L
1161  7D           0032        LD A,L
1162  320911       0033        LD (1109H),A
1165  3A0111       0034        LD A,(1101H)
1168  4F           0035        LD C,A
1169  CD0212       0036        CALL MULT
116C  3A0A11       0037 NASARD LD A,(110AH)
116F  6F           0038        LD L,A
1170  2610         0039        LD H,10H
1172  5E           0040        LD E,(HL)
```

Program continues on P.124

PET PRINTER PEP-UP

"When I got the new CBM 3022 printer for the PET I found its speed and clarity of print to be a tremendous help in program development. However it wasn't long before I also discovered the printer to be not fully compatible with the PET character set." J. C. Moore continues. . .

If you have tried using the POKE 59468, 14 statement in your programs to allow the use of mixed lower case, upper case and graphics on the screen, you will have found the printer failing to respond. Instead it prints lower case as upper case and upper case as graphics. This, of course, turns listings and printouts into gobbledegook.

The solution is either to rewrite all your existing programs or (and this is the point of the article) to use one of the programs given here to rewrite them automatically. Listing 1 was the first attempt (written in BASIC). Load it first, list it on the screen (it has been made as compact as possible for this purpose), load your own program, and then re-enter the unshift program directly off the screen using the screen editor. Finally, type "RUN 35000" to execute it. To show how things are progressing it will display each line number of your program as it processes it. When tried on a test program of about 700 lines it took 18 minutes to do the job which, although relatively slow, is quite painless!

To achieve a faster result use the assembly language version in Listing 2. This is loaded into the second cassette buffer area of memory. It doesn't display line numbers, it processes the 700 line test program in less than one second (a salutary reminder of the slowness of interpreters).

As the PET has no means of saving binary programs, use the BASIC loader version of the assembly language program given in Listing 3. Load it first, execute it and it will then be available by typing "SYS 826" anytime until you switch the power off.

Both the BASIC and the binary versions work by scanning the program text and removing the shift bit (bit 7) from all characters enclosed between string quotes which represent letters of the alphabet. Graphics obtained from the other keys are untouched as they still print correctly on the printer. The only exceptions to the latter rule are the 4 characters),→,↑ and : (Hex 29, 5F, 7F, 3A) which produce two different graphic characters each — did you know about these? As they are not documented or marked on the keyboard it was decided to ignore them. If you particularly wish to cater for them, you must add the four individual tests to either program.

Finally, having unshifted your program, it only remains to remove any POKE 59468, 14 statements and it will run successfully on both the screen and the printer.

Listing 1

```
70 REM ** THIS PROGRAM WILL UNSHIFT ANY LETTERS BETWEEN STRING QUOTES IN
80 REM ** YOUR PROGRAM. ENTER THIS ONE FIRST. RUN IT, THEN LOAD YOUR
90 REM ** OWN PROGRAM. TYPE SYS 826 TO EXECUTE.
100 DATA162,15,169,2,133,15,169,4,133,16,161,0,208,1,96,230
101 DATA15,208,2,230,16,230,15,208,2,230,16,230,15,208,2,230,16,161,0,208
102 DATA15,230,15,208,2,230,16,230,15,208,2,230,16,76,68,3,201,34,208,227,230
103 DATA15,208,2,230,16,161,0,240,227,201,34,240,213,201,193,144,8,201,219,176
104 DATA4,41,127,129,0,76,114,3
110 FORI=826TO910
120 READJ:POKEI,J:NEXTI
130 END
READY.
```

Listing 2

```
033A  A2  0F          LDX£  POINTERLOW
033C  A9  02          LDA£02
033E  85  0F          STA   POINTERLOW
0340  A9  04          LDA£04
0342  85  10          STA   POINTER HI
0344  A1  00    $3    LDAA(00,X) high byte of link address
0346  D0  01          BNE$4
0348  00              BRK   exit
0349  E6  0F    $4    INC   POINTERLOW
034B  D0  02          BNE   $8
```

Cont. on Page 128

10 PART PASCAL SERIES

THE COMPLETE PASCAL

BY SUE EISENBACH AND CHRIS SADLER

CHAPTER 9: ADVANCED PROGRAMMING TECHNIQUES

In this chapter the PASCAL implementation of a number of powerful programming tools is discussed. The use of these techniques can affect a programmer's style as profoundly as the "structured" control and data structures met earlier in this series.

Introduction

As programmers become more experienced the pressures imposed on them while engaged in program writing begin to resolve themselves. Some of these pressures emerge from the run-time environment where particular restrictions as to memory usage or execution time may require the overall programming strategy to be considerably modified. These pressures are often alleviated by hardware enhancements — like adding more memory or by the availability of such software tools as optimising compilers which reduce the effort required by the programmer to meet the run-time specifications of the program.

Other, more numerous, pressures exist at what might be described as "write-time". These may be imposed by the nature of the problem itself, by the algorithm which enables its solution, or by the syntax of the language in which the program is being written. In this series we have discussed the top-down design approach and shown how it can help the programmer to make a complex problem more manageable. Likewise, the constructs of structured programming can help the programmer to express the solution (i.e. the program) simply and effectively. Finally, we have described how programming languages have evolved to allow these programming philosophies to be formulated in a natural and concise manner, thus reducing these pressures.

Hardware improvements, software tools, sophisticated design techniques and a sympathetic language all contribute towards easing the programmer's load. But programming is still a tricky business that requires planning, concentration and skill and, inevitably, experienced programmers will learn to develop ploys to cut down coding, speed up some forms of manipulation or generally take further action to reduce both the write-time and run-time pressures. In this chapter we discuss a small but popular sample of these techniques — recursion, dynamic data structures and variable field records — and show how PASCAL deals with these. The chief problem, however, is not so much how the language realizes the required constructs, as how the underlying logic can be formulated to take advantage of the elegance or efficiency offered by the indicated technique. Like any skilled accomplishment, these methods will take practice and perserverance and many programmers may (legitimately) decide, after investigation, not to bother. Others may find them familiar or at least interesting. Either way, they complete the major features of PASCAL as a programming language.

Recursive programming

Recursion, or recursive programming is a concept to conjure with. To some it represents the peak of "intellectual" programming while to others it seems like a logical trick or an ineffectual waste of time. The truth must lie between these points of view since, while some desirable or even necessary outcomes are only possible by means of recursive methods, for most applications the result could often have been achieved with less effort and with greater machine efficiency by means of an iterative method. At the same time, however, a language which incorporates the facility to perform recursive algorithms offers an opportunity to produce elegant and concise code which, once the general principles are grasped, is usually more readable than the iterative alternative.

Consider the problem of searching a character string (called SENTENCE, say) for the first occurrence of some particular character (say "space"). Let us say that it will be convenient to write this as a function which returns an integer value equal to the position of the first space in the string, if one exists, and equal to zero if no space exists in the string. The call

I := FIRSTSPACE (SENTENCE)

will initiate the iterative version of the function (Box 1, lines 1 to 11). Tactically the function must search the character positions one-by-one, keeping count of the number of characters inspected and keeping a lookout for the end of the string. The REPEAT-UNTIL construct controls the search, moving from character to character until something happens (i.e. until one of the UNTIL conditions in line 7 is met).

In the second example, (the recursive case, lines 13 to 23), control of the search is handled in a subtly different way. The call

I :=FINDSPACE (SENTENCE, 1)

initiates this version, the constant '1' indicating that the search is to start at the first character position. First note that lines 15 and 18 are testing for the same conditions stipulated in line 7 and that the resulting assignments correspond (i.e. line 9 and 22; line 10 and 20). The search however, is controlled by means of the *recursive* function call in line 19 which has the effect of restarting FINDSPACE but with a modified starting character position HERE + 1 (=2 in the first case).

In an elementary example such as this the similarities between the iterative and recursive techniques are much more evident than the differences. Nevertheless it should be possible to discern the major features of the recursive approach. Firstly, a recursive procedure "calls

①

```
 1: FUNCTION FIRSTSPACE (SENTENCE : STRING) : INTEGER ;
 2: VAR J : INTEGER ;
 3: BEGIN
 4:    J := 0 ;
 5:    REPEAT
 6:       J := J+1
 7:    UNTIL (SENTENCE[J] = ' ') OR (J = LENGTH(SENTENCE)) ;
 8:    IF J = LENGTH(SENTENCE)
 9:    THEN FIRSTSPACE := 0
10:    ELSE FIRSTSPACE := J
11: END ; (FIRSTSPACE)
12:    ...
13: FUNCTION FINDSPACE(SENTENCE:STRING; HERE:INTEGER) : INTEGER ;
14: BEGIN
15:    IF HERE < LENGTH(SENTENCE)
16:    THEN
17:    BEGIN
18:       IF SENTENCE[HERE] <> ' '
19:       THEN FINDSPACE := FINDSPACE(SENTENCE, HERE+1)
20:       ELSE FINDSPACE := HERE
21:    END
22:    ELSE FINDSPACE := 0
23: END ; (FINDSPACE)
```

```
1:PROGRAM ANAGRAM ;
2:VAR I, LENGTH : INTEGER ;
3:    LETTER, NEWWORD : ARRAY [1..10] OF CHAR ;
4:    USED : ARRAY [1..10] OF BOOLEAN ;
5:PROCEDURE PERMUTE (COUNTDOWN : INTEGER) ;
6:VAR J : INTEGER ;
7:BEGIN
8:    IF COUNTDOWN = 0
9:    THEN
10:   BEGIN
11:     WRITELN ;
12:     FOR I := LENGTH DOWNTO 1 DO
13:        WRITE (NEWWORD[I])
14:   END
15:   ELSE
16:   BEGIN
17:      FOR J := 1 TO LENGTH DO
18:      BEGIN
19:         IF NOT USED[J]
20:         THEN
21:         BEGIN
22:            USED[J] := TRUE ;
23:            NEWWORD[COUNTDOWN] := LETTER[J] ;
24:            PERMUTE (COUNTDOWN - 1) ;
25:            USED[J] := FALSE
26:         END
27:      END
28:   END
29:END ; (PERMUTE)
30:BEGIN (MAIN PROGRAM)
31:   WRITE ('Please type in your word --->') ;
32:   READLN ;
33:   I := 0 ;
34:   REPEAT
35:      I := I + 1 ;
36:      USED[I] := FALSE ;
37:      READ (LETTER[I])
38:   UNTIL (I=10) OR EOLN ;
39:   LENGTH := I ;
40:   PERMUTE (LENGTH)
41:END.
```

②

```
PROCEDURE TRYAGAIN (parameter list); FORWARD ;

(*No "body" follows as this is the forward reference*)
PROCEDURE TRY (parameter list);
BEGIN
     IF NOSUCCESS
     THEN TRYAGAIN(parameters)
END ;

PROCEDURE TRYAGAIN ;  (*No parameter list!*)
BEGIN                 (*Body of TRYAGAIN*)
     -
     - (*Some code dealing with NOSUCCESS*)
     -
     TRY(parameters)
END ;

BEGIN  (*Main program*)
     TRY(parameters)
END .
```

③

itself" — (line 19). Programmers often experience a "Russian dolls" feeling when they first encounter this aspect of recursion, the implication being that an infinite sequence of nested procedure calls will ensue. Secondly, however, a recursive procedure always contains an escape clause — so there is a "mole" inside the innermost Russian doll. In FINDSPACE this consists of the different paths indicated by the conditionals on lines 15 and 18. Since these are of exactly the same nature as the loop-terminating conditions in FIRSTSPACE (line 7), the recursion is no more likely to "go infinite" than the loop (although careless programming can always bring this about).

Thirdly, compared with iteration, recursion tends not to produce code which executes particularly efficiently. Every procedure call implies another stack frame and set of local variables loaded onto the stack. This tends to eat up memory and also to slow down the program execution somewhat. On the other hand, recursion can be highly effective at write-time, producing concise, readable code which expresses the underlying algorithm clearly and elegantly. Proponents of recursion claim that recursive algorithms are more "natural" than their alternatives and certainly many mathematical relations may implicitly be expressed in recursive terms. Finally, once a programmer becomes accustomed to thinking along these lines, a recursive procedure is probably more "top-down" than its iterative equivalent in the sense that it usually requires less detailed analysis to realize a precise solution.

At run-time, the recursive mechanism depends heavily on the stack-oriented procedure call, as described in Chapter 7, to control the different levels of recurrence and to ensure the proper returns. Of course the depth of nesting possible depends on how much memory is available for the stack to grow into. Some innocent-looking mathematical recursive algorithms can nest to a fantastic depth very rapidly so that the program runs out of memory and crashes. Languages whose compilers are not so dependent on the stack, especially in the context of its procedure-calling mechanism, do not offer recursive facilities although the determined programmer can usually get away with building his own "software stack" to control the nesting depth and returns.

Program ANAGRAM in Box 2 is an example of a slightly more complex recursive task which would be very messy if tackled with iterative techniques. The idea is to print out every permutation of the letters of a particular input word (<= 10 characters). In the main program (lines 30 — 40) the word is read in and its length calculated. In line 40 the recursive procedure PERMUTE is called. This procedure produces all the permutations before it exits.

The algorithm hinges on the Boolean array USED[ ] which keeps track of which letters have already been used in the current permutation — the letters being held in LETTER[ ] in their original order. The array NEWWORD[ ] is used to accumulate the re-ordered letters one-by-one and the re-ordering is achieved by recursively calling PERMUTE (line 24) until every letter has been used (COUNTDOWN = 0) at which point the escape clause (lines 9-14) is invoked, printing out the current word and exiting. Control then shifts back one level and one element of USED is de-allocated (line 25) and so on until a new permutation can be formed. How far back control must go will depend on the combined states of USED, J and COUNTDOWN but when all the letters have been shuffled around to the original word, control returns to the main program.

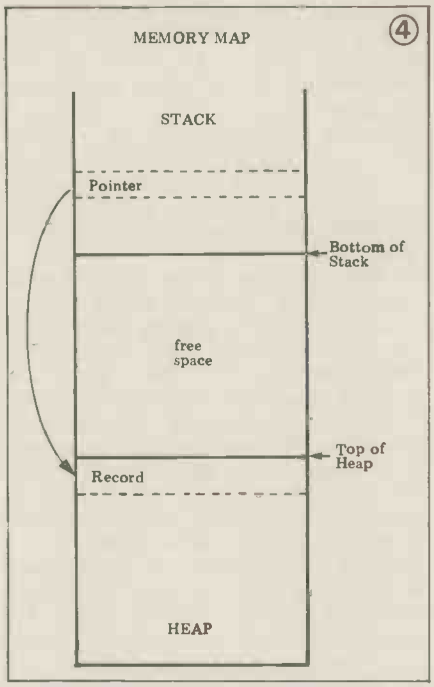
Take the unlikely situation where a procedure is required to call a second procedure which in turn calls the first procedure. Since a procedure can only be called if it is on at most the same level or nested in the calling procedure, the problem here arises as to which procedure to declare first. The remedy lies in the PASCAL facility to make a "dummy" procedure declaration called a *forward reference*. The format of a forward reference is as shown in Box 3.

This ploy provides the compiler with enough information (i.e. the parameter list) to set up that part of the stack frame which deals with communicating beyond the scope of the procedure whilst FORWARD tells the compiler to pick up the rest of the procedure when it is next declared. Although the example is somewhat artificial, the necessity of the forward reference can be seen by considering the reaction of the compiler if the forward reference were omitted.

Exercise: Desk-run PERMUTE on your favourite four letter word. Keep track of NEWWORD, USED, J and COUNTDOWN, especially COUNTDOWN which provides a measure of the depth to which PERMUTE has been called.

Dynamic data structures

At any point in a program the data which is being processed is normally held, either internally or externally, in one of the predefined data structures. Internally, the record is used to associate complex and varied data items together while an array offers the ability to contain a number of similar data items simultaneously and manipulate them at random. In a typical data processing application therefore, the most flexible arrangement is probably an array of records since the bulk of the processing is likely to be concerned with



manipulating matching fields within a group of the records.

This is not as flexible as it might be however. One problem is that the precise number of records needed in memory at run-time is not necessarily known when the program is written and will in any case vary from one run to the next. The programmer must therefore declare the array as large as the maximum number of records likely to be required even though at least some of this space will be wasted on most runs. For this reason, the array is known as a *static* structure. PASCAL is often criticized for not providing for *dynamic* (i.e. run-time) allocation of array space. In fact PASCAL does provide a dynamic data type via the *pointer type*. Instead of some particular variable (say a record) being embedded in the stack, as with other declarations, the pointer type declaration enables a *pointer* variable to be placed in the stack, associating (or *binding)* that pointer to the required data type (i.e. the record). When the record is created (dynamically) the memory locations will be allocated in a region of memory known as the *heap*, and the starting address of the record will be placed in the pointer variable on the stack. The heap is usually located at the bottom of memory while the stack is located at the top. As the program proceeds, the stack and heap grow towards one another, the former as a result of successive procedure calls and secondary processing; the latter as a result of the creation of new dynamic records — see Box 4. If the stack and the heap touch, the program has run out of memory.

The pointer type is declared as follows:

TYPE MARKERS =^DATATYPE

where MARKERS is the name of the pointer type and DATATYPE is the name of the data type — which need not be a record — to be dynamically allocated. The statement

VAR POINTER1, POINTER2,
DUMMY : MARKERS

then *binds* the variable names POINTER1 etc. to the data type DATATYPE. To initialise a pointer variable on the stack, a value NIL is assigned. This is a reserved word indicating that no address in the heap is being pointed to.

A variable of type DATATYPE may then be created by executing the statement

NEW (POINTER1)

at which time the memory locations in the heap will be allocated and their starting address will be placed in POINTER1. Note that the variable has no name of its own and can only be referred to by means of POINTER1 as follows:

POINTER1^.REFNUMBER := 301

assuming that DATATYPE is a record type and that an integer field REFNUMBER has been declared.

In this way, a series of records may be built up in the heap, each of which has its own pointer on the stack through which it may be referenced. If extra pointers have been declared (e.g. DUMMY) then one such record may have more than one pointer pointing to it. So

DUMMY := POINTER1

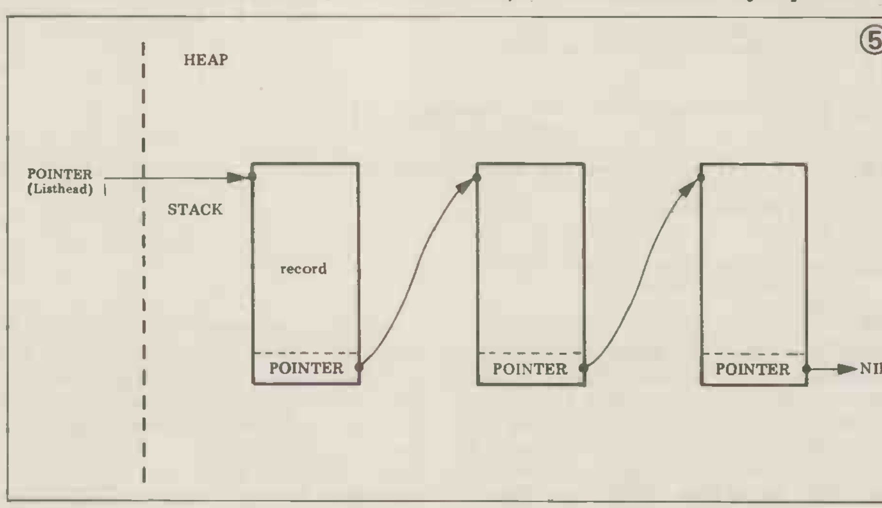
implies that DUMMY^ and POINTER1 refer to the same record on the heap. A record can be de-allocated by

POINTER2 := NIL

which means that the record will become inaccessible even though the space on the heap will stay occupied. The business of clearing up the de-allocated regions of the heap is known as "garbage collection" and is handled so differently, if at all, on the different systems, that we won't discuss it here.

The advantage of this scheme is that different records of the same type can easily be amended, enhanced or sorted into a different order. In a static array a record is accessed by its position in the array (e.g. NUMBER[3] will refer to the third element of an array NUMBER [1. .N]) and if the elements must be re-ordered, or one element eliminated say, a considerable amount of manipulation is required. A dynamic "array", on the other hand, can be created by defining an array of pointers and re-ordered simply by redirecting the pointers. Likewise, one record could be deleted by setting its pointer to NIL without disturbing the other elements at all.

A really powerful application can be brought about by declaring one of the fields *within* the dynamic record as a *pointer type*. By this means, one record in the heap can be set up to reference another record simply by assigning its pointer to the relevant field in the first record. In this way, a *linked list* of records can be built up, consisting of a set of records whose structure (i.e. order) is defined implicitly by the sequence of pointer fields rather than explicitly by some static format arbitrarily declared at compile-time. The last element of the linked list must always have its pointer field set to NIL and the first element (and only the first) will be referenced by a pointer in



6

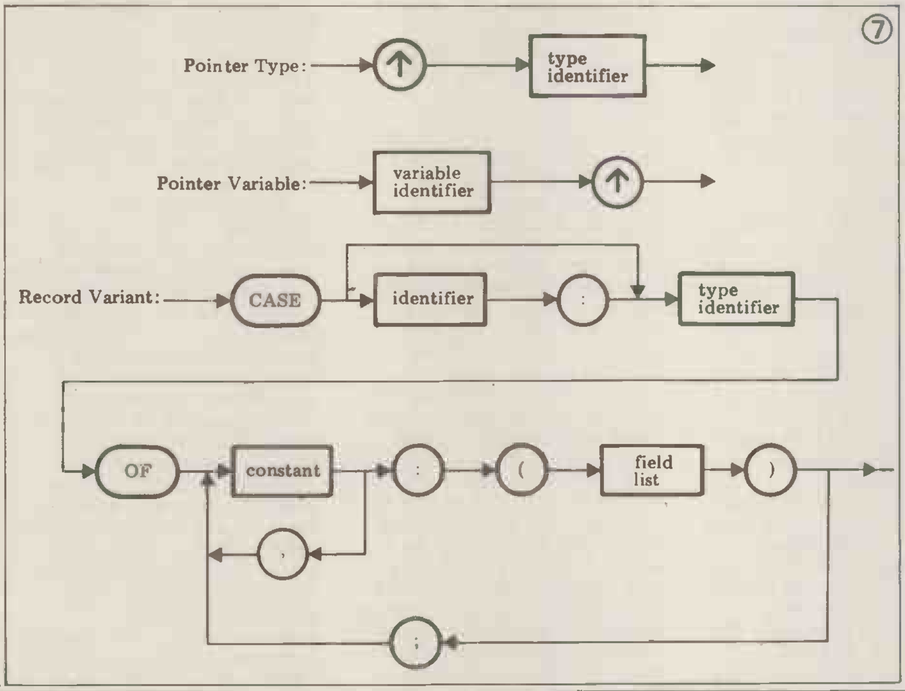
```
PROGRAM ESTATE ;
TYPE DATE = RECORD
        DAY : 1..31 ;
        MONTH : 1..12 ;
        YEAR : INTEGER
      END ; (DATE)
      NAME = PACKED ARRAY [1..20] OF CHAR ;
      OCCUPATION = (VACANT, FILLED) ;
      POINTER = ^FLAT ;
      FAMILY = RECORD
         SURNAME : NAME ;
         SIZE : 1..20
       END ; (FAMILY)
       FLAT = RECORD
          NUMBER : INTEGER ;
        ROOMS : 1.. 10 ;
        NEXT : POINTER ;
        CASE STATUS : OCCUPATION OF
           VACANT  : (LASTDATE : DATE) ;
           FILLED : (TENANTS :FAMILY)
      END ; (FLAT)

VAR FIRSTFILLED, FIRSTFREE, LINK : POINTER ;
    CHOICE : INTEGER ;
    NEWDATE : DATE ;

PROCEDURE STREADLN(VAR N : NAME) ;
VAR I, J : INTEGER ;
BEGIN
```

Box 6 Cont. on P. 130

the stack. Thus one pointer in the stack, sometimes called the *listhead*, grants access to the entire structure of records in the heap — see Box 5.

Instead of continuing with a description of the data-handling capabilities offered by linked lists, we prefer to illustrate these capabilities by means of the sample program ESTATE in Box 6. The purpose of this program is to assist a housing estate manager to keep track of the tenants in a block of flats. Initially, the flats are created as a linked list of records, called FLAT, in the heap. (FLAT is an example of a variant field record which will by fully discussed in the next section.) As flats are allocated to different people, the relevant fields in FLAT are updated, and as families move out the vacant flats are returned to the pool. Thus two linked lists will be maintained — one consists of the empty flats, beginning with the one that has been vacant longest; the second containing the occupied flats in alphabetic order of the tenants surnames. Individual flats will be transferred between these two as the occasion

Cont. on Page 128



Look up table

Computer Jargon
Compile-time / Static
Run-time / Dynamic
Recursion
Forward Reference
Pointer
Heap
Binding
Linked List
Listhead
Garbage Collection
Variant Field Record
Tag Field

Pascal Words
FORWARD
NEW
NIL
ORD

UCSD Exceptions
There is rudimentary garbage collection within the heap by means of standard procedures MARK and RELEASE — see UCSD User Manual.

Exercises:
1. Desk-run ANAGRAM
2. Write procedures to handle communication between linked lists and disc files.
3. Amend ESTATE to fit families into correctly-sized flats.

ACKNOWLEDGEMENTS:
1. LOGITEK — for loan of ALTOS 8000-2 with word-processing facilities.
2. TRANSAM — for CP/M version of TCL PASCAL system.

BOOKFARE

Good programming practice and robots are the diverse subjects that appear under the Malcolm Peltu microscope this month.

So what if it works!

At an international conference in 1977, one of the most respected of computer scientists, Professor Edsger Dijkstra (sic) made a violent attack on hobbyist programmers in general and the BASIC language in particular. At the same conference, a pioneer of data communications techniques, Paul Barran, opined that the standard of hobbyist programming often betters that of so-called professional programmers.

Although these comments seemed to be contradictory, Dr A.N. Walker of Nottingham University pointed out, in a letter to Computer Weekly, that both observations could be true: amateur programmers may be awful but professional ones are even worse. As if this kind of onslaught on their technical abilities was not enough, professional programmers and systems analysts are increasingly being criticised for failing to take organisational and human factors into sufficient account when designing systems.

Two new books make a significant and positive contribution to the debate about programming and systems practice.

The Guide to Good Programming Practice goes to the heart of Professor Dijkstra's criticisms — the need to understand and implement techniques which not only produce programs that work but that are also of a high standard in terms of bug-counts, simplicity of understanding and ease of maintenance. *The Human Side of Information Processing* is a collection of papers which shift the focus of computer systems design from purely technical issues to include wider sociological and psychological factors.

Professor Dijkstra's most popular claim to public fame is that he originated the move towards the software development techniques now known as structured programming. In 1968 he wrote a letter to the journal of the ACM (the American equivalent of the British Computer Society) headed "GOTO statements considered harmful" in which he stated why it was bad practice to use the GOTO statement. This letter triggered off wide discussion in the computer profession which coalesced around a variety of structured programming methods.

However, Dr I. D. Hill of the Medical Research Council, who wrote the section in the Guide on structured programming, credits one of the fathers of Algol, Peter Naur, as the source of the first public analysis of "GOTO-less programming", in 1963. This is not surprising because Algol was designed from scratch as a clear and elegant programming language; it wasn't scraped together in the more cobbled-up, pragmatic style of languages like Cobol, Fortran and dear old BASIC.

As Dr Hill explains, although GOTO became the *cause célèbre*, the main objective of structured programming and good programming practice in general is not directed towards eliminating or promoting any particular instructions or languages. The objective is to produce programs which are as simple and logically lucid as possible, eliminating any clever-clever trick programming, and structuring in such a modular and clearly documented way as to assist in developing and testing and in subsequent maintenance or enhancement.

Professor Dijkstra was "appalled" by the programs he read in the US hobbyist mags (PCW was not around at the time) because they broke the rules of structured programming and because BASIC, which grew in popularity on the back of the personal computer boom, is generally regarded as a poor language for writing elegant code and for handling complex data structures. The hobbyists had put back programming by 25 years, he bitterly commented.

Dr Hill lists seven basic principles of good programming, starting with the avoidance of any tricks . . . never use a complicated method where a simple one will do, is a piece of advice which applies to any language. But some of the other points he makes would be difficult or impossible to carry out fully in BASIC — for example using meaningful names for variables (i.e. more than just A or A1), employing the IF-THEN-ELSE statement which is available in languages like Algol and Pascal, and reducing to a minimum the number of GOTO statements.

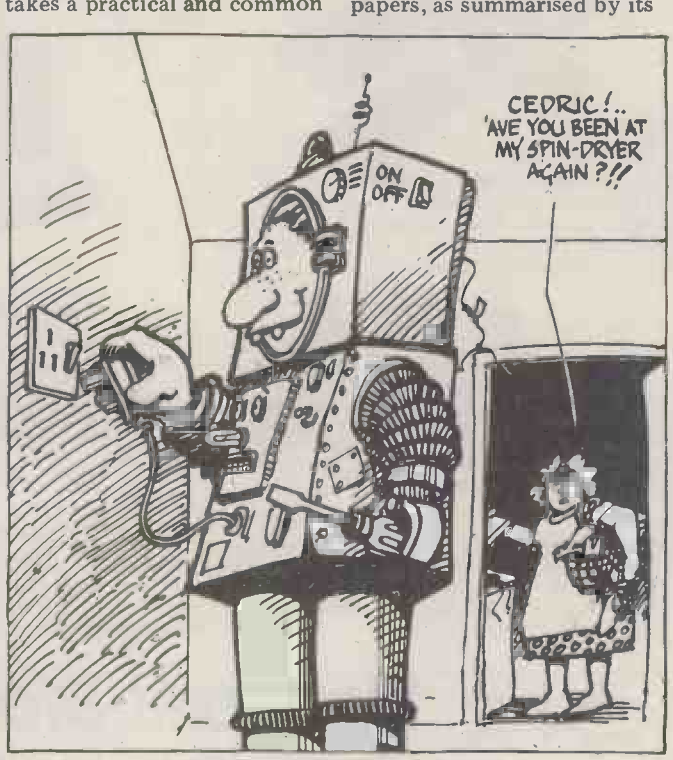
The argument against GOTOs is that they complicate logic flow; it's difficult to understand a program when the flow can't be followed in detail. In a sideswipe at BASIC, he points out that this language provides the most obvious examples of bad logic flow because every statement is numbered and can be gone to from any other line; therefore any clump of code could be entered at any point.

The Guide, which is intelligently edited by Brian Meek of Queen Elizabeth College, London and Patricia Heath of Plymouth Polytechnic, enlists Dr Hill as one of its ten contributors. Although the mixed authorship leads to some variability in the style and clarity/complexity of the descriptions, there is a strong editing hand which ties the sections together and draws general conclusions from detailed examples of particular languages (Algol and Fortran are used most frequently). The editors even point out that the sequence they chose to present the subjects is not necessarily the best one and they provide pointers to other sequences which a reader might prefer to follow.

In addition to structured programming, the Guide take takes a practical and common sense approach to such subjects as program documentation, choosing a language (if you have a choice), working in a programming team, testing and debugging, and improving run-time performance. There are also detailed looks at specialist problems such as heuristic programming (as used in artificial intelligence work) and real-time programs.

By distilling the experience of decades of mainframe and mini programming, the Guide provides a necessary and effective insight into the kinds of techniques that ought to be in-built into everybody's programming style. This would help to avoid the painful period of trial and error when moving from simple educational programs to something more complex that will need to be used and developed over a long period of time. The book also provides further support for the growing popularity of Pascal (although it doesn't push the language explicitly) because Pascal, as a descendant of Algol, falls more in line with the suggested good programming methods than BASIC.

The Human Side of Information Processing is the proceedings of a conference held in Copenhagen in 1978 and lacks the cohesiveness of a strongly directed book like the good programming guide. However, a sound theme does emerge from the papers, as summarised by its



Chris Welch

editor, Niels Bjorn-Anderson of the Copenhagen Business School: "For too long the design of information systems has been treated as a technical problem only. Some benefits have certainly been achieved but the major benefits with this technology lie in the broader perspective."

That broader perspective, according to the book, includes factors as varied as the politics of organisational change, using computers to design more humane working environments, user participation in systems design, the impact of computers on the working class (sic) and the future of systems designers. Inevitably, as a book based on papers given at an international conference, it's heavy going in some parts, particularly as there are some obvious translation boobs. There are also some ghastly poems by the editor at the start of each paper, which rhyme words like Lancashire and bank-cashier (for an article written by Enid Mumford from Manchester on an experiment in systems design at a bank.)

The human factor is being given growing priority in the design of computer systems and the book provides much food for thought. For the professional computer person, a challenging picture is painted with new social responsibilities thrust on to the already pressurised analysts and programmers. And Per Gröholt of the Norwegian Standard Telephone and Cable company goes as far as to suggest that "most so-called 'professionals' in systems design will disappear during the 1980s although a few will remain and become real professionals, i.e. hardware/software experts with an academic background." He believes that computer users will eventually become their own systems designers, taking into account their organisational needs and the wider social and human context.

The user as designer is, of course, a trend that was initiated in the personal computer world, which is one reason why personal computers, with colour TVs, graphics, synthesisers, et al, are so much more "user friendly" than their opposites in the traditional computer business. But if the "amateurs" do inherit the computing earth, I hope that they first read and assimilate the valuable advice offered in these two books.

Oy robot

One of my first robot loves recently made a guest appearance on Wonder Woman. He is called Robby and sci-fi buffs will know that he first appeared in *Forbidden Planet* in 1956. Since then Robby and robots have come a long way.

Now teenagers like Tod Loofbourrow not only build their own computer-controlled robots that can "see" and "hear", they also write DIY books on how to do it. But although Loofbourrow's robot, called Mike and based on a KIM-1, may be very clever, it doesn't have the twirly ears, flashing eyes and chubby arms of Robby.

Anyone interested in a DIY robot will find *How To Build A Computer-Controlled Robot* a good starting point, although some of the US-oriented details are inappropriate to the UK and, anyway, new products have come on to the market since it was published last year that will enhance any Mike look-alikes. Each step in the construction is described in full, from building the metal frame to fitting voice recognition equipment.

But for those who, like me, still enjoy fantasising about human robots, like Wonder Woman herself, a magazine called CineMagic presents a superb alternative DIY robot called ON/OFF, the Wonder Robot! ON/OFF (I wonder if he has any relations with four-letter Christian names) is motivated by human power and the jargon in the detailed guide includes references to rubber gloves and tin-can couplings.

Having twinned a serious book like Loofbourrow's with all this cine-freaking, I will now, Houdini-like, escape from this review with a neat punchline that draws the threads together: Did you know that the name of the forbidden planet on which Robby first appeared was, would you believe, Altair (a name which was of course assigned to the first of the personal computers). Another strange stream of unconsciousness is generated by the thought that the human in Forbidden Planet was called Dr Morbius, which reminds me of a Mobius Strip . . . and Strip makes me think of Wonder. . . oh well!

Featured in Bookfare this month were:
Guide To Good Programming Practice edited by Brian Meek and Patricia Heath (Ellis Horwood/John Wiley, £10.50);
Computer Programming in Basic by Ian Williamson, Rodney Dale and Tim Eiloart (Cambridge Learning Enterprises, Rivermill Lodge, St Ives, £7.50 for four volumes);
How to Build a Computer-controlled Robot by Tod Loofbourrow (Hayden/ Butterworth, £4.80);
CineMagic, (75p, obtained from Dark They Were And Golden Eyed, London);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RANDOM WRITINGS RESUMED

By Michael James

In Random Writings (PCW Vol. 1, No. 10) I consider what a random number is and go on to examine methods of generation. Now, picking up the threads, I move on to deal with some of the uses to which random numbers can be put. Most of the time the text will steer clear of explaining the theoretical foundations of the results; rather I'll just state the useful conclusions. (The more advanced reader might like to consult "further reading" listed at the end). For compactness, the BASIC function RND will be used in all the examples. However, if any of these methods are used for purposes other than game playing, then a good congruential generator should be used (such as the one included in the previous article).

Making things happen

(with a fixed probability)

The most elementary act in any simulation or game is making something happen with a known probability. This is easy given a random number generator supplying uniformly distributed numbers between zero and one. First recall that the words "uniformly distributed between zero and one" mean that *any* number between zero and one is as likely to be produced as any other. Suppose we want an event to happen with a probability of 0.75. If we write:

```
IF RND < .75 THEN "event happens"
```

in a program, then the event will occur 75 percent of the time. The reason is not difficult to see. Simply ask yourself what proportion of the time the random number will fall below 0.75 if it is equally likely to fall anywhere between zero and one. The answer is about three-quarters, ie. 0.75 of the time. In fact the general principle is just as easy to understand:
The *probability* of a uniformly distributed random number falling in any part of the line between zero and one is *equal* to the *length* of that part (see Fig.1).

Thus in general if we want an event to occur with a probability .P then we use:

```
IF RND < .P THEN "event happens"
```

Fig. 1

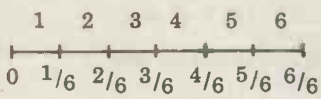
Many happenings

The above method is simple and OK for producing any number of events happening with various probabilities so long as the events are required to be *independent.* For example, a program for the tossing of two (fair) coins would be:

```
10 IF RND < .5 THEN 40
20 PRINT "COIN ONE = TAILS"
30 GOTO 50
40 PRINT "COIN ONE = HEADS"
50 IF RND < .5 THEN 80
60 PRINT "COIN TWO = TAILS"
70 GOTO 10
80 PRINT "COIN TWO = HEADS"
90 GOTO 10
```

However, when a number of dependent events must occur with specified probabilities this simple method will not work. If we were trying to simulate a dice, then only one of the numbers between 1 and 6 must be produced each time and each with the probability 1/6th. To solve this problem we must resort to our general principle. If each digit 1,2,3,4,5,6 is assigned a piece of a line 1/6th of the total length and, if we say that when the random number falls in a number's sixth this number has "come up", we have a dice. For example, we could divide the line up as in Fig.2. If RND falls in the interval 3/6 to 4/6 say, then we have thrown a 4, etc. This satisfies our requirement that only one number is produced at a time and, as the length of each piece of line is one-sixth (and hence is the probability of RND falling there), we have a fair dice.

Fig. 2



A BASIC dice program can now be written. Instead of simply testing, using IF statements, whether RND falls in any given interval, we can use a trick to speed things up. If RND lies in the interval n/6 to (n+1)/6 then RND*6 lies in the interval n to n+1 and INT(RND*6) equals n. Thus INT(RND*6) is either 0,1,2,3,4 or 5 with equal probability one-sixth. In general, to produce random integers from m to n with equal probability, the statement:

```
10 R = INT(RND*(N-M+1)) + M
```

can be used. For example, a dice would use R = INT(RND*6) + 1. In the same way, to produce random numbers uniformly distributed from a to b:

```
10 R = RND*(b-a) + a
```

can be used.

Various distributions

(and un-equal probabilities)

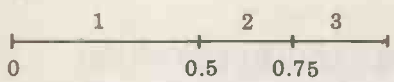
Using the fact that the probability of an event occurring is equal to the length of the part of the line we associate with it, we can see how to make events occur with unequal probabilities. For example a three-sided dice with the probability 0.5 of being 1, 0.25 of being 2 and 0.25 of being 3 can be simulated by dividing the line as shown in Fig. 3. In a BASIC program we would generate a random number and test if it was in the interval 0 to 0.5, 0.5 to 0.75 or 0.75 to 1. In fact this can be done in a simpler way. By asking if RND is less than 0.5 and then if less than 0.75, we can decide which interval it is in. If it is less than 0.5 it is in 1. If not and it's less than 0.75 it's in 2, and if it is not less than 0.75 then it must be in interval 3.

This simple observation gives us a routine way of obtaining *any* unequal probabilities. Given a set of probabilities $p_1, p_2, p_3, \ldots, p_n$, form the set of numbers p_1, $p_1 + p_2$, $p_1 + p_2 + p_3$, $\ldots$, $p_1 + p_2 + p_3 + \ldots + p_n$. Generate a random number. If RND is less than p_1 then event one happens. If not, and it is less than $p_1 + p_2$, then event two happens and so on. (See Fig.5, subroutine 7000.)

Continuous events

Until this point we have been considering a finite collection of separate events. It is possible that we could want to generate a set of random numbers distributed over some range with something other than a uniform probability. This is, in general, a very difficult thing to do. It is possible to give a few methods for the commoner distributions without going into too much theory and a collected list will prove useful to the more advanced or ambitious programmer. (If you don't recognise the distributions named below then it is unlikely that you would even want to use them, so skip to the next section.)

Fig. 3



1. THE NORMAL DISTRIBUTION

As this is a very important distribution two methods are given.

CENTRAL LIMIT THEOREM

```
10 F = SQR(3/N)
20 Z = 0
30 FOR I = 1 TO N
40 Z = Z + RND
50 NEXT I
60 Z = F * (2*Z - N)
```

Z is normal with a mean of zero and a standard deviation of one. N should be chosen between 20 and 50, the accuracy of the approximation improving with larger N.

BOX-MULLER METHOD

```
10 Z = SQR(-2*LOG(RND)) * COS
(3.145*RND)
```

Z is normal with a mean of zero and a standard deviation of one.

2. THE CHI-SQUARED DISTRIBUTION

```
10 X = -2 * LOG(RND)
```

X has a chi-squared distribution with

two degrees of freedom.

10 U = 1
20 FOR I = 1 TO D
30 U = U * RND
40 NEXT I
50 X = −2 * LOG(U)

X has a chi-squared distribution with 2D degrees of freedom. To generate intermediate degrees of freedom use

10 Z = X + Y*Y

where X is chi-squared with 2D degrees of freedom, Y is normal (mean = 0, S.D. = 1) and Z is chi-squared with 2D + 1 degrees of freedom.

3. THE EXPONENTIAL DISTRIBUTION

10 X = − (1/L) * LOG(RND)

X is distributed as 1 − exp(−LX).

4. THE LOGISTIC DISTRIBUTION

10 U = RND
20 X = A − B * LOG((1 − U)/U)

X is distributed as 1 + exp(−(X − A)/B).

5. THE GAMMA DISTRIBUTION

10 U = 1
20 FOR I = 1 TO K
30 U = U * RND
40 NEXT I
50 X = −(1/L) * LOG(U)

X is distributed as

$$\frac{L}{\Gamma(K)} (\lambda X)^{K-1} \exp(-LX)$$

These distributions are the ones most often found in simulations. Others may be obtained from the reference.

I have ignored one very important distribution — the Poisson. The reason is that, unlike the others, the Poisson is concerned with the non-negative integers and is more complicated. The following program gives values of K(=0,1,2,. . .) distributed as $(\exp(-L))L^K/K!$.

10 U = 0
20 K = 0
30 U = U − (1/L) * LOG(RND)
40 IF U > 1 THEN 70
50 K = K + 1
60 GOTO 30
70 rest of program

Improving random number generators

Any random number generator can be improved by shuffling. A typical shuffling alogrithm is:
1. Fill an array of size N with random numbers.
2. Generate an integer random number R in the range 1 to N (see earlier) and swap the contents of the first array element with the Rth.
3. Repeat (2) for each of the array elements until all have been swapped.
4. Use the N random numbers in the array as the next N in the sequence.

A subroutine for shuffling in BASIC is:

```
10    DIM A(N)
5000 FOR I = 1 TO N
5010 A(I) = RND
5020 NEXT I
5030 FOR I = 1 TO N
5040 T = A(I)
5050 R = INT(RND * N) +1
5060 A(I) = A(R)
5070 A(R) = T
5080 NEXT I
5090 RETURN
```

Fig. 5

```
0001 LINE= 200
0005 REM DIFFUSION SIMULATION
0010 DIM B(4),P(4)
0015 REM INPUT BOX SIZE M BY N AND APERTURE SIZE A
0025 REM AND PROBABILITIES
0030 GOSUB 1500
0035 REM CLEAR AND INIALISE VDU
0040 GOSUB 1000
0045 REM MOVE TO ABOUT THE CENTRE OF THE SCREEN
0050 FOR I=1 TO 5
0060 PRINT
0070 NEXT I
0105 REM DRAW BOX
0110 PRINT TAB(10);
0120 R=INT((M-A)/2)
0130 GOSUB 2000
0140 FOR I=1 TO A
0150 PRINT " ";
0160 NEXT I
0170 R=M-R-A+1
0180 GOSUB 2000
0190 PRINT
0200 FOR I=1 TO N
0210 PRINT TAB(10);"*";TAB(10+M);"*"
0220 NEXT I
0230 R=M+1
0240 PRINT TAB(10);
0250 GOSUB 2000
0260 GOSUB 3000
0270 GOSUB 5000
0280 GOSUB 5000
0290 X=M
0300 Y=N
0315 REM SET BOUNDARY FLAGS
0320 GOSUB 9000
0330 T=0
0585 REM START DIFFUSION
0595 REM GET DIRECTION
0600 GOSUB 7000
0610 FOR J=1 TO Z
0615 REM IF ON A BOUNDARY THEN REFLECT DIRECTION IF NECESSARY
0620 GOSUB 8000
0625 REM MOVE CURSOR
0630 ON D GOSUB 3000,6000,4000,5000
0640 IF Y<1 THEN GOTO 700
0645 REM SET BOUNDARY FLAGS
0650 GOSUB 9000
0660 T=T+1
0670 NEXT J
0680 GOTO 600
0700 IF E=1 THEN GOTO 600
0710 GOSUB 3000
0720 Y=Y-1
0730 X=-11
0740 E=1
0750 PRINT "ESCAPE  !!! AFTER ";T;" TIME UNITS"
0760 GOTO 600
0999 END
1000 PRINT CHR$(30);CHR$(19);CHR$(12);
1010 RETURN
1500 PRINT "WIDTH OF BOX";
1510 INPUT M
1520 PRINT "HEIGHT OF BOX";
1530 INPUT N
1540 PRINT "SIZE OF HOLE";
1550 INPUT A
1560 FOR I=1 TO 3
1570 PRINT "PROBABILITY OF MOVING IN DIRECTION ";I;
1580 INPUT P(I)
1590 IF I=1 THEN 1650
1600 P(I)=P(I-1)+P(I)
1650 NEXT I
1660 P(4)=1
1670 IF 1-P(3)<0 THEN GOTO 1560
1680 RETURN
2000 REM SUBROUTINE TO PLOT R *'S IN A LINE
2010 FOR I=1 TO R
2020 PRINT "*";
2030 NEXT I
2040 RETURN
2905 REM SUBROUTINES 3000,4000,5000,6000 MOVE THE CURSOR
2915 REM UP,DOWN,LEFT AND RIGHT  AND ADJUST THE
2925 REM X Y COORDINATES
3000 PRINT CHR$(1);
3010 Y=Y-1
```

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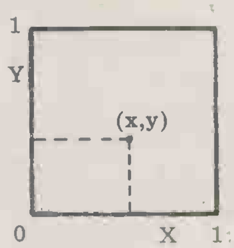
There are many ways of shuffling and the general rule seems to be that the more you shuffle the better the random numbers! Of course the trouble is that shuffling takes time and if you need a lot of random numbers it's probably better to work on the quality of your generator. Even so shuffling can make a very poor generator very good — if in doubt, shuffle!

More than one dimension

Using a random number generator which gives uniformly distributed numbers in the range zero to one to generate coordinates of a point in say two dimensions has its problems. Most people would agree that $X = RND_1$, $Y = RND_2$ would give a pair of numbers which could be interpreted as a point in the unit square (see Fig.4) which was uniformly distributed. That is, every point is as likely to be produced as every other. Unfortunately, and surprisingly, this is *not* so.

Fig. 4



If a random number is generated by any of the usual methods then X, Y will not be uniform over the unit square! There will be regions where *no* points fall. These regions usually take the form of strips and may be clearly seen if random points are plotted on a graphics display device. How important this is depends, as always, on the application. For game playing it can usually be ignored. The point is — do not always expect *pseudo*-random numbers to behave like *truly* random numbers. The solution to the problem seems to be to use *two different* pseudo-random number generators or to use shuffling to produce two separately shuffled streams of numbers.

An example

Finally we come to a simple example. The program listed in Fig.5 simulates, not very seriously it must be admitted, a gas molecule in a box! The molecule collides with other invisible molecules and the walls of the box until it find a hole (of variable size) in the top of the box. Thus the process bears a passing resemblance to diffusion of gas through a hole.

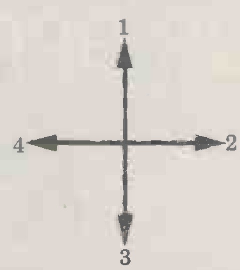
The program actually demonstrates another technique as well as simulation. By using the cursor of a VDU to represent the gas molecule and the cursor up, down, left and right commands to move it, we can produce a moving graphics display. This technique is sometimes known as pseudographics.

The program begins by asking for the size of the box, the size of the hole and the probability of the molecule moving in the various directions shown in Fig.6. The next major part of the program (45 — 250) draws the box on the screen using asterisks. This part

```
3020 RETURN
4000 PRINT CHR$(2);
4010 Y=Y+1
4020 RETURN
5000 PRINT CHR$(4);
5010 X=X-1
5020 RETURN
6000 PRINT CHR$(9);
6010 X=X+1
6020 RETURN
7000 Z=INT(RND*M/2)+1
7010 Q=RND
7020 I=1
7030 IF P(I)>=Q THEN 7400
7040 I=I+1
7050 GOTO 7030
7400 D=I
7410 RETURN
7415 REM SUBROUTINE TO REFLECT DIRECTION IF NECESSARY
8000 IF B(D)=0 THEN RETURN
8010 D=D+2-INT((D+1)/4)*4
8020 RETURN
8095 REM SUBROUTINE 900 SETS BOUNDARY FLAGS B(I)=1 MEANS "ON BOUNDARY I"
9000 FOR I=1 TO 4
9010 B(I)=0
9020 NEXT I
9030 IF X=M THEN B(2)=1
9040 IF X=1 THEN B(4)=1
9050 IF Y=1 THEN B(1)=1
9060 IF Y=N THEN B(3)=1
9070 IF B(1)<>1 THEN RETURN
9080 IF X<INT((M-A)/2) THEN RETURN
9090 IF X>INT((M+A)/2) THEN RETURN
9100 B(1)=0
9200 RETURN
```

is fairly straightforward and produces the box shown in Fig.7, leaving the cursor in the bottom right-hand corner.

Fig. 6



At this point we reach a VDU specific part of the program. Subroutines 3000 to 6000 move the cursor in directions 1 to 4. The control characters which will move the cursor of your own VDU in each direction must be found and substituted in the PRINT CHR$(code) statements.

If you don't know your VDU's cursor control characters, try

```
10 FOR I = 1 TO 128
20 PRINT I, CHR$ (I)
30 FOR J = 1 TO 200
40 NEXT J
50 NEXT I
```

As the program runs each ASCII character will be sent to the VDU — watch for the ones that move the cursor! If the cursor does not move in all the required directions then you cannot use pseudographics on your VDU. (If your VDU has a page and a scroll mode try again in page mode.) Subroutine 1000 must also be adjusted to initialise, i.e. clear, the screen and home up your VDU.

The part of the program that actually simulates the diffusion is 600 to 760. A call to subroutine 7000 gives a random value of Z between 1 and (M/2 + 1) as the distance that the molecule will travel before a collision (unless it hits a wall of course) and a random value of D equal to 1,2,3 or 4 as the direction of motion. Examination of subroutine 7000 will reveal two of the methods we have been discussing. Lines 610 to 670 move the cursor Z places in direction D. After each move, subroutine 9000 is called to discover whether the cursor is on a boundary and, if so, which. Notice that it could be more than one and that the hole does not count as part of boundary one. Subroutine 5000 checks to see whether the next step would take the cursor across the boundary and if so the direction of movement is reversed. The only other function is telling when the molecule passes through the hole and this is achieved by line 640. On leaving the box, the number of moves made is printed as a final result.

The program is not a particularly good simulation of a gas molecule, but it is fun to watch and provides an ideal starting point for a more ambitious program. Even so, the relationship between aperture size and time to escape can be investigated as, say, a classroom exercise. Interesting extensions of the program might include adding more directions and a more realistic distribution (the exponential — see sections on continuous distributions) of times between collisions.

Reference

J.M. Hammersley and D.C. Handscombe, *Monte Carlo Methods*, Methuen

Further reading

Yu. A. Schneider (Ed.), *The Monte Carlo Method*, Pergamon Press, 1966.
R. B. Coates and A. Parkin, *Computer Models in the Social Sciences*, Edward Arnold, 1977.

Fig. 7

```
RUN
WIDTH OF BOX? 40
HEIGHT OF BOX? 10
SIZE OF HOLE? 10
PROBABILITY OF MOVING IN DIRECTION 1 ? .25
PROBABILITY OF MOVING IN DIRECTION 2 ? .25
PROBABILITY OF MOVING IN DIRECTION 3 ? .25

                          Side 4
          **************         **************
          * 00                                *
          *                                   *
          *                                   *
          *                                   *
   Side 3 *                                   * Side 1
          *                                   *
          *                                   *
          *                                   *
          *                                   *
          *                                NM *
          *************************************
READY                     Side 2
#
```

This month Dick Pountain has handed over to reader N. Horwood who relates his experience of using the TI59 with printer for accountancy; the moral being that the calculator can often provide a cost effective alternative to the micro if you make a realistic analysis of the data requirements of your application.

NEW COURSES FOR TEXAN HORSES

I was in two minds when I bought the TI59 some two or three years ago, knowing nothing about programming, but having been involved in a user capacity in industry. Initially I tried to develop programs without the printer, but, except for very short and uncomplicated programs, I found editing and debugging extremely frustrating and time consuming. It wasn't long before I was forced to buy the print cradle which transformed the whole activity of program development. Even so, not being a recently trained mathematician but merely a middle aged Engineer, it took several months of all my spare time to become reasonably fluent in the Texas dialect. I have nothing but praise for the great assistance, patiently given to me by the TI people at Bedford, usually with me on the phone in yards of paper tape, having forgotten to read the excellent manual properly!

Once having gained confidence both in my ability to write useful programs and in the reliability of the machine mechanically and electronically, it occured to me that here was a very powerful device. Admittedly the storage capacity for bulk data was limited, but the logic and arithmetic capacity was of a very high order. I experimented with some simple applications in industrial costing and accountancy and found that by choosing the type of program structure which gave user prompting on the printer (which doubled as result annotation and dealt with the general form of the data processing so that a program was as flexible as possible — thus minimising the need to change magnetic cards for slightly altered requirements) it was possible to use this machine in a commercial context.

There are drawbacks. For example the 20 column printout is a little narrow for traditional layout, and while the printing rate of about two lines per second free running is acceptable, the data transfer rate round logic loops and into the four print registers is slow, and complex programs can be frustrating. There are ways of speeding up loops by using direct addressing, but this is only to be recommended after you are certain that no further changes will be required to the program and where there is plenty of spare space. Another trick is to use any spare data registers for print code instruction storage, thus releasing program space for logic instructions. There's no doubt that commercial type programs use enormous memory space for text, but in spite of these limitations I have been able to apply this machine to a wide variety of office and factory applications.

One of the first of these was my own (self-employed) accounts, incorporating all the requirements for VAT and the Inland Revenue, apportionments etc. Of course the program had to be cleared by the local VAT office, but, believe it or not, they were most helpful. Leading on from this I developed programs for the most used Retailers VAT special schemes, also cleared by the local friendly VAT man for general use. The ability of this machine to provide printed prompts in this type of application is invaluable since the routine is not in daily use, and although the users crib sheet sets out the procedure clearly enough, it's not the same as the point of use prompt. In fact I have found the printed prompt/title easier to use and less strain than most VDUs. It also provides the permanent record of the transaction. Okay, it's long and narrow, but it can easily be folded concertina-wise, and for less than £300 complete (including VAT) it must be good value.

I am not an accountant, although for my sins I have much to do with that fraternity. One of the mysteries associated with the running of any business is the manipulation of the simple figures derived from the purchase and sale of various items or services. The end result has to be a set of accounts. One of the beauties of the "59" is that data as well as program steps can be stored on magnetic cards. This means that data can be input and processed and stored in RAM and then transferred to magnetic card, just like tape or disc. The data may then be saved for future addition or modification. This is possible due to the four way split of the data banks, with each bank independent of the others.

Admittedly relatively small volumes of data can be stored at a time, but even so there is enough to allow a full set of analysed company accounts. The technique is to print and annotate automatically every cash book entry, giving a clear audit trail and hard copy of the input. This can be organised to segregate Capital and Revenue and Dr and Cr in batches of register locations. Program No. 1 carries out the trial balance with full annotation; with the data still intact a second program is overlaid from another magnetic card to produce the Profit and Loss A/C in more or less standard format, and yet another program is overlaid on this data to give the Balance sheet. For presentation purposes a matching set of descriptive headings may be preserved on another magnetic card to suit the user's needs. The whole set can be put together and Xeroxed for filing etc. It looks almost traditional!

One of the side benefits of the wider use of the TI59 has been the development of some "utility" programs which might be of general use. One is what I have called "Auto-Folio". This enables any value to be keyed in, along with its destination register number. Upon entry the value is loaded into that register and summed to what is already there, the value printed together with, on the same line and at the far right of the tape, the register, or folio number. This provides a much more compact listing than the Trace mode which prints everything twice, once before the destination and function code and again after.

The memory capacity allows up to 99 registers to be so addressed, 01 to 99. At the end of a batch of entries a listing routine prints an annotated statement of every register and clears all registers ready for a new batch. It takes about three seconds including printing for each entry to be completed. About the right tempo for the small keyboard and for the type of data analysis commonly required in say a Work Study office or laboratory. This program is shown in detail as it gives the encoding of numerical characters for loading into the No.4 print register. The Nop statements are left in the program in case it is required to speed up the action slightly by converting to direct addressing without having to change the program location numbers.

Another useful method of auto-routing data is to incorporate within a number a two digit code, or a series of two digit codes which may be decoded after splitting out of the original number. The example shown uses standard Op. codes, and can split a number of the form abcdefgh into four pairs, i.e. ab; cd; ef; gh, stored in four data registers ready for use as indirect addresses. There is a more complicated approach available, using the pseudo-Op. code HIR. This utilises the eight "pending result" registers, not normally available to the user except by inference when using nested parentheses. The great advantage in using them in the Code Splitter and similar programs is that precious data registers are not sacrificed in the splitting up process, and may be utilised for the safe storage of working data. However, be warned! There are many pitfalls in using these pseudo-ops., which is probably why they have not been included in the standard manual; however, used with care they increase the capability of this great little machine even further.

Another word of warning. If this machine, or similar magnetic card readers, are to be used more generally in industry, commerce, and schools (as their price level warrants) care must also be taken to ensure that the card reading mechanisms of different machines which have to share families of magnetic cards are matched. I have occasionally needed to adjust the card feed speed of a satellite machine to match the one which originally wrote the program on to the card. This is not

Continued on P. 127

Code Splitter

```
000  76  LBL
001  11  A
002  99  PRT
003  42  STO
004  04  04
005  59  INT
006  48  EXC
007  04  04
008  22  INV
009  59  INT
010  65  ×
011  01  1
012  00  0
013  00  0
014  95  =
015  48  EXC
016  04  04
017  55  ÷
018  01  1
019  00  0
020  00  0
021  95  =
022  42  STO
023  03  03
024  59  INT
025  48  EXC
026  03  03
027  22  INV
028  59  INT
029  65  ×
030  01  1
031  00  0
032  00  0
033  95  =
034  48  EXC
035  03  03
036  55  ÷
037  01  1
038  00  0
039  00  0
040  95  =
041  42  STO
042  02  02
043  22  INV
044  59  INT
045  65  ×
046  01  1
047  00  0
048  00  0
049  95  =
050  48  EXC
051  02  02
052  59  INT
053  42  STO
054  01  01
055  99  PRT
056  43  RCL
057  02  02
058  99  PRT
059  43  RCL
060  03  03
061  99  PRT
062  43  RCL
063  04  04
064  99  PRT
065  98  ADV
066  98  ADV
067  98  ADV
068  91  R/S
069  00  0
```

Press A to enter data.

Press B to list and clear

Sample Output

```
123456.78
       12.
       34.
       56.
       78.

     4.05
       0.
       0.
       4.
       5.
```

AUTO FOLIO

```
000  76  LBL
001  23  LNX
002  65  ×
003  01  1
004  00  0
005  00  0
006  95  =
007  82  HIR
008  32  32
009  82  HIR
010  12  12
011  69  OP
012  04  04
013  22  INV
014  86  STF
015  01  01
016  82  HIR
017  15  15
018  69  OP
019  06  06
020  74  SM*
021  00  00
022  91  R/S
023  76  LBL
024  25  CLR
025  85  +
026  03  3
027  95  =
028  87  IFF
029  01  01
030  23  LNX
031  68  NOP
032  82  HIR
033  02  02
034  76  LBL
035  34  ΓX
036  86  STF
037  01  01
038  82  HIR
039  14  14
040  59  INT
041  61  GTO
042  24  CE
043  68  NOP
044  76  LBL
045  11  A
046  82  HIR
047  05  05
048  91  R/S
049  42  STO
050  00  00
051  55  ÷
052  01  1
053  00  0
054  95  =
055  82  HIR
056  04  04
057  22  INV
058  59  INT
059  65  ×
060  01  1
061  00  0
062  95  =
063  76  LBL
064  24  CE
065  82  HIR
066  03  03
067  07  7
068  32  X:T
069  82  HIR
070  13  13
071  77  GE
072  25  CLR
073  68  NOP
074  85  +
075  01  1
076  95  =
077  87  IFF
078  01  01
079  23  LNX
080  68  NOP
081  82  HIR
082  02  02
083  61  GTO
084  34  ΓX
085  68  NOP
086  76  LBL
087  12  B
088  98  ADV
089  98  ADV
090  01  1
091  22  INV
092  90  LST
093  98  ADV
094  98  ADV
095  98  ADV
096  47  CMS
097  91  R/S
098  00  0
```

Press A to enter data.

Press R/S to enter address

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MIKE ROSE MICROS

From one of our regular contributors, a slightly jaundiced look at how governments attempt to reach their infinitely wise decisions; plus, a warning from Ted Cluff, Secretary-General of the IDPM, on the danger to companies of allowing the uncontrolled acquisition of micros.

Too much monkey business

Here is an idea to while away the dark hours before World War III (if it hasn't already begun by the time this is published).

The object of the game is simple and is well-known to those who drift around the corridors of power. Starting with a hot-potato-issue like "What is to be done about Britain's industrial decline?" each player aims to spend as much time as possible studying the issues to produce answers that are as self-evident as possible but which get the maximum amount of mashed media coverage. I call it the Infinite Wise Monkey game based on that well-known theory that an infinite number of monkeys banging away at an infinite number of typewriters for an infinite time will produce all the works of Shakespeare, Tom Sharpe and Saatchi and Saatchi. Make those monkeys wise and you have commissions galore.

In true modern socio-psychopseudary style, Wise Monkeys is a role playing game — of the "imagine you are king for a day, so how many palaces can you build with a Lego Kit" ilk.

Each player in Wise Monkey chooses a role. Those of a civil service bent can select an obscure sounding but pronouncable acronym, say ACARD, and then suggest it stands for something as modern but uncontroversial as Advisory Council for Applied Research and Development. Such players are represented by a Prime Minister's Ear — to which they have access via Cabinet Office connections. They are also supplied with special Working Party cards which they can shuffle about to create confusion amongst onlookers. These players start with the media handicap of complete facelessness.

More ego-tripping players can take the role of the Big Name in the Big Name Commission, as in the Longford Commission on porno or the Finniston Commission on engineers. These players start off with extra media "high personal profile cards", although they can be trumped by the political "change of government" joker which invalidates all their results if there is new government installed by the time the report is made — or if the new government was elected on a manifesto totally opposed to your conclusions (as in a recent Labour-initiated study of the National Health Service). On the other hand, this political joker can turn to your Big Name advantage if, as with Sir Monty Finniston's commission on engineers, the incoming government decides to take the glory for the last lot's initiative.

Although Wise Monkeys is a game for a large, if not an infinite number of players, some exclusivity must be maintained to separate the know-alls and think-we-knows from the honest don't-knows. So, in addition to playing at Government Working Party or Big Name Commission, those taking part can become Consultants and Pundits. Being a Pundit is a bit like being a banker at Monopoly — you are the focus of attention, your power over pretend (or pretentious) resources gives you status, and you can become involved with the activities of all the other players — the unscrupulous can pocket fortunes under false pretences.

Points in Wise Monkey are awarded for time taken to investigate, study, research and think about the subject, and its resultant media coverage, etc, etc. But the crucial point which must be reached by each player eventually is the Magic Answer to complete that well known phrase "The reason for Britain's decline is . . . . ."

An exciting feature of the game is that ratings vary with time. For example, during the early part of 1979, top points were given for those best sellers "failure to adapt to the micro-electronics revolution" and "too much government interference". However, in the 1980s, with the public still awash with the media Chip Crap, that culminated in the Chip joining Neasden, Talbot and Situations amongst Private Eye's Galaxy of Cliches, any reference to microelectronics in the Magic Answer now leads to the award of two-yawn backsteps while an answer on the lines of "Government's failure to direct/stimulate . . ." could result in a swift budget cutback and an "Do Not Pass Go, Do Not Collect Your Department of Industry £2,000 Consultancy". And as the "too much government" thesis begins to wear threadbare, you get more points by blaming "the people" for failing to swallow their nasty medicine.

For advanced students of Wise Monkeys, the (real) ACARD and Finniston reports provide some interesting insights into shrewd game plays. Way back in early 1978, Jim Callaghan thrust the mantle of glory on to ACARD (which then — as now — was little known). He set up three ACARD working parties; one looked at the industrial and business impact of semiconductors; another at innovation in small businesses and the third at the social impact of technology.

Since then, the Working Party cards have been played with sheer mastery.

Illustration by Conny Jude

The semiconductor study, rudely stimulated by the Horizon Chips film, seemed to break all the rules of Wise Monkeys — it took months not years to do the study and was acted upon immediately, with the setting up of various Department of Industry micro awareness and support schemes backed by millions of pounds.

The once eagerly awaited small business innovation report was silently slipped out by the social impact study, after running the whole gamut of rumours about arguments, suppression, delays because the chairman broke a leg, etc. It received many points for the time it was dragged out, eventually appearing so late in the day that everyone had forgotten about it.

The Finniston report, however, achieved even dizzier heights of successful play. It managed to take a couple of years to discover the same thing that has been found out by other studies in the last 100 years — that British society, led by the Oxbridge/Public School intellectual ethos has failed to give engineers/technologists the status and pay they deserve. The Finniston Commission scored heavily for producing a weighty document to support its self-evident thesis.

There was also a nice end-game ploy. For months (it seemed like years) before the report was published in January, details of the main conclusions were published in the press — for example in New Scientist. Yet when Sir Keith Joseph was interviewed on the day of official publication, he accepted the "urgency" of acting on it but said he had not had a chance to study it yet and needed time for more consultations before announcing a response. Doesn't he read the press, or get his minions to read it for him? And why wait for yet more consultations after such a thorough study? Answers to these questions get no points at all.

Wise Monkeys, like most games, can be ruined by spoil-sports. They point out that the Wise Monkeys, like the Emperor, have no clothes to cover their nakedness and they suggest that one reasonably intelligent, unbiased person, given a month of quiet research, could come up with similar conclusions. And a particularly intelligent person, with experience of the subject and imagination could reach a Magic Answer that was perceptive and original enough to have practical meaning. In 1977, for example, Iann Barron at a conference organised by a British Computer Society group and Computer Weekly gave a paper which succintly analysed the impact of Information Technology and laid out a clear national strategy to deal with it; given the will, the power and the insight, Barron's plan could have been put to effective use in helping Britain get ahead in Information Technology.

The infinite Monkeys thesis, says the spoil-sport, forgets or obscures the simplicity of one person at one typewriter producing works of originality and value. And as American comedian Bob Newhart pointed out on one of his records, when somebody watching one of the infinite monkeys banging away at a keyboard eventually finds something of interest, his report might go along the lines of . . . "Hey, we've really got something with this monkey . . . he's typing . .TO BE . . yeh . . . OR NOT . . . go on boy . . . TO BE, THAT IS THE KRIPST*"DT . . "

Malcolm Peltu

A question of boundaries

To keep one's feet on the ground whilst measuring one's ability to reach up to new levels — that is the problem. Such a surfeit of superlatives has been used in the popular press about micros, lay people can almost be forgiven for believing that problems fly out of the window having merely made a decision to acquire one. The first myth we have to dissipate is that a microcomputer can organise data input by a disorganised person.

I don't know whether it's the micro vendors or the press who are the more to blame for the misconceptions surrounding the new technology's undoubted benefits, but perhaps the message is getting through. One week before the Department of Employment produced a report saying that "micros will cause fewer job losses than feared" a one-day seminar I had hoped to attend on the social implication of micros was cancelled due to lack of support. Presumably no one believes anything is going to happen.

I am on record as being opposed to the marketing of micros as small business systems with very low cost software which cannot possibly be supported and hardly ever has the back-up needed to cater for the inevitable changes in business requirements resulting from growth or legislation. Every day brings more evidence that this warning is necessary if small businesses are not to be jeopardised by their unjustified faith in the efficacy of a system acquired at a much lower price than that charged by houses equipped with the resources to provide the necessary back-up.

There is, however, yet another key area where micros are being oversold — although not necessarily by the vendors. I refer to companies who already have centralised dp installations, some of which have problems of understaffing, or other causes of user dissatisfaction. The view is now widespread that users can achieve Nirvana merely by sneaking a micro in the backdoor without consulting the dp manager; superficially this may even be true.

Continued on Page 125

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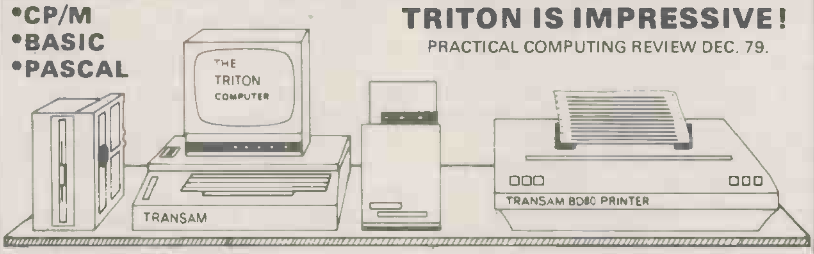

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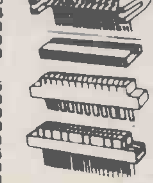

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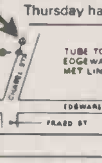

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There's a new name at the top of the page this month. For personal reasons John Coll has decided to stand down (although, happily, he has promised his continued part-time support); stepping into his shoes we welcome Derrick Daines.

Thanks

Those of us who know John Coll are aware of the tremendous pioneering work he has put in over the years to lift computer education off the ground in all sorts of ways. Thousands of youngsters were first introduced to the computer by John and Charles Sweeten, and many of them have grown up to join the computer industry. There must be quite a number of successful young business men in computing today who owe a lot to John's inspiration. He is quite a guy to follow and I just hope that I will be able to do nearly as well. In taking over from him, I must say that I find it a comfort to know that he is only as far away as the nearest telephone. Thanks, John — and keep taking the tablets!

Installations

Once I had agreed to join YCW (and the editor had taken his foot off my neck), one of the things that he gave me to look at was the report from Mr. Hemmings about the mother-and-daughter computer system they've got running in Sandbach High School. It looks a great idea to me and neatly solves several problems at once. Look out for a report next month.

The installation is a real step up with the added advantage that there's little necessity for hardware uniformity. In theory at least, any micro could talk to any other, with software taking care of translation problems. This thought brings in its train a whole lot of other questions that I would like your views on. For instance, given a certain amount of cash to spend on school computing — and Heaven knows, there 's little of it — would it be better to have three or four identical microcomputers, the same number of different kinds of computer, or one large machine? With recent new hardware and price reductions, more and more schools will be in the happy position of making this sort of decision; I'd like to hear, not only from young readers, but also their teachers, many of whom will be trying to make up their minds on this very point.

Competition

Would you like a badge or tee-shirt that tells those in the know that you're a computer freak? I'm sure that many would. Well, here's your chance. I'm after designs for a YCW logo and I'll give book tokens for the best. The winning design will appear monthly at the top of this page and we'll get somebody to make us a supply of metal badges for sale at cost — hopefully tee-shirts, too. Just think, your design could be the one that everybody's wearing!

I don't much mind what you put in your design, but it should convey something of what it's all about — computing — and, of course, it must look good. Don't worry too much if your artwork is poor — we've got some tame artists on the staff who can tidy it up. Oh, and since metal badges are usually circular, I suppose your logo design ought to be circular, too. Get doodling — I'll close the competition in a couple of months.

Him~um~her

You'll probably notice in my writing that I tend to assume my readers to be "hims", whereas they could just as well be "hers". It's YOUR fault, girls; you don't write in! Are there any girls out there? I want to hear from you, too! I know girls ARE interested in computing — I see them in their hundreds, tapping away at consoles all round the country — but they never get in touch. Now that's a pity because I just don't believe that good ideas spring only from boys' minds; girls are just as clever. Perhaps they'll prove it in our competition.

Programs

Keep 'em rolling in! We'll give book tokens for all small programs published in connection with this page and super ones will qualify for publication at normal rates — which can't be bad. Of course, we don't undertake to publish all those that we receive, but we'll do our best.

An example of this policy at work is this month's teleprinter/printer conversion article by Tim Steele. Tim is only 16 and a pupil at Solihull School. He originally submitted his article to this page, but it's so good that it deserves a wider audience; so it gets "the treatment" and Tim gets a fat cheque. Well done, Tim!

Another program deserving of a wider audience was sent in by D.J. Danziger of Manchester Grammar School. This is a BASIC renumber package running to five pages — representing an awful lot of work by its author. We're having it rewritten in the more common Microsoft BASIC so that more of you will be able to use it when it's published.

PROGRAMS RECEIVED
SNAP — by Paul Bowden of Truro (11)
BASE CONVERSION — by Jonathan Roberts of Ilford (15)
WORD PROCESSOR — by Tony Hailes of Camberley (15)
EQUATION PROGRAM, GAMBLING — by Mark Taylor of Leeds (15)
MAZE GAME — by A Stirges of Wolverhampton (15)
ALIEN INVADERS — by T Carter of London (17)
NUMBER GUESSING, MEMORY CLEARER — by Richard Powell of Coventry (13)

Thanks a bunch to all of you! Take a look at the program listings to see which the editor has managed to get in this issue!

SIMPLE WORD PROCESSOR — by Tony Hailes

```
10 CLEAR4500
11 PRINTTAB(10);"SIMPLE WORD PROCESSER"
12 PRINT
15 DIMA$(100)
16 FORA=1TO5:READA1:NEXT
17 FORA=0TO14
19 READA1
20 POKEA,A1
21 NEXTA
25 DATA76,80,65,70,67
27 DATA245,253,126,61,246,128,253,119,69,211,254,241,195,18,224
45 PRINT"TYPE IN YOUR TEXT, EACH LINE STARTING WITH A ";CHR$(34)
;".
46 PRINT"AT THE END OF EACH LINE, PRESS RETURN."
47 PRINT"WHEN YOU HAVE FINISHED, TYPE [END] ."
50 N=N+1
60 INPUTA$(N)
80 IF A$(N)<>"[END]"THEN50
85 N=N-1
90 PRINT:PRINT:PRINT
100 PRINT"YOUR LETTER....."
110 PRINT
115 PRINT"LINE"
120 FORA=1TON
130 PRINTA;CHR$(34);A$(A)
140 NEXTA
150 PRINT
160 PRINT"________________________________________________________
"
______
161 PRINT
165 IFB=1THEN240
170 PRINT:PRINT"EDITING."
180 PRINT"COMMANDS:"
190 PRINT:PRINT"LIST - TO LIST LETTER"
200 PRINT"PRINT - TO PRINT LETTER ON PRINTER"
210 PRINT"<LINE NUMBER> - TO CHANGE THAT LINE"
211 PRINT"-<LINE NUMBER> - TO DELETE THAT LINE"
212 PRINT"<LINE NUMBER>+0.5 - TO INSERT A LINE"
213 PRINT"ADD - TO ADD LINES ONTO THE END"
214 PRINT"FIND - FINDS ANY SEARCH STRING IN THE TEXT"
215 PRINT"CHANGE - TO INSERT OR DELETE ANYTHING IN ONE LINE"
220 PRINT
230 B=1
240 INPUT"COMMAND";A$
250 A=VAL(A$)
```

Program Cont. on Page 126

Personal Computer World

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Volume 1 No. 8 December 1978 Computers and Art/3-D Noughts and Crosses/Mickie — the interviewing micro.

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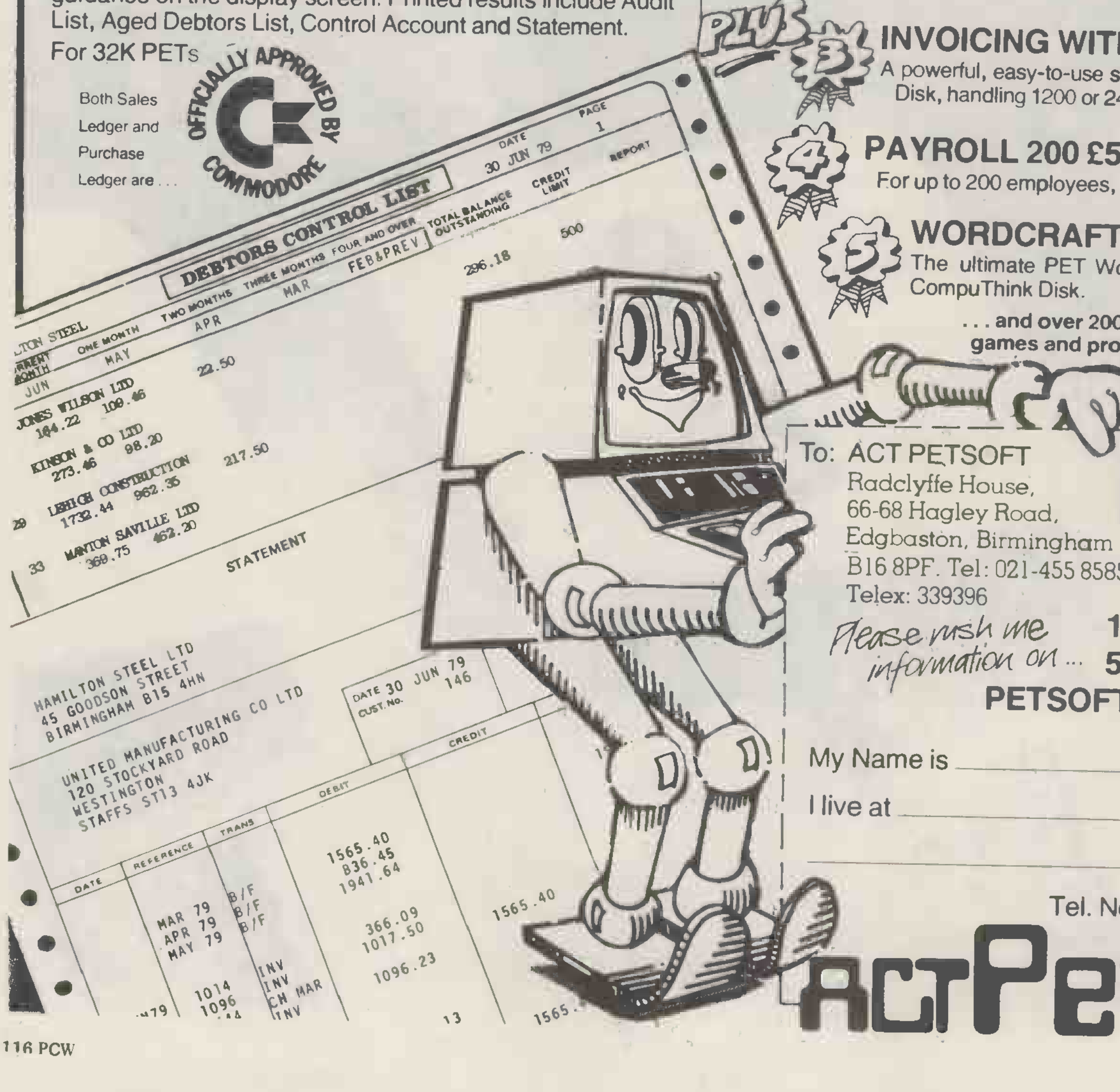

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Act System 800 (£3950)	ACT: 021-455 8585 (50)	48K RAM: 6502: dual 5¼" F/D (800K): 12", 30x64 VDU: 1 S/P: 1 P/P	MDOS: BASIC: A: PL/M: Fifth	Fully IBM compatible K/B: high resolution graphics: available with dual 8" F/D (2.4MB), £4950: (E)
Alpha Micro (£8,200)	Alpha Micro (UK) Ltd 01-250 1616 (TBA)	64K-16M RAM: 16 bit: dual 8" F/D (2.4MB): 6 S/P: modular	multi-user O/S: BASIC: M/A: Pascal: U	Expands to 1200 MB, 32 terminal system: (E)
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Billings BC-12FD (£4,295)	Mitech: 04862 23131 (TBA)	64K RAM: Z80A: dual 5" F/D (640K): 12", 24x80 b&w VDU	DOS: BASIC: *Fortran: Cobol: A*	8" F/D (2MB) to replace 5", £6,000: additional dual 8" F/D, £2,750 (S)
Canon BX-1 (£3,850)	Canon Business Machines (UK) Ltd: 01-680 7700	64K RAM: 6800: Single 5¼" F/D (65K): 12", 25x80 VDU: 5xV24 ports: options — single 5¼" F/D (65K), £1,500	DOS: ExBASIC: *A*:	Also supplied with integral thermal printer instead of VDU: (S&H)
CBS Mk 2&3 (£5900;£8648)	Compelec: 01-636 1392 (N/A)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 VDU; 132 col, 30 cps printer: 2 S/P: 1 P/P	CP/M: BASIC	Mk. 2 with 2MB F/D, £5,900. Can upgrade to Mk.3 — £8,150 (11MB H/D and 4 more S/Ps): Desk mounted: Up to 44MB H/D possible, £4,529 extra: multi user system with 208K RAM, £10,648: (S&H)
Challenger 1P & C2 (1P, £238; C2, £404)	CTS: 0706 79332: MBM: 01-980 3993. Mutek: 0225 743289. Millbank Computing: 01-549 7262. U-Microcomputers: 0606 853390. Byte Shop: 01-518 1414	4-32K RAM: 6502: C int: RS232 port:	O/S: BASIC: A: *ExBASIC*	D/A conv: col capability: 8K microsoft BASIC in ROM: option — dual 5¼" F/D (160K), £550: for C2, dual 8" F/D (1.15MB) and 20MB H/D: runs OSI business software on 8" F/D. (S)
Challenger C3 (£2,334)	As above	32-56K RAM: 6502, 6800, Z80: dual 8" F/D (1.15MB): 2-16 S/P	OS65U: BASIC: *CP/M: Fortran: Cobol*	Also C3B & C3P H/D modules: 74MB for about £10,000: (S&H)
Comma VO3 (£4,200)	Comma: 0277 811131: (N/A)	32K RAM: LSI 11: dual 8" F/D (512K): 4 serial DLU11S ports: modular	*RT11 O/S (£750): BASIC: Cobol: Fortran*	Many configurations possible: (H)
Compucolor II (£998)	Abacus: 01-580 8841: (6)	8-32K RAM: 8086: 13", 32x64 8-colour VDU: single 5¼" F/D (51K): RS232 port	ExBASIC (ROM): A	16K module, £1,078: 34K, £1,209: maintenance and programming manual available: (I)
Compucorp 625 (£6,000)	Compucorp: 01-952 7860: (17)	60K RAM: Z80: dual 5¼" F/D (700K): 9", 16x80 b&w VDU: 40 cps printer: 1 RS232 port	A: BASIC: U	Also 655 model with 320K F/D capability and 12", 20x80 VDU — £4,345 (B)
Comp Workshop System 1 (£1,600)	Comp Workshop: 01-491 7507 (N/A)	32K RAM: dual 5¼" F/D (170K): 9", 16x64 b&W VDU: modular	A: BASIC: Fortran: Flex: Pascal: Pilot	This is an example configuration from a fully compatible modular range: (E)
Cromemco System 2, System Z2H, System 3 (£1,995/£4,998/£3,293)	Comart: 0480 215005; Datron: 0742 585490; Microcentre: 031 225 2022 (20)	64K RAM: Z80: dual 5¼" F/D (346K) Sys 2 and Z2H... dual 8" F/D (1.24MB) Sys. 3: S/P: P/P	CDOS: *BASIC: Cobol: Fortran; Multi-user BASIC: A:*	All systems expandable to multi-user (2—7 users), £3,455 £6,400: 11 and 22MB options: also dual 8" F/D (996K) on Sys. 2 and 3: (E)
DAI (£998 48K version)	Data Applications (UK): 0285 2588 (TBA)	12-48K RAM: 8080: C int: 24x60 VDU int: RS232 port: Over 20 industrial ints: 2 C ints	BASIC (ROM): U (ROM)	Up to 255x335 resolution graphics: 3 notes and noise generator: PAL output to TV: games paddle
Diablo 3000 (£9450)	Business Computers Ltd: 01-207 3344 (TBA)	32K RAM: 8085: dual 8" F/D (1.2MB):12", 24 x 80 b&w VDU: 45cps printer	DOS: DACL: A: U:	Selection of business packages supplied in price: (S)
Digital Microsystem DSC-2 (£5,395)	Modata: 0892 39591 (TBA)	64K RAM: Z80: dual 8" F/D (2.28MB): 4 RS232 ports: EIA port	CP/M: BASIC-E: *CBASIC: Cobol Fortran: Pascal*	Up to 6 additional F/D units possible: (H)
Durango F-85 (£8,250)	Comp Ancillaries: 07843 6455 (12)	64K RAM: 8085: dual 5¼ F/D (1MB): 9", 16x64 green VDU: 132 col 165 cps printer: N/P	*O/S: DBASIC*	Takes up to 5 work stations: fully integrated system: options — additional dual 5¼" F/D (1MB) and 12 MB H/D: (S)
Dynabyte DB8/1 (£1,500)	Dynabyte UK/Europe Ltd: 0723 65559 (6)	32-64K RAM: Z80: S100 bus: 2 RS232 ports: 1 P/P	CP/M: BASIC: Cobol: *Pascal*	Expands to multi-user system: option — dual 8" F/D (1MB), £2,000: also DB8/2 with dual 5¼" F/D (400K), £3,000 (E)
Equinox 200 (£7,500)	Equinox: 01-739 2387 (N/A)	64-256K RAM: Z80: 10MB H/D: 1 S/P: 1 P/P	CP/M: CBASIC: *cobol: Fortran:*	Multi-user MVT/FAMOS available in place of CP/M: (S/H)

List of Abbreviations

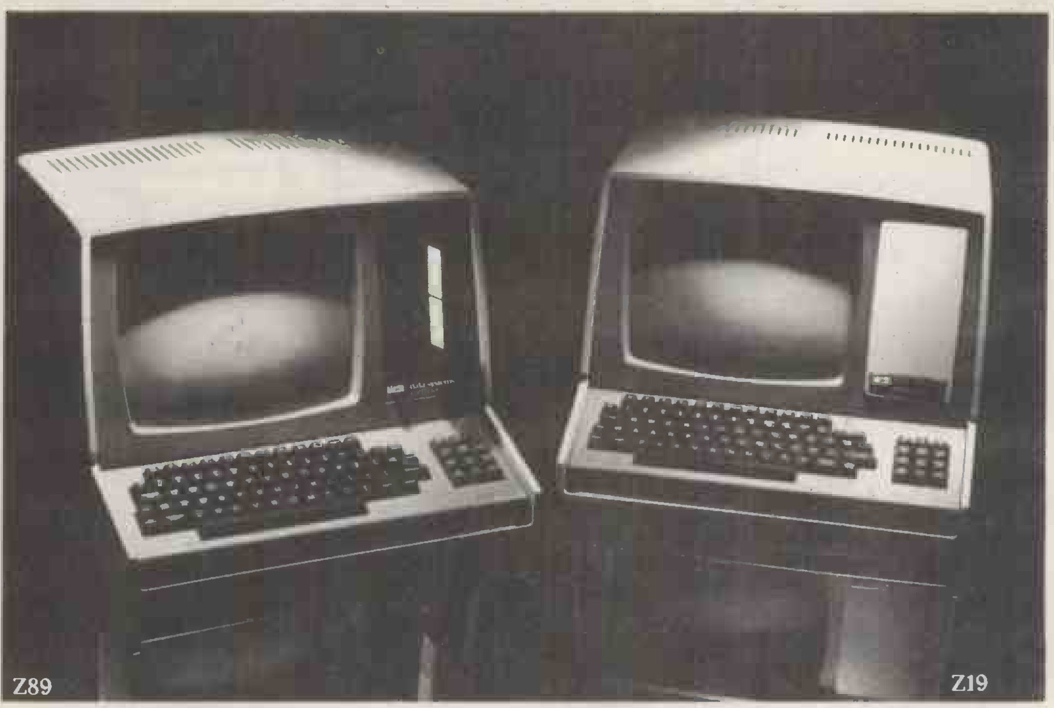
A	Assembler	F/D	Floppy disc	M/A	Macro assembler	S/P	Serial port
B	BASIC	G/C	Graphics card	N/A	Not available	T/E	Text editor
C	Cassette	H	Hardware	N/P	Numeric pad	TBA	To be announced
E	Extensive	H/D	Hard disc	O/S	Operating system	U	Utility
		I	Introductory	P/P	Parallel port		
		Int	Interface	S	Software		

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

DIRECT ACCESS

IN STORE

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software	Miscellaneous (Documentation)
Euroc (£7,995)	Eurocalc Ltd: 01-405 3113 (TBA)	64K RAM: 8080A: dual 8" F/D (1MB): 15", 25x80 b&w VDU: 132 col 140cps printer	CP/M: CBASIC: A: U:	A year's maintenance and stationery supply inc: (S)
Executive Minicomputer	Binatone 01-903 5211	See Video Genie		
Exidy Sorcerer (£650)	Liveport Data Products 0736 798157 (27)	8-32K RAM: Z80: RS232: 1 P/P: S100 connector: 30 x 64 VDU I/O	O/S: ExBASIC (ROM): *Editor: A: CP/M: Algol: Fortran*	High res graphics capability: 16K version, £760: 32K £859: 48K, £960: option — dual 5¼" F/D (630K), £1,200: User programmable character set: (I)
HP 85 (£2,240)	Hewlett Packard Ltd: 0734 784774 (16)	16-32K RAM: C.P.U.: 5" 16x32 b&w VDU: C (200K): 64 cps printer: RS232 port: 4 P/P	BASIC:	Full dot matrix graphics: N/P: compact portable unit: (S)
IMS 5000 (£1,935)	Equinox: 01-739 2387 (20)	32-64K RAM: Z80: dual 5¼" F/D (320K)	CP/M: CBASIC: *Cobol: Fortran:*	3 drives option: (S&H)
IMS 8000 (£3,515)	As above	64-256K RAM: Z80: dual 8" F/D (1MB)	CP/M: CBASIC: *Cobol: Fortran: MicroCOBOL*	Multi-user MVT/FAMOS available in place of CP/M: (S&H)
IMSAI VDP 42 (£3,900)	Computermarket: 0603 615089 (TBA)	32-64K RAM: 8085: dual 5¼" F/D (400K): 9", 24x80 b&w VDU: 1 S/P: 1 P/P	IMDOS (CP/M comp): A: ExBASIC: U: *CBASIC: Cobol: Fortran*	Supports 8 additional F/D drives: also available, VDP 44 with F/D (780K), £4,400: (H)
IMSAI VDP 80 (£6,200)	As above	32-64K RAM: 8085: dual 8" F/D (1.2MB): 12", 24x80 b&w VDU: 1 S/P: 1 P/P	IMDOS: A: ExBASIC: U: *CBASIC: Cobol: Fortran*	(H)
ITT 2020 (£867)	ITT: 0268 3040 (15)	16-48K RAM: 6502	Monitor: A: ExBASIC: Dis A:	360x192 high res graphics: ExBASIC in 6K ROM: options — single 5¼" F/D (116K), £425; 16K RAM, £110; RS232 port, £96: 32K system, £931: 48K system, £995: (B)
LSI M-One (£5995)	LSI Computers: 04862 23411	8K RAM: 8080: dual 8" F/D (1.2MB): 12", 24 x 80 b&w VDU	FMOS: A	A choice of standard business package included in price: (S)
LSI M-One Model 5 (£9900)	As above	16K RAM: 8080: dual 8" F/D (2.4MB): 2x12", 24x80 VDU's: 120cps bidirectional printer	FMOS: A	One of the VDU's is for inquiry only: (S)
LX-500 (£3,500)	Logabax Ltd: 01 965 0061 (13)	32K RAM: Z80: dual 5¼" F/D (180K): 12" 25x80 b&w VDU: 100cps printer	DOS: BASIC: A	Other printers available: (S)
Megamicro (£6.080)	Bytronics: 0252 726814 (5)	256K: 8080A: dual 8" F/D (1MB): 12", 20x80 b&w VDU: 120cps printer: 2 S/P: 2 P/P	CP/M: U	(H&B)
Microstar 45 Plus (£4800)	Microsense; 0442 41191 (30)	64K RAM: 8085: dual 8" F/D (1.2MB): 3 S/P: RS232 port	STARDOS: CP/M: BASIC: Cobol: Fortran	(E)
MSI 6800 (£1,203)	Strumech: 05433 4321 (5)	16K RAM: 6800: C: 9", 16x64 b&w VDU: 1 S/P	BASIC: Mini A: U	Up to 8 serial or parallel ints possible: (S&H)
MSI 6800 System 1 (£2,175)	As above	32K RAM: 6800: dual 5¼" F/D (160K): 9" 16x24 b&w VDU: 1 RS232 port	DOS: BASIC: U: *A: Fortran*	As above: option — dual 8" F/D (624K), £1,640: (S&H)
MSI 6800 System 2 (£7,500)	As above	56K RAM: 6800: single 8" F/D (312K): 10MB H/D: RS232 port: 9", 16x64 b&w VDU	DOS: BASIC: Multi-user BASIC: A	Rack mounted: options — dual 8" F/D (624K), £1,640; 10MB H/D, £4,250: (S&H)
MSI System 7 (£5,200)	As above	56K RAM: 6800: dual 5¼" F/D (640K): 9", 16x24 VDU: 1 P/P	DOS: BASIC: A	Choice of FDOS, SDOS or Flex: also option — 10MB H/D: (H&S)
Nanocomputer (£420)	Midwich: Waltham Cross 29310 (TBA)	4K RAM: 2K ROM: Z80: C int: 8 digit LED: K/B: RS232 port: 4 P/P	Machine language: *BASIC: A: T/E:*	Designed for hardware education: expandable to 64K RAM system with F/D: (E)
North Star Horizon (48K, £4,650)	Comart: 0480 215005; Comma: 0277 811131; Equinox: 01-739 2387 (20)	24-56K RAM: Z80A: dual 5¼" F/D (360K): 15", 24x80 b&w VDU: 150 cps printer: 2 1 P/P	DOS: BASIC: *CP/M Cobol: Fortran: Pascal*	(E)
Oxford Minicomputer	Binatone 01-903 5211	See Video Genie		
Panasonic JD740U; JD840U (£4550, £5500)	Teletronix: 01-262 3121 (10)	56K RAM: 8085A: 2-4K PROM: dual 5¼" F/D (570K) JD740U: dual 8" F/D (2MB) JD840U: 12", 24 x 80 b&g VDU: 3xRS232 ports.	CP/M: BASIC: *Microcobol*	Also available — JD700U with 140K disc capacity, £4175; JD800U with ½ MB disc, £4750
Pascal Microengine (£2,080)	Pronto: 01-599 3041 (TBA)	64K RAM: MCP 1600: 2 RS232 ports: 2P/P: options — dual 5¼" F/D (1MB), £1550: dual 8" F/D (2MB), £1950	BASIC: Pascal	CPU has user written word set:
Periflex 630/48; 1024/64 (£2500; £3300)	Sintrom:0734 85464 (5)	48K RAM, 630/48: 64K RAM; 1024/64: Z80: dual 5¼" F/D (630K), 630/48: dual 8" F/D (1MB), 1024/64: 2xRS232 ports: 1 P/P: Options — dual 5¼" F/D (630K) £859; dual 8" F/D (1MB) £1025	CP/M: *BASIC: Fortran: Cobol: A*	One day installation training on site included in price (S&H)
PET 8K,16K & 32K (£550, £675 & £795)	Commodore: 01-388 5702 (150)	8-32K RAM: 6502: C: 9" 25x40 VDU: IEEE488 port	O/S: BASIC: A: *Forth Pilot:*	BASIC in 8K ROM: options — dual 5¼" F/D (353K), £795; same, but (800K), £995, plus, with the 2001-8, £30 for the disc operating ROM: (I)
Powerhouse 2 (£1,175)	Powerhouse Micros: 0422 48422 (TBA)	32-64K RAM: Z80A: 5", 27x96 b&w VDU: 1 P/P: RS232 port	FDOS: BOS: BASIC: *ExBASIC: (14K EPROM), £260*	Graphics card available, £190: option — dual 5¼" F/D (700K): (I)
Rair Black Box (£2,300)	Rair: 01-836 4663 (N/A)	32-64K RAM: 8085: dual 5¼" F/D (160K): 2 RS232 ports	CP/M: BASIC: Cobol: Fortran: M/A	16K RAM expansion, £250; dual 5¼" F/D (520K) £1,000: (H)
Research Machines 380-Z (£1,048)	Research Machines: 0865 49791 (N/A)	16-56K RAM: Z80A: C: RS232 port:	Tiny BASIC: graphics: *A: ExBASIC: CBASIC: Cobol: Fortran: Algol: CP/M: U:*	Designed for education: high res graphics being developed: options — dual 5¼" F/D (168K), £895 and dual 8" F/D (1MB), £1,695: 56K version, £1,654: (S)
SDS 100 (£4,290)	Airamco: 0294 57755 (11)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 VDU: S100 bus: RS232 port: N/P: 1 P/P	CP/M: A: ExBASIC: *Cobol: Fortran*	Facility for 8K PROM: (E)



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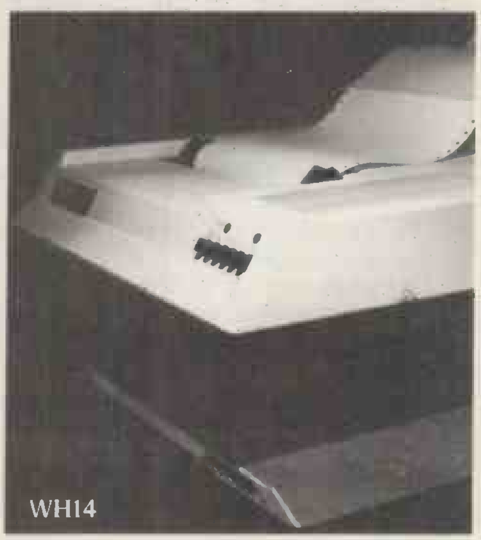

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Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software	Miscellaneous (Documentation)
S.E.E.D. System One (£2,175)	Strumech: 05433 4321 (4)	32-56K RAM: 6800: dual 5¼" F/D (160K): 9", 16x24 b&w VDU: RS232 port	DOS: BASIC: U: *Fortran: Cobol: M/A*	Up to 8 I/O ports: max of 4 F/D drives: option — dual 8" F/D (624K): (E)
Semel 1 (£2,900)	Strutt Electrical: 0822 5439 (N/A)	16-64K RAM: Z80: single 8" F/D (250K): 12", 24x80 b&w VDU: RS232 port	BASIC: *Cobol: Fortran*	Supports up to 8 drives option — single 8" F/D (250K), £500: (I)
Sharp MZ-80K (£520)	Sharp Electronics (UK) Ltd: 061 205 7321 (22)	6-34K RAM: Z80: C: 10", 24x40 b&w VDU	BASIC: A:	Graphics: loudspeaker: BASIC in 14K RAM: 34K machine, £740: (B)
Sinclair ZX80 (£100)	Science of Cambridge: 0223 311488 (N/A)	1-16K RAM: 780-1: C int: T.V. int: full K/B: 44 pin expansion port	4K BASIC in ROM	CPU is NEC 3.25 MHz version of Z80A: available as kit, £80: mains adaptor £9: (S)
Sirocco (£3,900)	Elvingate Computers: 069 245189 (TBA)	64K RAM: Z80: dual 5¼" F/D (940K): 12", 24x80 VDU: RS232 port	CP/M: CBASIC: *Cobol: MBASIC: Fortran*	Direct memory addressing: memory mapped VDU: free standing keyboard: option — 10MB H/D
Smoke Signal Chieftain 1 (£3,050)	Windrush Micro Designs 069 245189 (TBA)	32-64K RAM: 6800: dual 5¼" F/D (160K): 12", 24x80 VDU: 112 cps printer: RS232C port	DOS: BASIC: *DBASIC: RBASIC: A: Fortran: U*	Also Chieftain 3 with dual 8" F/D (1MB), £3,950 (E)
Solitaire WP & BS200 (£6,750& £7,950)	Solitaire KPG: 01-995 3573 (TBA)	64K RAM: 8085: 14" VDU (with own CPU): 45 cps printer: CPU port: dual 5¼" F/D (700K) with "WP", and dual 8" F/D (960K) with "BS200"	DOS: BASIC (optional on the "WP")	All Solitaire systems are compatible: graphics on 11x13 dot matrix: (S)
Solitaire/HBS100 (£9,500)	As above	64K RAM: 8085: 10MB H/D: 14" VDU (with own CPU): 200 cps printer: CPU port	DOS: BASIC	Up to 8 interface terminals can be used: also HBS200 with 20-80 MB of H/D: HBS100 limit is 40MB: (S)
Sord M100 ACE (£2,650)	Midas Computer Services Ltd: 0903 814523	48K RAM: Z80: single 5¼" F/D (143K): 12" 24x64 col VDU RS232 port	O/S: BASIC	With colour graphics: 8K ROM: option — single 5¼" F/D, £300: (I)
Sord M223 (£3,500)	As above	64K RAM: Z80: single 5¼" F/D (350K): 12", 24x80 b&w VDU: S100 bus: RS232 port	O/S: BASIC	Other configs possible: extra F/D, £450: (I)
Superbrain (£1,995)	Icarus: 0632 29593 (TBA)	64K RAM: 2xZ80: dual 5¼" F/D (320K): 12", 25x80 b&w VDU: S100 bus: RS232: TRS80 port	CP/M: A: *BASIC: Cobol: Fortran: APL Pascal*	Limited graphics: mainframe int available: options — dual 5¼" F/D (320K): dual 8" F/D (2.4MB): 8-120 MB H/D: (S&H)
Tandberg EC10 (£5,000)	Tandberg: 0532 35111: (N/A)	50K RAM: 8080A: single 8" F/D (250K): 12", 25x80 b&w VDU: RS232 port	ExBASIC (24K): Multi-user BASIC: A: U: *Cobol*	(S&H)
Tandy TRS 80 Level 1 (£380)	Tandy: 021 556 6101 (200)	4-16K RAM: Z80: C: 12", 16x64 b&w VDU	BASIC: A:	BASIC in 4K ROM: upgradable to level 2: (I)
Tandy TRS 80 Level II (£515)	As above	4-48K RAM: Z80: C: 12", 16x64 b&w VDU: RS232 int: 1 P/P	BASIC: *M/A: Fortran*	16K machine includes N/P: 4-16K upgrade, £120 (£85 without pad): max config, £1,005: option — single 5¼" F/D (78K), £478 (max of 4): (I)
Tandy TRS80 Model 2 (£2290)	As above	32-64K RAM: Z80A single 8" F/D (500K) 12", 24x80 VDU: 2S/P 1P/P	DOS: BASIC	Keyboard has numeric pad: 64K version, £2250: (S)
TECS (£1,600)	Technalogics: 051 724 2695 (TBA)	16-56K RAM: 6800: 8K PROM: RS232 port: C int	BASIC: *T.DOS: Prestel: Monitor:*	256 ch graphics: Prestel compatible: plugs into standard TV: option — dual 5¼" F/D (320K), £800: (S&H)
TEI 208 (£3,841)	Abacus: 01-580 8811 (5)	32-60K RAM: 8080/8085: dual 5¼" F/D (320K): 9", 24x80 green VDU: 3 S/P: 3 P/P	CP/M: *BASIC: Cobol: Fortran: Pascal: Algol*	(S&H)
TEI 212 (£4,886)	As above	32-60K RAM: 8080/8085: dual 8" F/D (1MB): 15", 24x80 green VDU: 3 S/P: 3 P/P	CP/M: *BASIC: Cobol: Fortran: Pascal: Algol*	(S&H)
Terodec DPS 64/1-4 (£3,014)	Terodec (Micro-systems) Ltd: 0344 51160: (TBA)	64K RAM: Z80: dual 8" F/D (1MB): 12", 24x80 b&w VDU: 2 S/P: 3 P/P	CP/M: *BASIC: Cobol: CBASIC: Fortran: Algol: Pascal*	TMZ 80, enhanced model in integral work station, £5,495 (with 4MB F/D): DPS 64 with 2MB F/D is £3,319: options — dual 8" F/D (1MB), £1,150: dual 8" F/D (2MB), £1,455: (S&H)
Vector Graphics MZ (£2,595)	Almarc: 0602 625035: Sintrom Microshop: 0734 85464: Metrotech 0895 57780: (5)	56K RAM: Z80: dual 5¼" F/D (630K): 3 S/P: 2 P/P	DOS: BASIC: A: *CP/M2: Algol: CBASIC: Cobol: Fortran: Pascal*	Includes PROM burner: also System B with graphics and N/P, £3,195: (E)
Video Genie EG 3003 (£378)	Lowe Electronics: 0629 2817: Binatone: 01-903 5211 (N/A)	16K RAM: Z80: 500 bps C: 32x64 TV int: extra C int: 1 P/P	BASIC: *M/A: Fortran*	BASIC in 12K ROM: graphics available: F/D under development: Binatone call *their* 16K model "Executive Minicomputer" and a 4K version, "Oxford Minicomputer" — prices TBA: (I)
Zenith WH-11A (£4,359)	Heath Ltd 0452 29451 and 01-636 7349 (N/A)	LSI 11: 16-32K RAM: 25x80 VDU: S/P: P/P	O/S: *BASIC: Fortran: A: U:*	PDP 11 compatible: option — dual 8" F/D (512K): (S&H)
Zenith Z89 (£1,490)	As above	16-48K RAM: Z80: single 5¼" F/D (102K): 12", 25x80 b&g VDU: RS232	*BASIC: A: H.DOS: CP/M: MBASIC: CBASIC: Fortran*	3 drives option: (I)
Zentec (£5,700)	Zigal Dynamics Ltd: 02405 75681 (1)	32-64K RAM: 2x8080: dual 5¼" F/D (512K): 15", 25x80 b&w VDU: RS232 port	O/S: A: U: *BASIC: Micro Cobol*	User programmable character set: option — dual 8" F/D (1MB): (S)
Zilog MCZ 1/05 (portable): MCZ 1/20A (£4200, £4800)	Micropower: 0256 54121: Memec: 084421 5471 (N/A)	64K RAM: Z80: dual 8" F/D (600K): RS232 port: MCZ 1/20 A only. . . 1P/P: option— 10MB H/D, £7100	RIO: O/S: *Cobol: BASIC: Fortran: Pascal* 1/05. . *M/A: U* 1/20A. . *PLZ: U*	Available desk top or rack mounted: Debug in 3K PROM: 1/20A runs multi-user Cobol and has up to 5 terminals and 40MB possible: (S&H)
Z Plus (£4,000)	Rostronics: 01-874 3665 (TBA)	32-64K RAM: Z80: dual 8" F/D (1MB): 2 S/P: 2 P/P	CP/M: A: U: *BASIC: Cobol: Fortran: Pascal*	(S&H)

List of Abbreviations

A Assembler	F/D Floppy disc	M/A Macro assembler	S/P Serial port
B BASIC	G/C Graphics card	N/A Not available	T/E Text editor
C Cassette	H Hardware	N/P Numeric pad	TBA To be announced
E Extensive	H/D Hard disc	O/S Operating system	U Utility
	I Introductory	P/P Parallel port	
	Int Interface	S Software	

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

IN STORE

SINGLE BOARDS

Machine (Price from)	Main Distributor/s (No. of Dealers)	Hardware	Software/ Firmware	Miscellaneous (Documentation)
Acorn (£65)	Acorn: 0223 312772 (N/A)	1.1/8K RAM: 6502: EPROM socket: Hex K/B: C int: 8 digit LED display: up to 16 ports: options — Eurocard 64 way connector: VDU card: Full K/B card	½K monitor: *BASIC*	Kit: programmable address linking; on board 5V regulator: available assembled, £79 (S&H)
Aim 65C (£265)	Pelco: 0273 722155 (4)	1-4K RAM: 6502: 12K ROM: full K/B: 20 char LED display: 20 char thermal printer: Cx2: RS232 port.	A: Dis A: T/E: 8K monitor in ROM	Available as S100 system with A or BASIC in ROM (£480) from Portable Micros (0280 702017): they also have briefcase version (£750) (E)
Cromemco SC (£260)	Comart: 0480 215005 (17)	1K RAM: Z80A: 8K EPROM sockets: RS232 port: 3 P/P: option — S100 bus.	*Monitor and control BASIC in EPROM*	5 program interval timers: can put own BASIC programs in EPROM (E)
ELF II (£114)	Newtronics: 01-348 3325	1/4K RAM: RCA 1802: Hex K/B: 2 digit LED: TV int: C int: RS232 port: options — 4K RAM, £69; full K/B; VDU card	1K monitor: A: Dis A: T/E: *BASIC:* 244	TTY, n-line decoders: low resolution graphics (high resolution available) kit (H)
Explorer (£295)	Newtronics: 01-739 1582 (15)	4K RAM: 8085: Hex K/B: RS232 port: S100 bus: C int: options — 6 slot S100 £32; 8K EPROM sockets £50.	2K monitor: *CP/M: BASIC*	Programmable 14 bit counter: kit (S&H)
H8 (£262)	Heath: 0452 29451 (TBA)	4K RAM: 8080A: Octal K/B: 6 digit LED: speaker: options — single 5¼" F/D (102K), £399; 16K RAM, £314; C int, £72	1K monitor: *BASIC in RAM: FORTRAN: T/E: A: U:*	Kit (S&H)
Hewart 6800S (£299)	Hewart: 0625 22030 (N/A)	16K RAM: 6800: full K/B: VDU int: 2xC int; 1 S/P: 2 P/P: option — 16K RAM, £90	1K monitor: A: T/E	Can be upgraded with 6809 (H)
Hewart 6800 MkIII (£152)	As above	1K RAM: 6800: VDU board: options — single 5¼" F/D (75K), £350; PROM programmer, £32: calculator board, £32	1K monitor	(H)
Mk 14 (£39.95)	Science of Cambridge: 0223 311488 (N/A)	8060: 1/4-2K RAM: Hex K/B: 7 char LED: options — VDU int (32x16 with graphics), £29; C int, £6; PROM prog, £10, 2K memory expansion, £15	Machine code	Designed for control applications rather than high level computing expansion (H)
Microtan 65 (£69)	Tangerine: 0353 3633	1K RAM: 6502: 16x32 T.V. int: options — TANEX board, 7K RAM, 6K ROM, 8K BASIC; 3S/P	1K TANBUG monitor: *BASIC*	Optional 64x64 pixel graphics:(E)
Nascom 1 (£165)	Nascom: 02405 75155 (20)	4K RAM: Z80: full K/B: TV int: 2 P/P: 1 S/P	2K monitor: *BBASIC: tiny BASIC: A: T/E: U*	Now available as Nascom 2 with 8K RAM and 8K microsoft BASIC in ROM, £295
77/68 (£90)	Newbear: 0635 30505 (N/A)	4K RAM: 6800: LED: C int: VDU int.	1K Monitor: *BASIC:*	Expandable to racked Nascom compatible system: (B)
SBC 100 (£135)	Airamco: 0294 57755 (11)	1K RAM: Z80: 8K ROM: S100 1 S/P: 1 P/P: option — voltage regulator	*1K monitor: DOS in ROM*	Kit: available assembled, £196 (E)
Superboard (£188)	MBM: 01-981 3993 (N/A)	4-8K RAM: 6502: 10K ROM: full K/B: VDU int: C int: options — RS232; single 5¼" F/D (100K), £316; 8K RAM, £188	BASIC in 8K ROM:	Available with 32K RAM and single 5¼" F/D, £867 (S&H)
SYM-1 (£160)	Newbear: 0635 30505 (N/A)	1-4K RAM: 6502: bps C int: VDU int: 2x6522 ports: option — TV int.	4K monitor: *BASIC: A*	Can be expanded to 64K RAM (S&H)
Triton 4.1 (£286)	Transam: 01-402 8137 (N/A)	2K RAM: 8080: 3K ROM: full K/B: 16x64 VDU or TV int: C 1 S/P: option — 2K RAM, £30	1K monitor: 2K BASIC: U	64 character graphics: 8 levels interrupt: kit (S&H)
Triton 5.1 (£294)	As above	2K RAM: 1K VDU RAM: 8080: C int: T.V. int	1½K monitor: 2½K BASIC: *A: Dis A: 8K BASIC: Pascal*	Graphics facility: disc interface running CP/M, about £200: (S&H)
Tuscan (£170)	As above	8K RAM: 8K ROM: Z80: 6xS100 slots: RS232 int: T.V. int: C int	8K monitor: or 8K BASIC	DD disc controller, £195: graphics: (S&H)
UK 101 (£219)	Computer Shop: 01-440 7033	4K RAM: 6502: full K/B: 16x48 VDU or TV int: C int: RS232 port: option — 4K RAM, £49	1K monitor: 8K BASIC: *Dis A: U*	Graphics: will run Superboard software (S&H)

TRANSACTION FILE

The classified service that's FREE to readers (but not companies, please). Advertisements 50 words maximum to: PCW Transaction File, 14 Rathbone Place, London W1P 1DE.

For sale

PET 2001-8K. . . good condition, little used, 5 months old — £495 ono. Contact C H Towns, 57 Woodend Walk, Armadale, West Lothian, EH48 3QN

Teletype ASR 35. . . ASCII code, good condition, some manuals. Will haggle around £250. Phone Welwyn Garden (07073) 23742.

MK 14. . . with latest monitor, extra RAM, cassette interface, single step addition and improved K/B — £40. Phone Ashby-de-la-Zouch 6231.

PET - 8K. . . new ROMs, big keyboard, cassette, green screen, lots of pages, £400. Phone Biggin Hill 71742 (eves).

Casio FX502P. . . programming calculator (see PCW Sept '79) with FA-1 data storage adaptor. Plus "Master Pack" software pack package, manual (with over 100 programs) and many games — £75. Phone South Benfleet 52147.

Superboard II. . . power supply, modulator and Cottis Blandford tape interface connected, all fully working — £200. Ring A. Forster on 0323 30742 (Sussex).

TRS 80 Level II. . . 16K, plugs into own TV and cassette, hardly used. Offers to Ely 721508

MK.14. . . extra RAM, cassette interface, new keyboard, revised monitor, single step. Extension board with all data, control, address and I/O lines available. Extensive SC/MP documentation and PSU — £50. Phone Robin Lowis on Bristol 30124.

Challenger C2.4P model 2 . . . one month old, 8K Microsoft BASIC; 8K RAM; RS232 port; D/A converter; audio output to speaker; 3 32 lines by 64 ch display; 53-key keyboard with full auto repeat; can be expanded to disc system. Software are games and BASIC renumber — £395 ono. Phone 01-560 8806 (Tony Chow) — anytime.

PET 2001. . . with Expandamem to 32K; nearest offer to silly price of £550 will secure. Phone Henry Barnett on 01-843 1288 (day), 01 01-954 5588 (eve).

Nascom 1. . . PSU, buffer board, T2 monitor and CCSoft Level A Tiny BASIC. Includes all documentation, fully functional — £125 ono. Also non-functional 8 8K memory board with 8K BASIC ROM (RAM chips believed damaged by static) — only £25. Phone Mark Burgis on 01-567 2024 (West London), eves.

TRS 80 Level 1&2 (switchable) . . . plus some software including chess and T-Bug — £450. Phone 061-320 8512.

Triton Motherboard. . . with 5 out of 8 sockets — £45. Printer Mechanism. . . impact dot matrix, 2 steppers, no logic — £50. Star Devices. . . touch keboard — £25. TV Monitor. . . 12" in strong chassis — £50. Elektor TV Oscilliscope. . . needs attention, hence £120. Ring David Pearce on Biggin Hill 73585.

TRS 80 Level II. . . 16K with video and cassette deck. Plus editor, assembler, RSM 2D monitor, T Bug, Renumber, Starwars and other games. Phone Al on Andover 61486.

UK101. . . cased, some extra RAM and programs, modified cassette — £315. Phone 061-643 2343.

ITT 2020. . . 48K version with floppy disc drive and controller card. Also included — colour modulator for TV and printer controller card. Total rig, £1300. Phone (0385) 61765.

Expandoram. . . S.D. Sales RAM memory board, 32K, for S100 bus; assembled & tested — £120 inc. p&p. Phone Portsmouth 67865.

Tandy TRS 80 Level II. . . 32K, comprising VDU, DOS 2.2 plus; 2xdisc drive; tractor feed line printer; quick printer and many extras. Will separate; £2750 ono. Phone 021-558 2468. (6-9pm)

Nascom 1. . . PSU and T2 monitor with all documentation and some games tapes. Best offer secures or exchange for audio equipment. Phone Watford 48096 anytime.

Texas Silent 700. . . keyboard, send/receive printer terminal, RS232 interface and acoustic coupler. Complete with case and 110 V transformer. Brand new — £650. Phone 01-427 8634 (after 7pm)

MK.14. . . built and working, full fully socketed, revised monitor and decoding, RAM I/O, extra RAM, tape interface, click switch, keyboard in case with PSU, manual and 2 SC/MP guides — £60. Phone Ken on Southend (0702) 335380 (eves).

PET 2001-8K. . . fitted upgrade ROM, hobby use only. With manuals and many programs (tutorials, utilities and games) — £425. Phone Blackpool (0253) 869108 evenings/weekends.

MK.14. . . with VDU, 5 Amp 5 Volt PSU, revised monitor, single step, RAM I/O, click keyboard, 32x16 VDU (has own 1K of RAM). Also full documentation, useful programs — bargain at £65! What's the catch? Buyer must collect from Kensington. Phone 01-937 8632

PET Bargain . . . 32K business PET with 2040 dual floppy disc. 8 months old and little used — £1200 ono. Phone Gerrards Cross (02813) 83095.

Compukit 4K . . . onto bigger things! Fully assembled and working — £190 (including assembler/editor). Also Kim . . . hardly used, with power supply and First Book of Kim — £89. Phone 01-866 3326 (evenings/weekends).

PET 2001-8K . . . with 24K memory expansion and Computhink disc drive. Also second cassette unit, external keyboard, TIS Workbooks and a vast selection of software and tapes — £1600 ono for the complete system. Phone Brighton 202918 (office hours) or Storrington 2663 (evenings/weekends).

TRS 80 . . . 48K, expansion interface, including Level III and Mon 3 with games galore. As new, cost £1000, now asking £700 ono (cash preferably).

Contact I. Wilkinson, 234 Union Road, Oswaldtwistle, Lancashire BB5 3JB.

Wanted

National Charity would welcome the donation of a microprocessor and/or printer. We can collect. Cancer Prevention Research Trust, 36 Roehampton Vale, London SW15.

September and/or October issues of PCW. Must be in good condition. Phone 01-848 0020 or 01-868 4411 and ask for George.

PET system . . . if you're selling all or part of your system (PET, discs and/or printer) contact Mr Andrews on 01-520 2230.

DIARY DATA

London, England	All Electronic Show. All Electronic Show, 34-36 High Street, Saffron Walden, Essex. Tel: 0799 22612	Apr 29 - May 1
Liverpool, England	Mersey Micro Show. Online Conferences Ltd., Cleveland Road, Uxbridge UB8 2DD. Tel: 0895 39262	April 30 - May 2
Brussels, Belgium	Compec Europe Exhibition. Iliffe Promotions Ltd., Dorset House, Stamford Street, London SE1 9LU. Tel: 01-261 8000.	May 6 - May 8
Manchester,England	Business Efficiency & Office Equipment Exhibition, Gwen Shillaber Design, 81 Whiteladies Rd., Clifton, Bristol BS8 2NT. Tel: 0272 312850	May 13 - May 15
Anaheim, USA	National Computer Conference and Exhibition (NCC). 210 Summit Ave., Montvale, NJ 07645	May 19 - May 22
Dallas, USA	Int. Telecommunications Exbn — INTELCOM. Horizon House — Microsol Inc., 25 Victoria Street, London SW1H OEX. Tel: 01-222 0466	May 19 - May 23
London, England	International Word Processing Exhibition and Conference. Business Equipment Trade Association, 109 Kingsway, London WC2B 6PU. Tel: 01-405 6233	May 20 - May 23
Dublin, Ireland	International Computing Exhibition — COMPUTEX. SDL Exhibitions Ltd., 68 Fitzwilliam Square, Dublin 2, Ireland. Tel: Dublin 763871	June 17 — June 19
Geneva, Switzerland	International Microcomputers, Minicomputers, Microprocessors & Datacommunications Exhibition — IMMM/DATACOMM. Kiver Communications S.A., 171/185 Ewell Road, Surbiton, Surrey. Tel: 01-390 0281	June 17 — June 19

FAX

DIRECT ACCESS

SC/MP MNEMONICS ARRANGED BY OPCODE

MSB \ LSB	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F
0	HALT	XAE	CCL	SCL	DINT	IEN	CSA	CAS	NOP							
1													SR	SRL	RR	RRL
2																
3	XPAL*				XPAH*								XPPC*			
4	LDE															
5	ANE								ORE							
6	XRE								DAE							
7	ADE								CAE							
8																DLY DISP
9	JMP DISP*				JP DISP*				JZ DISP*				JNZ DISP*			
A									ILD DISP*							
B									DLD DISP*							
C	LD DISP ◢				LDI DATA				ST DISP ◢							
D	AND DISP ◢				ANI DATA				OR DISP ◢				ORI DATA			
E	XOR DISP ◢				XRI DATA				DAD DISP ◢				DAI DATA			
F	ADD DISP ◢				ADI DATA				CAD DISP ◢				CAI DATA			
	0	1	2	3	4	5	6	7	8	9	A	B	C	D	E	F

◢ Bits 0—2 auto index flag and pointer register

* Bits 0 and 1 = pointer register

Wave-Making on a NASCOM I *cont. from p.90*

```
1173  2C              INC L
1174  2C              INC L
1175  2C              INC L
1176  7D              LD A,L
1177  320A11          LD (110AH),A
117A  3A0211          LD A,(1102H)
117D  4F              LD C,A
117E  CD0212          CALL MULT
1181  3A0B11  FT2     LD A,(110BH)
1184  6F              LD L,A
1185  2610            LD H,10H
1187  5E              LD E,(HL)
1188  3E04            LD A,04'
118A  85              ADD A,L
118B  320B11          LD (110BH),A
118E  3A0311          LD A,(1103H)
1191  4F              LD C,A
1192  CD0212          CALL MULT
1195  3A0C11  TIERCE  LD A,(110CH)
1198  6F              LD L,A
1199  2610            LD H,10H
119B  5E              LD E,(HL)
119C  3E05            LD A,05
119E  85              ADD A,L
119F  320C11          LD (110CH),A
11A2  3A0411          LD A,(1104H)
11A5  4F              LD C,A
11A6  CD0212          CALL MULT
11A9  3A0D11  LARIGOT LD A,(110DH)
11AC  6F              LD L,A
11AD  2610            LD H,10H
11AF  5E              LD E,(HL)
11B0  3E06            LD A,06
11B2  85              ADD A,L
11B3  320D11          LD (110DH),A
11B6  3A0511          LD A,(1105H)
11B9  4F              LD C,A
11BA  CD0212          CALL MULT
11BD  3A0E11  FT1     LD A,(110EH)
11C0  6F              LD L,A
11C1  2610            LD H,10H
11C3  5E              LD E,(HL)
11C4  3E08            LD A,08
11C6  85              ADD A,L
11C7  320E11          LD (110EH),A
11CA  3A0611          LD A,(1106H)
11CD  4F              LD C,A
11CE  CD0212          CALL MULT
11D1  CB7C    SIGN    BIT 7,H
11D3  201D            JR NZ,COMP
11D5  CD2012          CALL DIV
11D8  260E    STNS    LD H,0EH
11DA  3A0711          LD A,(1107H)
11DD  6F              LD L,A
11DE  79              LD A,C
11DF  77              LD (HL),A
11E0  2C              INC L
11E1  7D              LD A,L
11E2  320711          LD (1107H),A
11E5  3A1211  COUNT   LD A,(1112H)
11E8  3D              DEC A
11E9  321211          LD (1112H),A
11EC  C24511          JP NZ,FT8
11EF  C38602          JP 0286H
11F2  7D      COMP    LD A,L
11F3  2F              CPL
11F4  6F              LD L,A
11F5  7C              LD A,H
11F6  2F              CPL
11F7  67              LD H,A
11F8  23              INC HL
11F9  CD2012          CALL DIV
```

```
11FC  79                 LD A,C
11FD  2F                 CPL
11FE  3C                 INC A
11FF  4F                 LD C,A
1200  18D6               JR STNS
1202  0608      MULT     LD B,08
1204  210000             LD HL,00
1207  1600               LD D,00
1209  CB7B               BIT 7,E
120B  2802               JR Z,SHIFT
120D  16FF               LD D,0FFH
120F  29        SHIFT    ADD HL,HL
1210  CB21               SLA C
1212  3001               JR NC,DEC
1214  19                 ADD HL,DE
1215  10F8      DEC      DJNZ SHIFT
1217  ED5B0F11           LD DE,(110FH)
121B  19                 ADD HL,DE
121C  220F11             LD (110FH),HL
121F  C9                 RET
1220  010008    DIV      LD BC,0800H
1223  59                 LD E,C
1224  3A1111             LD A,(1111H)
1227  57                 LD D,A
1228  A7        MOVE    AND A
1229  CB1A               RR D
122B  CB1B               RR E
122D  E5                 PUSH HL
122E  A7                 AND A
122F  ED52               SBC HL,DE
1231  3003               JR NC,NXT
1233  E1                 POP HL
1234  1802               JR FLAG
1236  DDE1      NXT      POP IX
1238  3F        FLAG     CCF
1239  CB11               RL C
123B  10EB               DJNZ MOVE
123D  210000             LD HL,00
1240  220F11             LD (110FH),HL
1243  C9                 RET
```

Interrupt cont. from p.111

However what lies below the surface is of longer term importance. If one user can get away with it, doing his own programming in BASIC perhaps, there's nothing to stop another trying and yet another . . . all from the same company. And with at least 164 different micros on the market the chances of several users in one company all acquiring different and probably incompatible units and then writing programs in different versions of BASIC are high.

What are the chances of them being able to communicate with each other either by wire or on disc? Ah, you will say, why should they want to? My reply is that, as the number of user operated micros increases, so the chances of requiring interchange of data or programs will probably be squared. But not only will incompatible equipment tend to preclude this, so will the lack of any standards or disciplines to which the users should conform.

The problem really is that personal computing assumes expertise in several areas that a user may not have, because it goes against the concept of area specialisation; that's why we have accountants, salesmen, lawyers, etc. It's a false assumption to say that a specialist in one area may also become an efficient computer programmer. At best, their computing function will be secondary to their main job.

I recently heard of a top man planning to replace his central dp installation with 1,000 micros (if true, a nice order for someone). But personal computing is contrary to the principles of functional management. A group of individual department managers would be replacing the dp manager in deciding on which applications are to be most cost/effective, construction of files, the documentation of the systems. Instead of increasing the overall efficiency of the organisation, there will tend to be increased empire building and departmental isolation. It would become increasingly difficult for one department to know what another was doing, to co-ordinate efforts and to control costs.

It's a fallacy to believe it is possible to demolish a centrally managed structure and replace it completely by a distributed structure that has no management. It's also a fallacy to believe that with multi-users, the dp skills of the professionals will be unnecessary. It's a question of recognising the boundaries of what is possible.

Edward G Cluff, Secretary-General, Institute of Data Processing Management

YCW cont. from p.113

```
255 IFA<>0THEN290
256 RESTORE
260 FORA1=1TO5
270 READA2
275 IFASC(A$)=A2THEN279
277 NEXTA1
278 GOTO180
279 ONA1GOTO100,500,50,750,820
280 IFA=0THEN240
290 IFA>NTHENN=A
292 IFA<0THEN690
295 IF INT(A)<>ATHEN630
300 PRINTA-1;CHR$(34);A$(A-1)
310 INPUT" ";A$(A)
330 PRINTA+1;CHR$(34);A$(A+1)
340 GOTO240
500 POKE8142,0
510 A1=PEEK(8144)
520 A2=PEEK(8145)
530 POKE8144,0
540 POKE8145,0
550 NULL4
555 PRINT:PRINT:PRINT:PRINT
560 FORA=1TON
570 PRINTA$(A)
580 NEXTA
590 POKE8144,A1
600 POKE8145,A2
610 NULL0
620 END
630 FOR I=NTO(INT(A)+1) STEP-1
640 A$(I+1)=A$(I)
650 NEXT
660 N=N+1
670 A=INT(A)+1
680 GOTO300
690 A=ABS(A)
700 FOR I=A+1TON
710 A$(I-1)=A$(I)
720 NEXT
730 N=N-1
740 GOTO240
750 INPUT"ENTER SEARCH STRING: ";B$
760 B=LEN(B$)
770 FORI=1TON
780 GOSUB1000
782 IFC$=""THEN800
784 PRINTI;C$:PRINTI;
785 IFT=1THEN795
786 FORJ=1TOT-1
788 PRINT" ";
790 NEXTJ
795 PRINT"↑"
800 NEXTI
810 GOTO240
820 INPUT"ENTER LINE NUMBER";I
830 INPUT"ENTER OLD TEXT";B$
835 B=LEN(B$)
840 GOSUB1000
850 IFC$<>""THEN885
860 PRINTI;A$(I)
870 PRINT"ERROR - TEXT NOT FOUND"
880 GOTO240
885 INPUT"ENTER NEW TEXT";C$
887 C=LEN(C$)
888 A$=A$(I)
890 A$(I)=MID$(A$,1,T-1)+C$
892 IFT-1+B>ATHEN900
895 A$(I)=A$(I)+MID$(A$,T+B,A-B-T+1)
900 PRINTI;A$(I)
910 GOTO240
1000 C$=""
1010 A=LEN(A$(I))
1020 FORT=1TOA-B+1
1030 IFMID$(A$(I),T,B)<>B$THEN1060
1040 C$=A$(I)
1050 GOTO1070
1060 NEXTT
1070 RETURN
READY
```

(program for an 8K Exidy Sorcerer)

SNAP–*FOR A NASCOM 2*

```
10   CLS
20   PRINT TAB(20); "SNAP"
30   POKE 3200,25311
40   POKE 3202,312
50   POKE 3204,18351
60   POKE 3206,10927
70   POKE 3208,–8179
80   POKE 3210,233
90   POKE 4100,3200
100  LET A=INT(RND(1)*13)+1
110  LET B=INT(RND(1)*13)+1
```

```
120 LET X=INT(A/4)+1 : IF X>4 THEN 100
130 LET Y=INT(B/4)+1 : IF Y>4 THEN 110
140 FOR H= 1 TO 13
150 IF A>H THEN 170
160 PRINT CHR$(X+187);
170 NEXT H : PRINT
180 FOR H= 1 TO 13
190 IF B>H THEN 200
195 PRINT CHR$(Y+187);
200 NEXT H : PRINT
210 IF A=B THEN 300
220 FOR A=1 TO 100: NEXT A:S=S+1
225 IF S+G+L >52 THEN 500
230 GOTO 10
300 FOR A= 1 TO 180
310 LET X=USR(0): IF X<>0 THEN 330
320 NEXT A
330 IF A>60 THEN 400
340 FOR A=1 TO 100
350 PRINT "YOUR SNAP"
360 NEXT A
370 G = G+1
380 GOTO 10
390 PRINT
400 FOR A=1 TO 100
410 PRINT "MY SNAP"
420 NEXT A
430 L=L+1
440 GOTO 10
500 PRINT "FINAL SCORE"
510 PRINT "YOURS";G;"MINE";L
```

Calculator Corner cont. from p.107

too difficult when you know how, but it should not be necessary. Texas Instruments please note.

In spite of the minor problems, and no machine is perfect, I hope that I have been able to demonstrate the extra scope available with the application of some imagination to the use of these inexpensive but powerful calculators.

Postscript

Mr Horwood has expressed his willingness to answer any further enquiries about these applications. You can write to him at: 11 Melville Hall, Holly Road, Edgbaston, Birmingham B16 9NJ (and not to PCW please!).

Here, to stop you all pestering me, is the answer to the problem which Rolf Howarth set in his TI59 Pseudo Op codes article:-

It is possible to examine the internal routines which perform the P/R, decimal/sexagesimal and statistic operations by keying in the following:

10 Op 17 (6 Op 17 for the TI58)
99 STO 00
Pgm 01 A
CLR D.MS

Then press LRN and examine the program using SST. Note that on pressing BST, Del or Ins they do not behave normally, and may crash the calculator. The program is 380 steps long, after which garbage is found — which must presumably have some purpose. Any guesses?

The routines start at the following steps:

Op 12	000
Op 15	047
Op 14	058
x	067
Op 11	084
INV x	107
Op 13	149
Σ+	192
INV Σ+	213
INV P/R	250
P/R	284
D.MS	303
INV D.MS	341

Noughts and Crosses cont. from p.87

Key the move, and press EXE. Moves need not necessarily be positive integers, as the program will correct the negative, integer + fraction moves, taking the integer part only, but all moves must lie on the interval (1,9); attempts to enter either moves outside this range, or moves which have already been made, will cause the opponent to be penalised by having the move denied, and the calculator will be given the option to move.

The calculator will display its move as above, together with the current board positions and move count.

4. If the calculator wins, the HLT status indicator will disappear, and the winning move, together with the updated board position and move count, will flash alternately with '2' in the same format. No further moves can be made. If either player's move completes the board, that move, together with the updated board and move count, will flash alternately with '9'.

To stop the flashing, press HLT (not AC, as this only stops the flashing temporarily); (if you are impatient to play another game, don't bother pressing HLT, just press PO); and if you want to review the moves made by both players during the game, press MR .4; a zero in the number indicates an attempted illegal move by the opponent (except when the illegal move was attempted on the opponent's first move in a game where the opponent moves first — not as daft as it sounds). For example, a game played to a draw might yield a sequence thus:

635419827

if the calculator moved first, its move sequence would be the 1st, 3rd, 5th, etc., numbers: i.e., 6,5,1,8,7. If the opponent attempts to cheat, the sequence might look like this:

63504

In the above example, the opponent attempted an illegal move at the fourth move in the game (i.e., his second move), whereupon the calculator took immediate advantage, and won. Note that if the opponent takes the option to move first, and then enters an illegal move, the calculator will discard its original random move, and determine a first move based on its game strategy. For most games this is unlikely to occur, but when it does, the calculator always takes the centre position (5) which forces a draw.

5. The program does not possess the facility to check for an opponent win (the move time would increase) and it has remained unbeaten to date. I have learned that it is unwise to tell a prospective opponent that they cannot possibly win; either they give up immediately, or they go to the other extreme and spend hours trying to prove you wrong. It is therefore highly embarrassing when they find the only flaw in the program that allows them to win (and they never let you forget it!). So this program is not unbeatable, only unbeaten. If anyone CAN beat it, I'd be interested in the move sequence (naturally).

For users of other calculators or computers the following notes may be useful:

Min n = Enter Memory n (STOn)
MR n = Recall Memory n (RCLn)
INV is merely a SHIFT (2nd Function) instruction and may be ignored.
GSB = GOSUB
RNDn = Round off to n digits

Pet Printer Pep-Up cont. from p.91

```
034D  E6  10              INC   POINTER HI
034F  E6  0F        $8    INC   POINTERLOW
0351  D0  02              BNE   $9
0353  E6  10              INC   POINTER HI
0355  E6  0F        $9    INC   POINTERLOW
0357  D0  02              BNE   $10
0359  E6  10              INC   POINTER HI
035B  A1  00        $10   LDA   (00,X) get byte
035D  D0  0F              BNE   $1 end of line?
035F  E6  0F        $6    INC   POINTERLOW
0361  D0  02              BNE   $11
0363  E6  10              INC   POINTER HI
0365  E6  0F        $11   INC   POINTERLOW
0367  D0  02              BNE   $12
0369  E6  10              INC   POINTER HI
036B  4C  44  03    $12   JMP   $3
036E  C9  22        $1    CMP   £X'22' opening quote?
0370  D0  E3              BNE   $9
0372  E6  0F        $7    INC   POINTERLOW
0374  D0  02              BNE   $5
0376  E6  10              INC   POINTER HI
0378  A1  00        $5    LDA   (00,X) get next byte
037A  F0  E3              BEQ   $6 end of line?
037C  C9  22              CMP£X'22' closing quote?
037E  F0  D5              BEQ   $9
0380  C9  C1              CMP£X'C1'
0382  90  08              BCC   $12
0384  C9  DB              CMP£X'DB'
0386  B0  04              BCS   $12
0388  29  7F              AND   £X'7F' remove shift bit
038A  81  00              STA   (00,X)
038C  4C  72  03    $12   JMP   $7
```

Listing 3

```
35000 I=1027:REM UNSHIFT PROGRAM
35010 F=1:A=256*PEEK(I+1)+PEEK(I):IFA>34999THENPRINT:PRINT"FINISHED":END
35020 PRINTA;:I=I+1
35030 I=I+1:X=PEEK(I):IFX=0THENI=I+3:GOTO35010
35040 IFX=34THENF=-1*F:GOTO35030
35050 IFF=1THEN35030
35060 IFX>192ANDX<219THENX=X-128:POKEI,X
35070 GOTO35030
READY.
```

Thanks to Microflow Pathfinder Limited of Farnborough for kindly loaning the necessary equipment.

Checkout cont. from p.76

ed, legs down, into a layer of antistatic foam, and timing is initiated by closing the lid. At the end of the 8 minutes (or so) the light switches off and a beeper sounds with a pleasant but insistent note to attract attention.

The box is well sealed against escape of UV light. I examined it in a dark room with the light operating and could detect only a very faint leakage, right at the back. There is thus no risk of inadvertently exposing the eyes to UV light.

Overall then my conclusion is that the UV8 is well made, good value at the price, and very efficient at its job. It would certainly be a good buy for any industrial user of EPROMs and even some hobbyists could find it a worthwhile investment.

Pascal cont. from p.95

arises.

The first thing to notice in program ESTATE is the declaration of the pointer type POINTER (line 9) and the declaration of the pointer variables FIRSTFILLED etc. as type POINTER in line 23. The record FLAT is declared in lines 14 to 21 and line 17 declares the field NEXT as a field of type POINTER. It is this mechanism which allows the linked list to be formed since the address of the next flat will be stored in NEXT.

In order to make the program both interactive and complete, the main program offers the user a MENU of different options (lines 50 — 55) including:
INITIALISE — which "commissions" the block to start with.
MOVEIN and MOVEOUT — which manipulate the flats between the two linked lists.
FREEFLATS and TENANTLIST — which offer the user the opportunity of listing the vacant or occupied flats at any time.
Procedure INITIALISE (lines 67 — 87) constructs the entire linked list once the number of flats is known (line 71). First, two listhead pointers are initialised (72 and 73) and a record of type FLAT is created in line 76. Then the relevant data are assigned to the fields of the variable LINK^(77 — 85). Note the two pointer assignments on lines 79 and 84. NEXT is the pointer field within the record so that the first time through, NEXT is set to NIL and this record will always be the last record in the list. In line 84, the pointer to this record (LINK) is assigned to FIRSTFREE so that when the next record is created, this value can be placed into its NEXT field (line 79 again). The second record is thus linked to the first.

Procedure MOVEIN is designed to allow a predefined number of flats to be allocated to families. In order to do this a second linked list is formed although no new FLAT records will be created. Instead, some of the links in the current vacant list will be broken and new ones forged to build up a list of occupied flats. Procedure FINDFLAT tests for the first vacant flat and, if one is there, passes its pointer address to the pointer NEXTFLAT so that when the next procedure, FILLFLAT, needs the flat record it has merely to reference NEXTFLAT∧ (line 140). FILLFLAT however also has the tricky job of linking the new flat into the list of occupied flats so that the tenants' names are in alphabetical order. This is done in SETPOINTERS with the help of the Boolean function BEFORE (106 — 117) which returns the value TRUE provided that the first string passed to it (N1) comes before the second (N2), taken alphabetically. BEFORE is a recursive function (line 116) which recalls itself as long as there are still uninspected characters left in the string (tested for in lines 108 and 110) and as long as corresponding characters in the two strings (referenced by the integer P) are identical (checked in lines 112 and 114). Note the use of the PASCAL standard function ORD which maps its argument (which must be a character) onto a set of integers, one for each character in the character set. The letters of the alphabet form part of this character set so that two letters can be compared as in line 112 and alphabetically ordered by placing the lower one first. (i.e. A<B<. . .<Z).

SETPOINTERS itself is an example of the ease with which a linked list can be used. Line 121 (and 128) ensures that the search loop will run until the end of the list is reached if necessary. Line 130 drives the search through the list by redirecting the search pointer (LINK) to the record indicated by the current record's pointer field. Once the correct place in the list has been found, control moves to the final sequence of SETPOINTERS (133 — 137), where the new flat is detached from the list of vacant flats, its link pointer being assigned the address of the next record up the list while its address is passed to the pointer field of the last record down the list (or the listhead pointer if necessary). Procedure MOVEOUT performs the opposite process, seaching out specified occupied flats and removing them from the list (EVICTIFTHERE) and ensuring that the flat that has been vacant longest will be the first to be filled (TIDYUP). Further use is made of recursion in EVICTIFTHERE and TIDYUP, demonstrating how concisely a linked list may be traversed (lines 181 and 194). In comparison the procedures FREEFLATS and TENANTLIST access the same lists but iteratively. Note how EVICTIFTHERE deletes a record, pinpointing the flat to be cleared in line 178 and excluding it from the list by linking its immediate neighbours together in line 179.
Exercises: (1) No-one would use a program like this because as soon as the machine is switched off all the data would be lost. Write procedures to dump both lists onto disc files at the end of each day and to build up a new heap from the same disc files when the system is booted up next morning.

(2) Modify FINDFLAT so that it finds the first vacant flat in the list with sufficient rooms to provide at least one room per person.

Variant field records

It is a frequent occurrence that the data one wishes to associate together in one record will not fit conveniently into any fixed record format. For these occasions PASCAL provides a means of building *variants* into the record declaration so that a portion of the record can contain alternative (and different) formats depending on the nature of the items in the fixed part of the record.

An example of this feature appears in the program in Box 6. The information required in the record of a vacant flat (e.g. date last occupied) is quite different from the information needed for an occupied flat (name of tenants and size of family). Consequently, in the record declaration of FLAT (lines 14 — 21) the first few fields are common to both types of flat but at line 18 some sort of split has to be made. This is done by means of a CASE statement which must enumerate the different possibilities open at this point.

The format for such a variant field declaration is as follows:

```
CASE tag field : type OF
        const1 : (fields of const1) ;
        const2 : (fields of const2) ;
        —
        —
```

Note that there is no "END" reserved word to close off the case statement. The *tag field* is a variable (common to all records) which acts as a selector, picking out the appropriate variant format. In ESTATE the tag field is STATUS (line 18) which can be either VACANT (implying a variant field named LASTDATE) or FILLED (implying TENANTS).

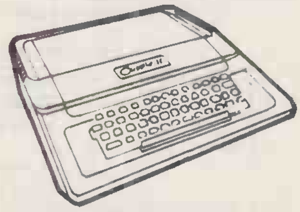
When a record is assigned (e.g. lines 140 – 143), as soon as STATUS is defined, the required variant field is selected and can itself be subsequently assigned. If STATUS is altered (lines 189 – 192) the new variant is automatically switched in and overwrites the previous data. Note that a record type may only contain one set of variant fields (i.e. one CASE statement) although record types (with their own variant fields) may be nested within the variations. Box 7 contains the syntax diagrams for both pointer types and record field variants.

Pascal Box 6 cont. from p.94

```
30:    READLN ;
31:    I := 0 ;
32:    REPEAT
33:       I := I + 1 ;
34:       READ(N[I])
35:    UNTIL EOLN OR (I=20) ;
36:    FOR J := I+1 TO 20 DO
37:       N[J] := ' '
38:END ; (STREADLN)
39:FUNCTION LENGTH(N : NAME) : INTEGER ;
40:VAR I : INTEGER ;
41:BEGIN
42:    I := 20 ;
43:    WHILE (I>0) AND (N[I]=' ') DO
44:       I := I-1 ;
45:    LENGTH := I
46:END ; (LENGTH)
47:
48:PROCEDURE MENU ;
49:BEGIN
50:    WRITELN('0.  EXIT FROM THIS PROGRAM.') ;
51:    WRITELN('1.  SET UP A NEW ESTATE.') ;
52:    WRITELN('2.  MOVE NEW TENANTS IN.') ;
53:    WRITELN('3.  MOVE TENANTS OUT.') ;
54:    WRITELN('4.  SEE FREE FLATS.') ;
55:    WRITELN('5.  SEE LIST OF TENANTS.')
56:END ; (MENU)
57:PROCEDURE GETDATE ;
58:BEGIN
59:   WITH NEWDATE DO
60:   BEGIN
61:      WRITE('DAY--->') ; READ(DAY);
62:      WRITE('MONTH--->') ; READ(MONTH) ;
63:      WRITE('YEAR--->') ; READ(YEAR)
64:    END
65:END ;(GETDATE)
66:
67:PROCEDURE INITIALISE ;
68:VAR NUM, I : INTEGER ;
69:BEGIN
70:    GETDATE ;
71:    WRITE('NUMBER OF FLPTS--->') ; READ (NUM) ;
72:    FIRSTFILLED := NIL ;
73:    FIRSTFREE := NIL ;
74:    FOR I := 1 TO NUM DO
75:    BEGIN
76:       NEW(LINK) ;
77:       WITH LINK^ DO
78:       BEGIN
79:          NEXT := FIRSTFREE ;
80:          WRITE('FLAT NUMBER--->') ; READ(NUMBER) ;
81:          WRITE('NUMBER OF ROOMS--->') ; READ(ROOMS) ;
82:          STATUS := VACANT ;
83:          LASTDATE := NEWDATE ;
84:          FIRSTFREE := LINK
85:       END
86:    EN
87:END ; (INITIALISE)
88:PROCEDURE MOVEIN ;
89:VAR I, NUM : INTEGER ;
90:     FOUND : BOOLEAN ;
91:     NEXTFAMILY : FAMILY ;
92:     NEXTFLAT, PREVIOUSLINK : POINTER ;
93:PROCEDURE FINDFLAT ;
94:BEGIN
95:    IF FIRSTFREE = NIL
96:    THEN FOUND := FALSE
97:    ELSE
98:    BEGIN
99:       FOUND := TRUE ;
100:      NEXTFLAT := FIRSTFREE
101:   END
102:END ;
103:PROCEDURE FILLFLAT ;
104:PROCEDURE SETPOINTERS ;
105:VAR CONTINUE : BOOLEAN ;
106:FUNCTION BEFORE(N1, N2 :NAME ; P:INTEGER) : BOOLEAN ;
107:BEGIN
108:   IF P = LENGTH(N2)
109:   THEN BEFORE := FALSE
110:   ELSE IF P= LENGTH(N1)
111:        THEN BEFORE := TRUE
112:        ELSE IF ORD(N2[P]) < ORD(N1[P])
113:             THEN BEFORE := FALSE
114:             ELSE IF ORD(N1[P]) < ORD(N2[P])
115:                  THEN BEFORE := TRUE
116:                  ELSE BEFORE := BEFORE(N1,N2,P+1)
117:END ; (BEFORE)
118:BEGIN (SETPOINTERS)
119:   LINK := FIRSTFILLED ;
120:   PREVIOUSLINK := FIRSTFILLED ;
```

```
   CONTINUE := LINK <> NIL ;
   WHILE CONTINUE DO
   BEGIN
      IF BEFORE(NEXTFAMILY.SURNAME, LINK^.TENANTS.SURNAME, 1)
      THEN CONTINUE := FALSE
      ELSE
      BEGIN
         CONTINUE :=  LINK <> NIL ;
         PREVIOUSLINK := LINK ;
         LINK := LINK^.NEXT
      END
   END ;
   FIRSTFREE := NEXTFLAT^.NEXT ; (TAKE FLAT OFF FREE LIST)
   NEXTFLAT^.NEXT := LINK ;    (LINK NEW FLAT INTO OCCUPIED LIST)
   IF (FIRSTFILLED = NIL) OR (PREVIOUSLINK=LINK)
   THEN FIRSTFILLED := NEXTFLAT
   ELSE PREVIOUSLINK^.NEXT := NEXTFLAT
END ; (SETPOINTERS)
BEGIN (FILLFLAT)
   WITH NEXTFLAT^ DO
   BEGIN
      STATUS := FILLED ;
      TENANTS := NEXTFAMILY ;
      SETPOINTERS
   END
END ; (FILLFLAT)
BEGIN (MOVEIN)
   WRITE('HOW MANY NEW TENANTS--->') ;
   READ (NUM) ;
   FOR I := 1 TO NUM DO
   BEGIN
     WITH NEXTFAMILY DO
     BEGIN
       WRITE('SURNAME--->') ; STREADLN(SURNAME) ;
       WRITE('SIZE--->') ; READ(SIZE) ;
       FINDFLAT ;
       IF FOUND
       THEN FILLFLAT
       ELSE WRITELN('CAN''T BE DONE.')
     END
   END
END ; (MOVEIN)
PROCEDURE MOVEOUT ;
VAR LASTNAME : NAME ;
    FOUND : BOOLEAN ;
    I, NUM : INTEGER ;
    EMPTYFLAT : POINTER ;
PROCEDURE EVICTIFTHERE ( VAR EMPTYFLAT, LINK:POINTER );
BEGIN
   FOUND := TRUE ;
   IF LINK = NIL
   THEN FOUND := FALSE
   ELSE
   BEGIN
      IF LINK^.TENANTS.SURNAME = LASTNAME
      THEN
      BEGIN
         EMPTYFLAT := LINK ;
         LINK := LINK^.NEXT
      END
      ELSE EVICTIFTHERE (EMPTYFLAT, LINK^.NEXT)
   END
END ; (EVICTIFTHERE)
PROCEDURE TIDYUP (VAR LINK : POINTER ; EMPTYFLAT :POINTER) ;
BEGIN
   IF LINK = NIL
   THEN
   BEGIN
      LINK := EMPTYFLAT ;
      LINK^.NEXT := NIL ;
      LINK^.STATUS := VACANT ;
      LINK^.LASTDATE := NEWDATE
   END
   ELSE TIDYUP (LINK^.NEXT, EMPTYFLAT)
END ; (TIDYUP)
BEGIN (MOVOUT)
   GETDATE ;
   WRITE ('HOW MANY FAMILIES ARE LEAVING-->') ;
   READ (NUM) ;
   FOR I := 1 TO NUM DO
   BEGIN
      WRITE ('WHAT IS THE SURNAME OF THE LEAVING FAMILY-->') ;
      STREADLN(LASTNAME) ;
      EVICTIFTHERE(EMPTYFLAT, FIRSTFILLED) ;
      IF FOUND
      THEN TIDYUP (FIRSTFREE, EMPTYFLAT)
      ELSE WRITELN (LASTNAME, ' DON''T LIVE HERE.')
   END
END ; (MOVEOUT)

PROCEDURE FREEFLATS ;
BEGIN
   WRITELN ('FLAT NUMBER           ROOMS') ;
   LINK := FIRSTFREE ;
   WHILE LINK <> NIL DO
   BEGIN
     WRITELN(LINK^.NUMBER,             ',LINK^.ROOMS) ;
     LINK := LINK^.NEXT
   END
END ; (FREEFLATS)
PROCEDURE TENANTLIST ;
BEGIN
   WRITELN('NAME                FLAT NUMBER') ;
```

```
    LINK := FIRSTFILLED ;
    WHILE LINK <> NIL DO
    BEGIN
       WRITELN (LINK^.TENANTS.SURNAME, LINK^.NUMBER) ;
       LINK := LINK^.NEXT
    END
END ; (TENANTLIST)

BEGIN (MAIN PROGRAM)
     REPEAT
       MENU ;
       WRITE('YOUR CHOICE-->') ; READ(CHOICE) ;
       WRITELN ; WRITELN ; WRITELN ;
       IF (CHOICE>5) OR (CHOICE<0) THEN CHOICE := 0 ;
       CASE CHOICE OF
        0 : WRITELN('GOOD BYE') ;
        1 : INITIALISE ;
        2 : MOVEIN ;
        3 : MOVEOUT ;
        4 : FREEFLATS ;
        5 : TENANTLIST
       END ; (CASE)
       WRITELN ; WRITELN ; WRITELN
     UNTIL CHOICE = 0
END.
```

PROGRAMS

PET Backgammon

by J. Aughton

We figured that as "Programs" is somewhat short this month we would give you a real treat.

This program is one of the best that we have ever received at PCW; it will more than repay the effort involved in keying it in.

You will notice a POKE in line 9010. This is because the original program used lower case letters in the "instructions" section. As you probably know this produces gibberish on the PET printer. We've left the POKE there in case you decide to restore the instructions to their former glory.

```
30 REM**************************
40 REM*       BACKGAMMON       *
50 REM*                        *
60 REM*      BY J.AUGHTON      *
70 REM**************************
80 W(1)=-300:W(2)=500:W(3)=100
90 W(4)=-300:W(5)=-500:W(6)=-1200
100 W(7)=70:W(8)=700:REM WEIGHTS
110 DIMA$(6),A%(25),P%(12),Q%(12)
120 U$="TTTTTTT":D$="▒▒▒▒▒▒▒▒▒▒▒▒"
130 DEFFNA(X)=INT(X*RND(7)+1)
140 A$(1)="▒   ▒███ ● ▒███    "
150 A$(2)="▒  ●▒███   ▒███▶   "
160 A$(3)="▒●  ▒███ ● ▒███   ●"
170 A$(4)="▒● ●▒███   ▒███▶  ●"
180 A$(5)="▒● ●▒███ ● ▒███▶  ●"
190 A$(6)="▒● ●▒███▶ ●▒███▶  ●"
200 Z$="                ":GOTO9000
500 REM INITIALISE
510 F=0:BH=0:BP=0:NH=15:NP=15
520 RESTORE:FORI=1TO12:READA%(I)
530 A%(25-I)=-A%(I):NEXT
540 DATA2,0,0,0,0,-5,0,-3,0,0,0,5
550 PRINT"▒PRESS SPACE TO START ";
560 PRINT"IN THE USUAL WAY
570 GETA$:IFA$<>" "THEN570
575 POKE59468,12
580 PRINT"▒▒▒▒▒▒▒▒▒   PET   YOU
585 PRINT"▒I PLAY ● - YOU PLAY o
590 GOSUB4000:IFP=QTHEN590
600 GOSUB5600:GOSUB5600:GOSUB6000
610 GOSUB5000:F=1:FM=1:IFP>QTHEN2000
620 GOTO1040
1000 REM HUMAN MOVE
1010 GOSUB5500
1020 PRINT"PRESS SPACE TO ROLL DICE
1030 GETA$:IFA$<>" "THEN1030
1040 GOSUB4000:K=0:M=2:IFP=QTHENM=4
1050 FM=0:GOSUB5500:GOSUB1510
1060 PRINT"YOUR MOVE WITH THE";P;"? ";
1070 GETA$:IFA$=""THEN1070
1080 N=ASC(A$)-64
1090 IFN>26ORN<1THEN1050
1100 PRINTA$:IFN=25THEN1330
```

PROGRAMS

```
1105 IFN=26THEN1370
1110 IFBH=0THEN1140
1120 GOSUB5500:PRINT"YOU'RE ON THE BAR
1130 GOSUB5600:GOTO1050
1140 REM
1150 IFA%(N)>0THEN1180
1160 GOSUB5500:PRINT"NOTHING THERE !
1170 GOTO1130
1180 IFN+P<25THEN1220
1190 IFHI=NHTHENF=0:GOTO1410
1200 GOSUB5500:PRINT"OFF THE BOARD !
1210 GOTO1130
1220 IFA%(N+P)>-2THEN1250
1230 GOSUB5500:PRINT"SORRY IT'S BLOCKED
1240 GOTO1130
1250 A%(N)=A%(N)-1:GOSUB5000:N=N+P
1260 IFA%(N)>-1THEN1290
1270 A%(N)=0:BP=BP+1:GOSUB5500
1280 PRINT"OUCH !-YOU GOT ME
1290 A%(N)=A%(N)+1:M=M-1:GOSUB5000
1300 P=Q:IFM>0THEN1050
1310 GOTO2000
1330 IFBHTHEN1350
1340 GOTO1160
1350 IFA%(P)<-1THEN1230
1360 N=0:BH=BH-1:GOTO1250
1370 IFK=0THEN1400
1380 GOSUB5500:PRINT"YOU'RE STUCK(?)
1390 GOSUB5600:GOTO2000
1400 K=P:P=Q:Q=K:GOTO1050
1410 IFN+P>25THEN1460
1420 NH=NH-1:IFNHTHEN1450
1430 GOSUB5500:PRINT"YOU WIN
1440 GOSUB5600:GOTO7000
1450 A%(N)=A%(N)-1:N=0:GOTO1290
1460 FORI=19TON-1
1470 IFA%(I)<=0THEN1500
1480 GOSUB5500:PRINT"YOU CAN'T-YOU ";
1490 PRINT"CAN MOVE AT ";CHR$(I+64):GOTO1130
1500 NEXT:GOTO1420
1510 HI=0:FORI=19TO24
1520 IFA%(I)>0THENHI=HI+A%(I)
1530 NEXT:RETURN
2000 REM PET MOVE
2010 K=0:GOSUB5500:PRINT"IT'S MY MOVE
2020 GOSUB4000:M=2:IFP=QTHENM=4
2030 FM=0:IFBP>0THEN2240
2040 PI=0:FORI=1TO6
2050 IFA%(I)<0THENPI=PI-A%(I)
2060 NEXT:IFPI=NPTHENF=0:GOTO2320
2070 GOSUB4500:GOSUB3000
2080 IFQM>0THEN2210
2090 IFPM>0THENN=P%(X):GOTO2120
2100 GOSUB5500:PRINT"I CAN'T MOVE
2110 GOSUB5600:GOTO1000
2120 GOSUB5500:PRINT"WITH THE";P;
2130 PRINT"I'LL MOVE ";CHR$(64+N)
2140 A%(N)=A%(N)+1:GOSUB5000:N=N-P
2150 IFA%(N)<1THEN2180
2160 A%(N)=0:BH=BH+1:GOSUB5500
2170 PRINT"TAKE THAT !
2180 A%(N)=A%(N)-1:M=M-1:GOSUB5000
2190 K=1:P=Q:IFM>0THEN2030
2200 GOTO1000
2210 IFPM=0THEN2230
2220 IFPM<QMTHENN=P%(X):GOTO2120
2230 N=Q%(Y):K=P:P=Q:Q=K:GOTO2120
2240 IFA%(25-Q)<2THEN2280
2250 IFA%(25-P)<2THEN2270
2260 GOTO2100
2270 N=25:BP=BP-1:GOTO2120
2280 IFA%(25-P)<2THEN2300
2290 K=P:P=Q:Q=K:GOTO2270
2300 GOSUB4500:IFQM<=PMTHEN2290
2310 GOTO2270
2320 IFA%(P)>=0THEN2390
2330 GOSUB5500:PRINT"I WILL BEAR ";
2340 PRINT"OFF WITH THE";P
2350 NP=NP-1:IFNPTHEN2380
2360 GOSUB5500:PRINT"I WIN
2370 GOSUB5600:GOTO8000
2380 N=P:A%(N)=A%(N)+2:GOTO2180
2390 FORI=6TO1STEP-1
2400 IFA%(I)<0ANDI>PTHEN2070
2410 IFA%(I)<0THEN2430
2420 NEXT
2430 GOSUB5500:PRINT"I CAN BEAR OFF ";
2440 PRINTCHR$(64+I);" WITH THE";P
2450 P=I:GOTO2350
3000 REM INTELLIGENT MOVES
3003 IFKTHEN3010
3005 GOSUB5500:PRINT"LET ME THINK..
3010 IFPM=0THEN3170
3020 IFHI=NHTHEN3500
3030 E=-9999:FORI=1TOPM:H=0
```

MICROMART

PERSONAL COMPUTER WORLD APOLOGISES TO FARMPLAN FOR THE TYPOGRAPHICAL ERRORS IN THEIR AD ON PAGE 20 OF OUR MARCH ISSUE.

PROGRAMS

```
3040 U=P%(I):V=W(7)*U
3050 A%(U)=A%(U)+1:IFA%(U-P)<1THEN3070
3060 H=1:A%(U-P)=0:V=V+W(8):IFU>18+PTHENV=V+450
3070 A%(U-P)=A%(U-P)-1
3080 FORJ=1TO24:IFA%(J)>=0THEN3130
3090 L=6:IFA%(J)>-6THENL=-A%(J)
3120 V=V+W(L)-200*(L=1)*(J<7)
3130 NEXTJ:IFV>ETHENE=V:X=I
3140 A%(U)=A%(U)-1
3150 IFH=1THENA%(U-P)=0
3160 A%(U-P)=A%(U-P)+1:NEXTI
3170 IFKOR(QM=0)THEN3400
3180 D=-9999:FORI=1TOQM:H=0
3190 U=Q%(I):V=W(7)*U
3200 A%(U)=A%(U)+1:IFA%(U-Q)<1THEN3220
3210 H=1:A%(U-Q)=0:V=V+W(8):IFU>18+QTHENV=V+450
3220 A%(U-Q)=A%(U-Q)-1
3230 FORJ=1TO24:IFA%(J)>=0THEN3270
3240 L=6:IFA%(J)>-6THENL=-A%(J)
3260 V=V+W(L)-200*(L=1)*(J<7)
3270 NEXTJ:IFV>DTHEND=V:Y=I
3280 A%(U)=A%(U)-1
3290 IFH=1THENA%(U-Q)=0
3300 A%(U-Q)=A%(U-Q)+1:NEXTI
3310 QM=12:IFD>ETHENPM=12
3400 RETURN
3500 X=PM:Y=QM:PM=SGN(PM):QM=SGN(QM)
3510 GOTO3400
4000 IFFMTHEN4050:REM DICE
4010 P=FNA(6):Q=FNA(6):T=TI
4020 IFTI-T>120THEN4040
4030 P=P+1:IFP>6THENP=1
4040 Q=Q+1:IFQ>6THENQ=1
4050 PRINT"███";D$;A$(P);"███";A$(Q)
4060 IFTI-T<210THEN4020
4070 RETURN
4500 REM GENERATE AVAILABLE MOVES
4510 PM=0:QM=0:FORI=1TO24
4520 IFA%(I)>=0THEN4590
4530 IFI-P<1THEN4560
4540 IFA%(I-P)>1THEN4560
4550 PM=PM+1:P%(PM)=I
4560 IFK>0ORI-Q<1THEN4590
4570 IFA%(I-Q)>1THEN4590
4580 QM=QM+1:Q%(QM)=I
4590 NEXT:RETURN
5000 REM PRINT PIECES
5010 B$="███":W$="██":T=0:GOSUB5110
5020 B$=B$+D$+LEFT$(D$,8):W$="██"
5030 T=1:GOSUB5110
5040 PRINT"█";D$;SPC(21);
5050 IFBP=0THENPRINTZ$:GOTO5070
5060 FORI=1TOBP:PRINT"● ██";:NEXT
5070 PRINT"█";D$;"██";SPC(21);
5080 IFBH=0THENPRINTZ$:GOTO5100
5090 FORI=1TOBH:PRINT"O ██";:NEXT
5100 RETURN
5110 FORI=1TO12:V=T*(25-I)-I*(T=0)
5120 IFV<>NANDF>0THEN5200
5130 A$=" ":IF(VAND1)=0THENA$="█ █"
5140 PRINTB$SPC(3*I-(I>6)-1);
5150 IFA%(V)=0THEN5190
5160 K=209:IFA%(V)>0THENK=215
5170 FORJ=1TOABS(A%(V))
5180 PRINTCHR$(K);W$;:NEXT
5190 PRINTA$
5200 NEXT:RETURN
5500 REM CLEAR PAGE
5510 PRINT"█";Z$;Z$;Z$;Z$;"█";:RETURN
5600 REM DELAY
5610 FORI=1TO2000:NEXT:RETURN
6000 REM DRAW BOARD
6010 B$="|  █████  █████  █████  |█████| |█████| |█████| |█████ └┘"
|█████ █ █ "
6030 PRINT"███":FORI=1TO21
6040 PRINT"█ ";SPC(18);" ";SPC(18);" "
6050 NEXT:PRINT"██":J=65:K=1
6060 GOSUB6130:GOSUB6130
6070 PRINT" ";D$;LEFT$(D$,9):J=88:K=-1
6080 GOSUB6130:GOSUB6130:PRINT" ███"
6090 GOSUB6150:GOSUB6150:PRINTD$
|||   █"
6110 W$=" ┌┐ █████||█████||█████| |█████|  █████  █████  █████   |"
6120 GOSUB6150:GOSUB6150
6125 PRINT"██";D$;SPC(19);"███":RETURN
6130 FORI=1TO6:PRINT"█  ";CHR$(J);
6140 J=J+K:NEXT:PRINT" ";:RETURN
6150 PRINT"██";:FORI=1TO3
6160 PRINTB$;U$;W$;U$;:NEXT:RETURN
7000 REM HUMAN WIN
7010 PRINT"█THANKS FOR THE GAME!█
7020 PRINT"YOU WERE TOO GOOD FOR ME
7030 PRINT"█PLAY AGAIN? (Y OR N)
7040 GETA$:IFA$=""THEN7040
```

```
 7050 IFA$="Y"THEN500
 7060 END
 8000 REM PET WINS
 8010 PRINT"▯WOW !!-I WON !!▯
 8020 PRINT"I REALLY ENJOYED THAT !
 8030 GOTO7030
 9000 REM INSTRUCTIONS
 9010 POKE59468,14:PRINT"▯";TAB(13);
 9020 PRINT"BACKGAMMON▯
 9030 PRINT" I PLAY ALL THE USUAL RU";
 9040 PRINT"LES , WHICH YOU SHOULD K";
 9050 PRINT"NOW BEFORE YOU PLAY ME.▯
 9060 PRINT" FROM NOW ON THE ONLY ";
 9070 PRINT"KEYS YOU NEED TO  PRESS ";
 9080 PRINT" ARE AS FOLLOWS.▯
 9090 PRINT" A-X  TO MOVE FROM A POINT"
 9100 PRINT"  Y   TO RETURN FROM THE BAR"
 9110 PRINT"  Z   TO PLAY THE DICE IN REVERSE ORDER"
 9120 PRINT"SPACE AS INDICATED▯"
 9130 PRINT" IF YOU PRESS Z TWICE YOU";
 9140 PRINT" WILL SURRENDER YOUR MOVE.";
 9150 PRINT"REMEMBER THAT YOU MUST ";
 9160 PRINT"USE   ALL OF YOUR MOVE IF TH";
 9170 PRINT"IS IS POSSIBLE. I WILL TRU";
 9180 PRINT"ST YOU IN THIS (AFTER A";
 9190 PRINT"LL YOU   HAVE TO TRUST ME";
 9200 PRINT"-WHO ROLLS THE DICE?)▯
 9210 GOTO500
READY.
```

LEISURE LINES

With J. J. Clessa

An excellent response to the cube problem — 127 entries were received (including one from Norway), not to mention a further 25 late entries for the previous palindromic square puzzle (sorry chaps, the prize had gone). Of the 127 entries, 102 plumped for green, 19 for yellow and 6 for blue.

I wish I could say the answer was red, but the statistical evidence is too strong — GREEN is the correct solution.

The problem is not too difficult to solve by trial and error (since the number of possibilities is small), if you realise that, of the five colours: 1) if a colour is present on two faces, then obviously the other four colours can only be on one face each, and b) when a colour is only present on one face, then successive views showing this colour must, of course, be of the same cube face.

One reader, by the way, said it took him 30 seconds to solve, whereas the Irish crossword took him 15 minutes. . . sorry to hear that, Patrick!

Anyway, the winning entry (as picked by our biased random number generator) comes from a lady (at last!). Congratulations to Miss V. Mason of Cobham, Surrey. . . your book token is on its way.

QUICKIE

A train leaves Edinburgh at 8.00am and travels to London at 60mph. At 9.00am another train leaves London and travels towards Glasgow at 90mph. Which train is nearest to London when they pass each other *(I don't believe it — Ed).*

PRIZE PUZZLE

A turkey farmer has 100 cages ranged in the form of a continuous circle around the perimeter of his farm. The cages are numbered clockwise sequentially from 1 to 100, with cage number 100 completing the circle and immediately adjacent to cage number 1. In each cage is a turkey.

The farmer decides to kill one turkey only per month, and in order to make his monthly selection, he counts clockwise N birds from the cage of last month's victim (N being the number of days in that month) to obtain his current month's turkey dinner.

Assuming his first bird comes from cage number 31 in January 1980, a) which will be the last bird to be eaten, and b) which bird will be Xmas dinner in 1985?

Note that the count is made on BIRDS, not on cages.

Answers please on a *postcard* to Puzzle No. 9, Personal Computer World, 14 Rathbone Place, London W1P 1DE. All solutions must arrive by May 12th latest.

PRIZE OF THE MONTH

Winging its way towards the lucky winner will be a pack of ten, C-90 blank tape cassettes.

BLUDNERS

March 1980. Page 80: Macronoia needs a bit more tweaking. Line 875 should read (J—1) not (J — I) and line 1680 should read INT(P1(J)*1000)/10 at the end of the line.

March 1980: Page 107: Mark Franklin's Ds were misread as 2s, accordingly 0F36 now reads CD01 and 0F4D reads C8DA.

April 1980. Page 73: Imphex lost a line immediately above Figure 2. It reads: "computer is limited to 26 single-letter". Now you know why you should feel cuckolded.

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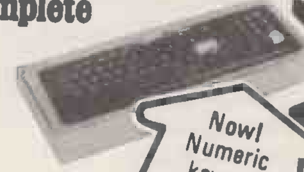

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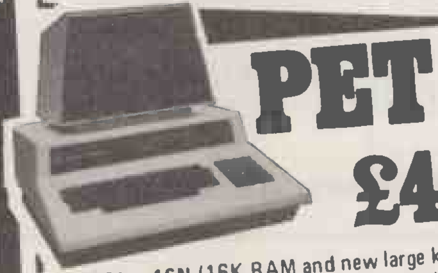

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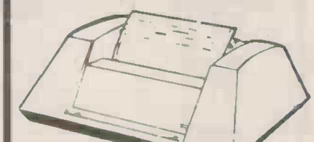

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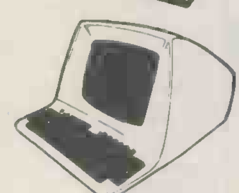

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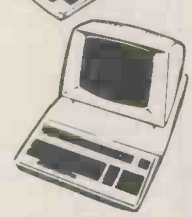

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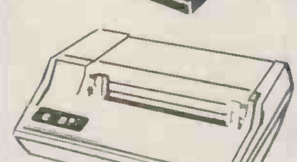

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CP/M software is several years ahead of software available for non CP/M family machines.

If you don't:

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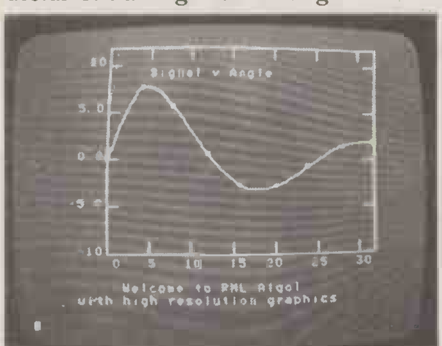

It is worth remembering too that neither our low resolution graphics nor our optional scientific (high resolution) graphics has any limiting effect on your memory usage, and in both you can freely mix upper and lower case text and diagrams.

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Don't buy a 380Z on patriotic grounds.

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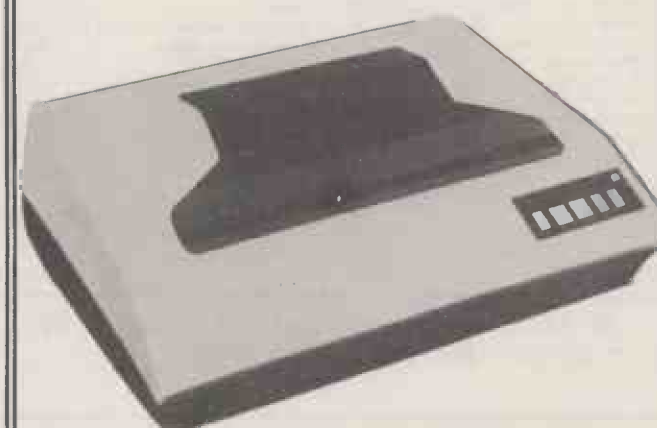

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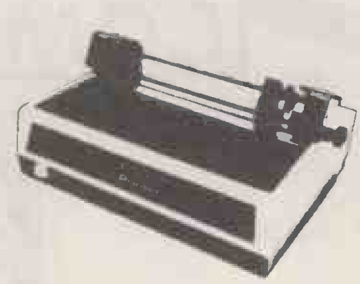

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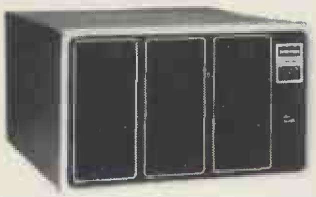

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