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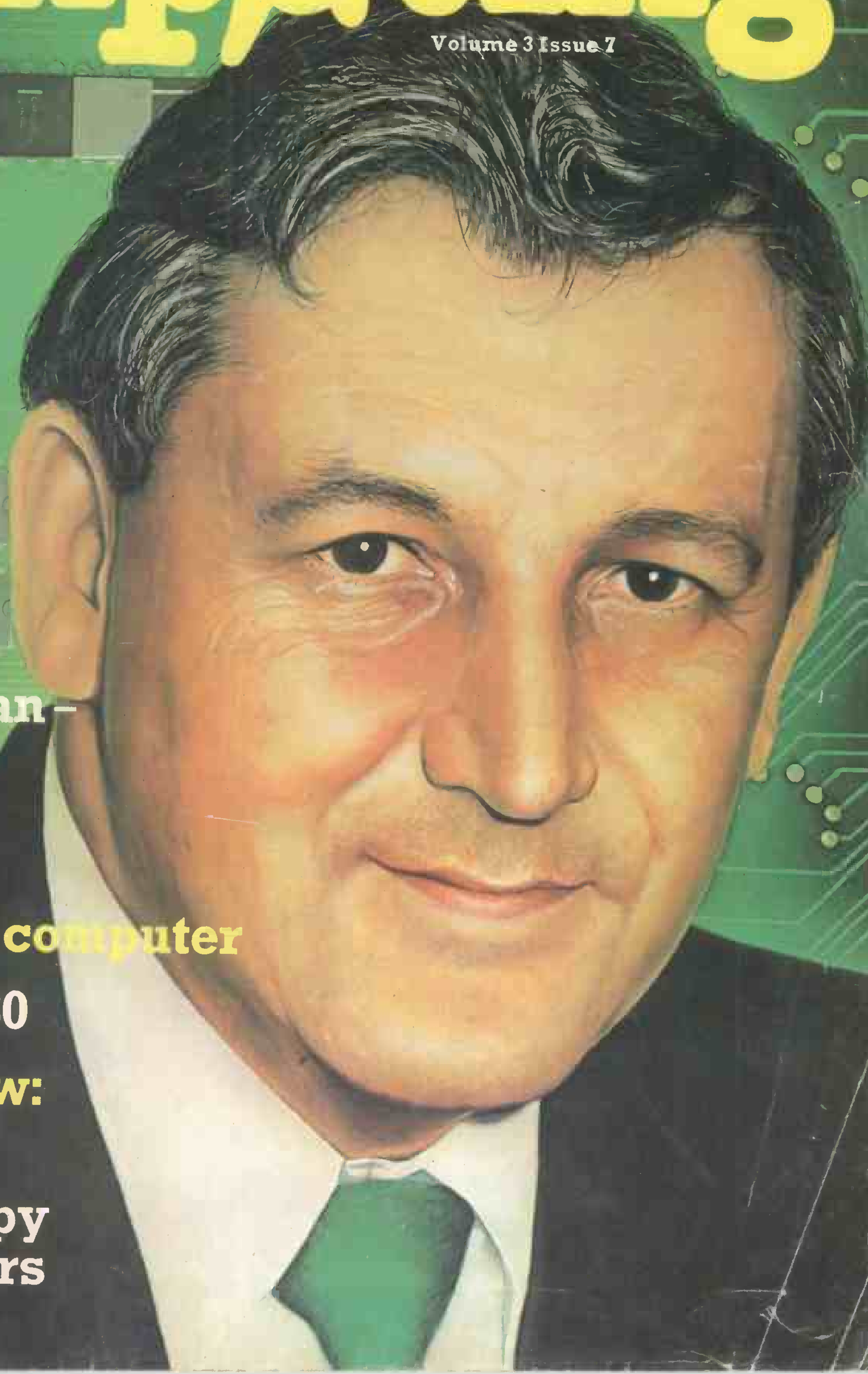

Transam Tuscan – the designer's story

Reviews: Sharp's pocket computer

Inside the ZX-80

Software review: Payroll-200

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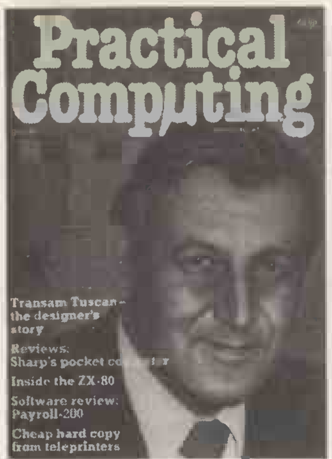

The face that launched a thousand chips — Mike Hughes. The Transam Tuscan designer's story is on page 62.

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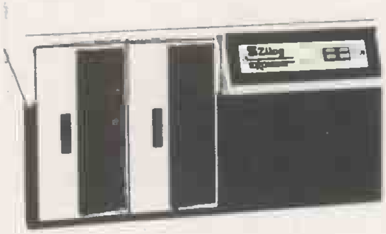

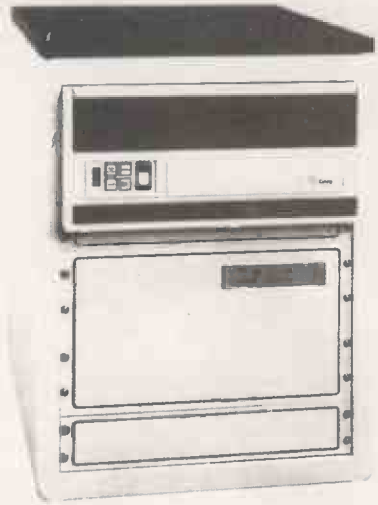

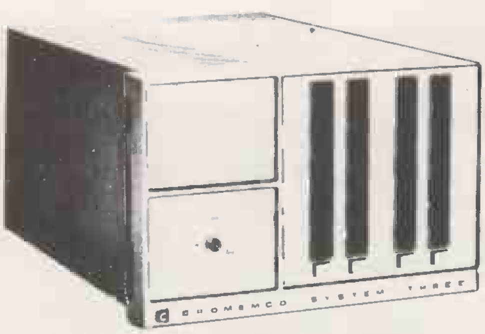

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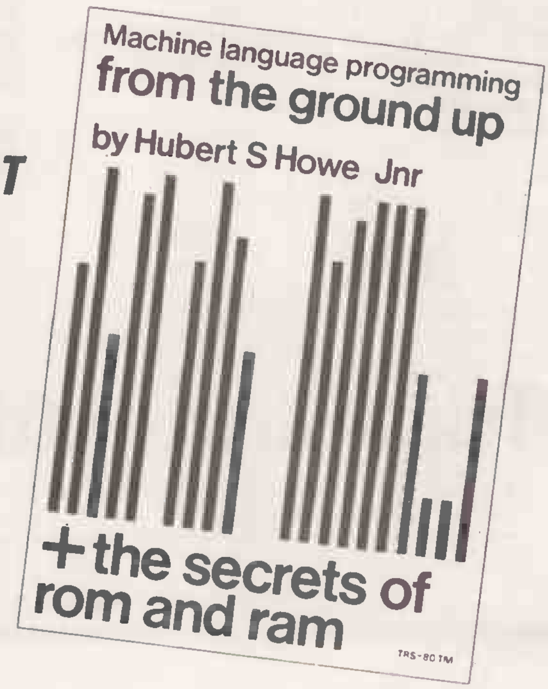

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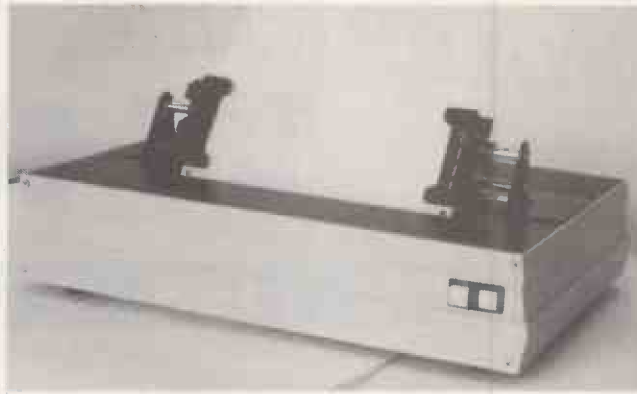

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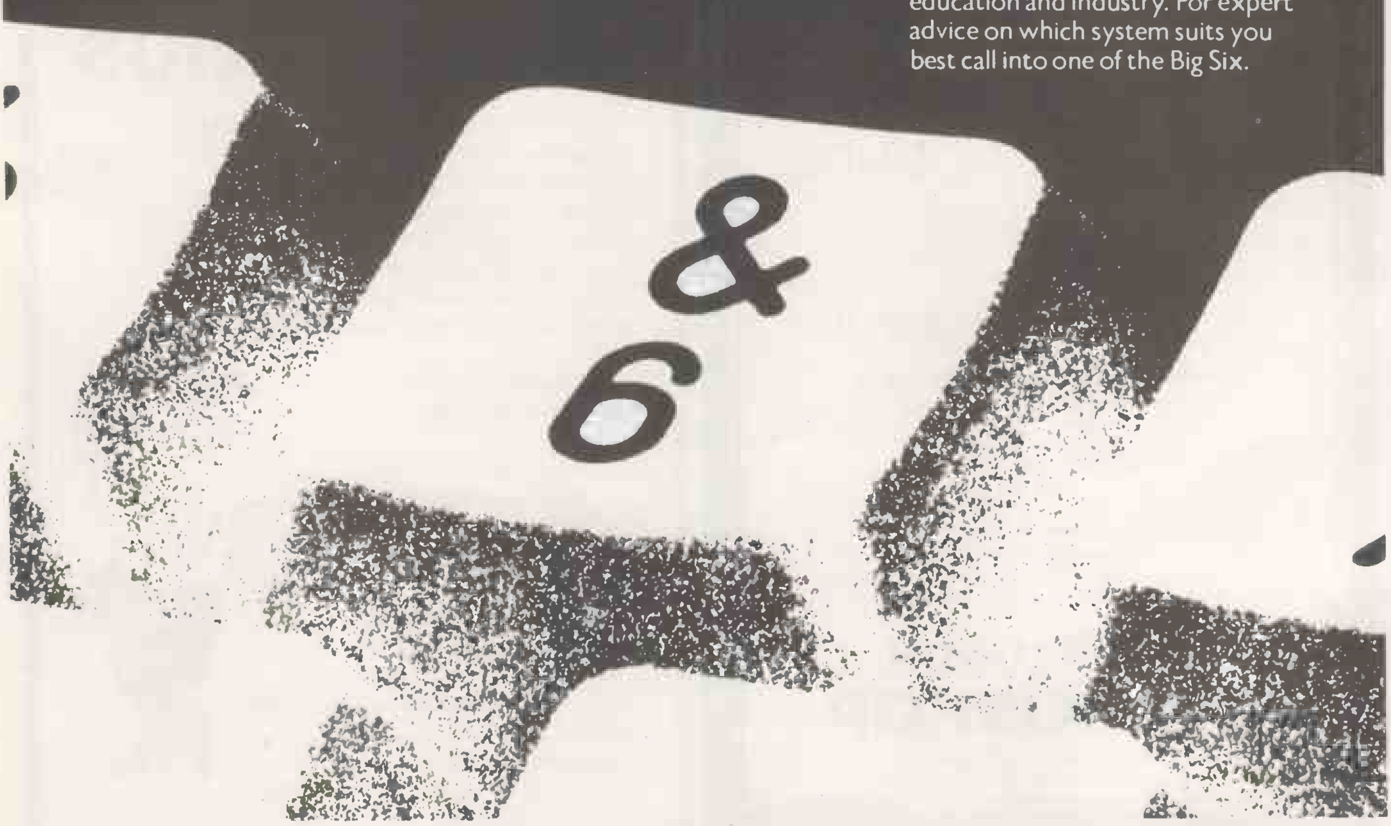

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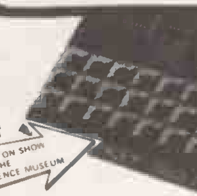

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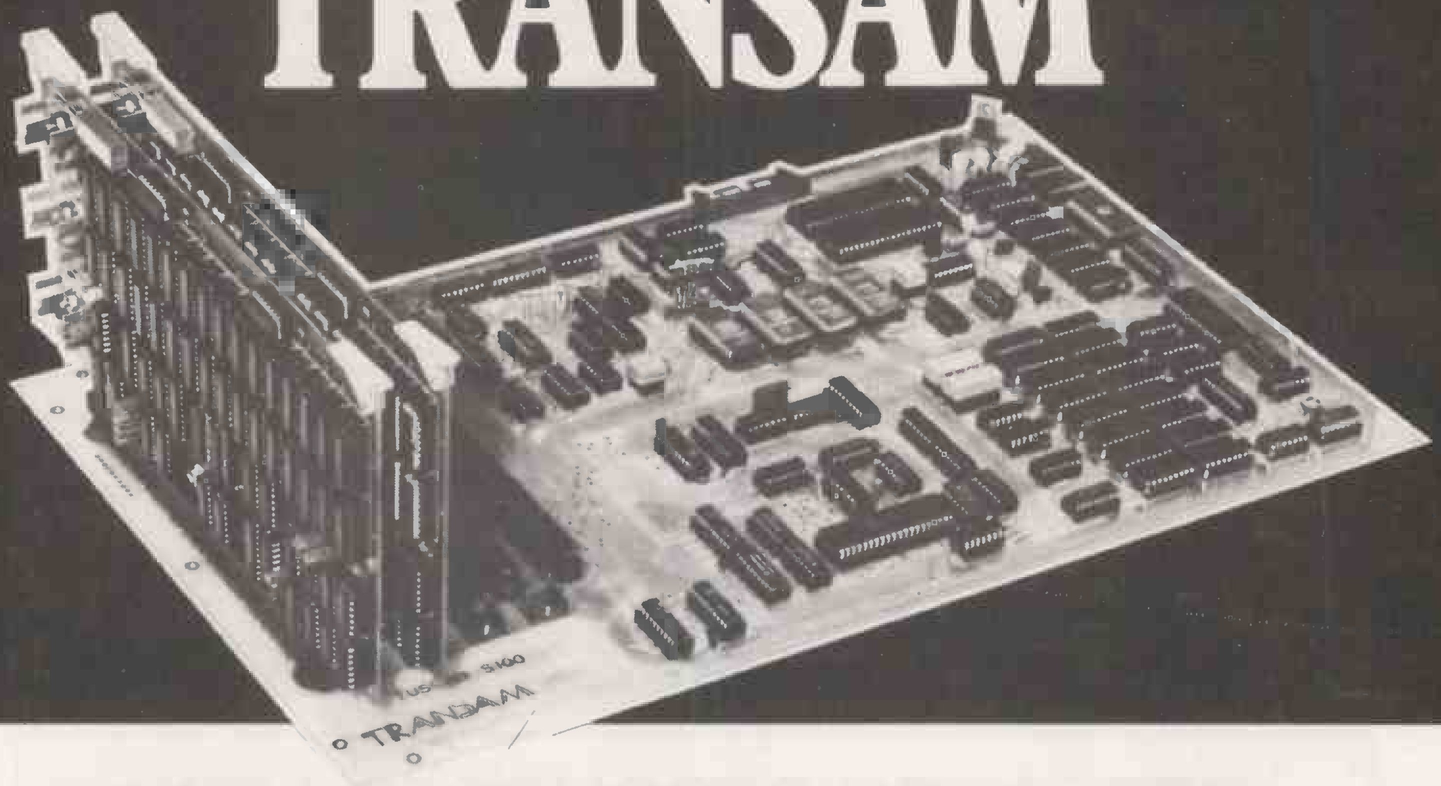

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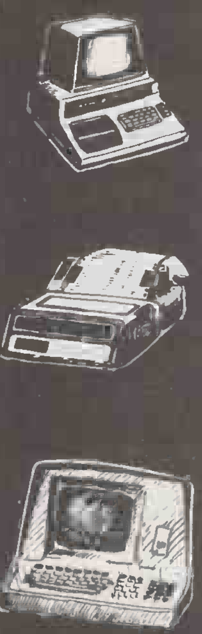

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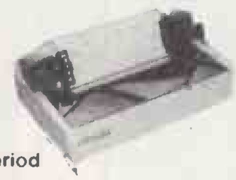

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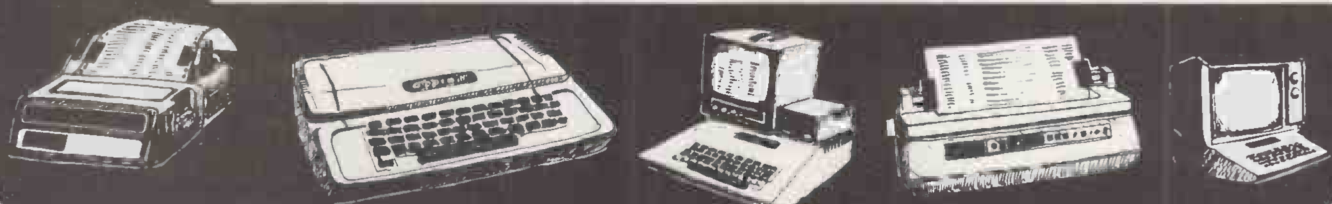

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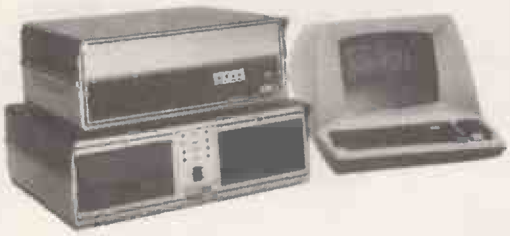

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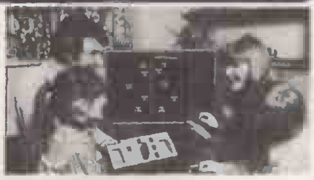

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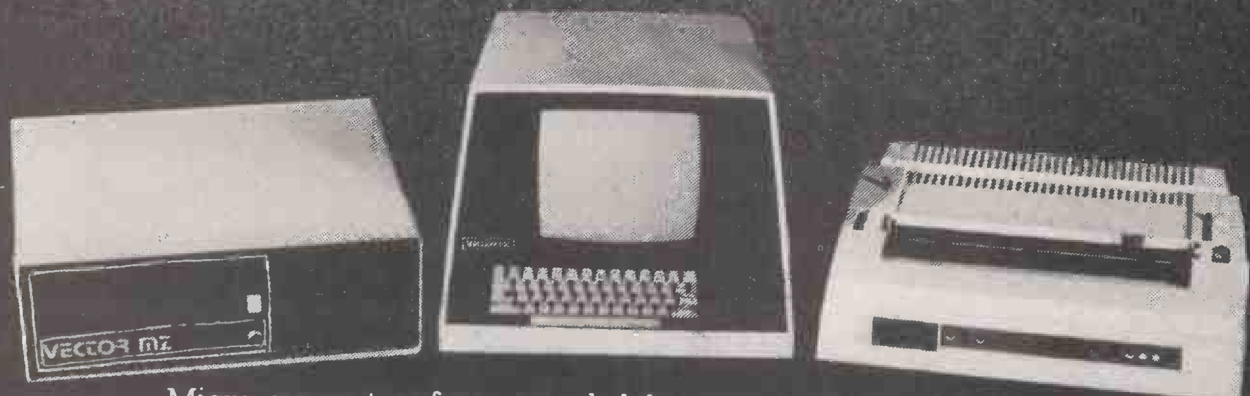

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• Circle No. 141

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If you do:

Given good hardware, software availability completely determines the flexibility and usefulness of your system. There is absolutely no question that a Z80 based micro-computer which uses the industry-standard CP/M* disk operating system has several times more software on the market available to it than non CP/M computers.

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If you don't:

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For many people a disk machine is too expensive – but at least the 380Z approach will allow your students to advance.

380Z BASIC is not frozen in ROM. An enhanced BASIC could be loaded in mid 1980 and a BASIC with structured features sometime later.

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Does our research-oriented design pay off in classroom hardware?

Our scientific graphics was produced for the professional user. Interest in it for classroom use has been surprising.

The 380Z has the best graphics now available on a microcomputer, allowing multiple resolutions, multiple paging, fading and accurate control over colour. All these features help bring excitement to efforts in computer assisted learning.

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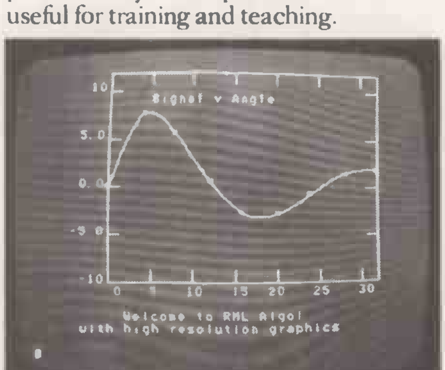

It is worth remembering too that neither our low resolution graphics nor our optional scientific (high resolution) graphics has any limiting effect on your memory usage, and in both you can

freely mix upper and lower case text and diagrams.

Mains noise can cause system crashes which result in loss of programs and data. All current 380Zs include a mains filter which significantly reduces the chances of this happening.

Don't buy a 380Z on patriotic grounds.

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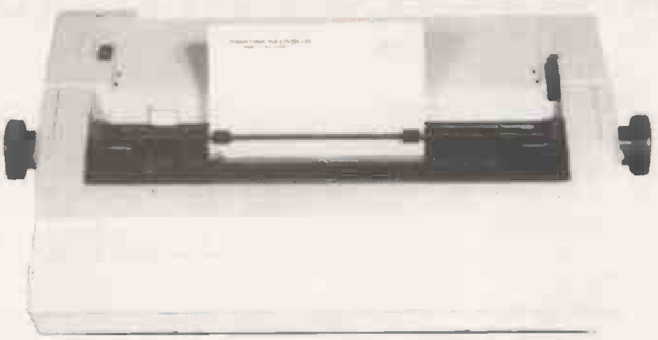

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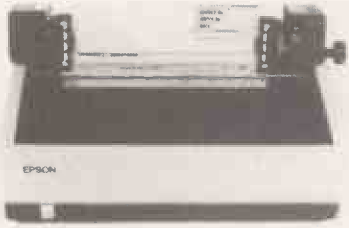

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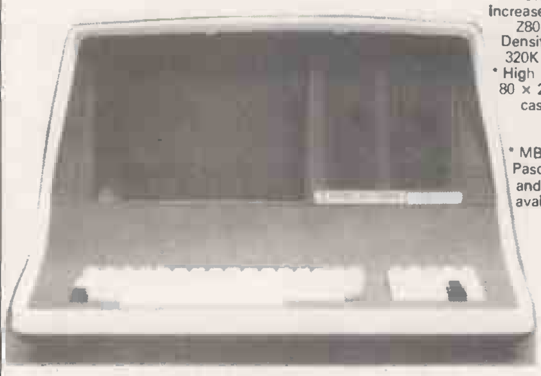

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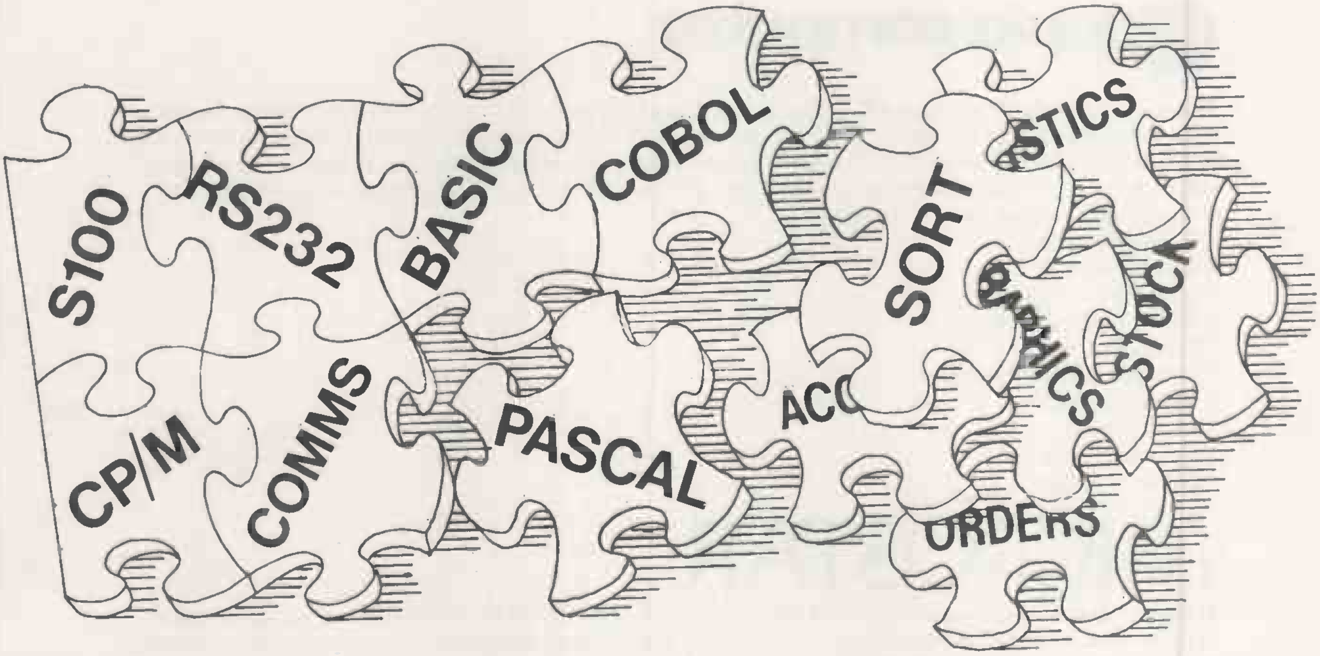

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• Circle No. 154

Software copyright and the law

THE VEXED question of software copyright is not often a matter for the English courts but the subject was aired when Science of Cambridge Ltd and Sinclair Research Ltd alleged that Compshop Ltd had copied certain features of the ZX-80 so flatteringly exactly on the MicroAce that it rendered itself liable to various sanctions that the law provides for those who tread on another's copyrights.

The case was of some interest because as the law stands many interpretations are possible — we will not know what the law is until a new Act is passed or a judge applies the old law to this very new problem.

Continuing problems

Science of Cambridge and Sinclair Research sought an injunction on the grounds that Compshop had infringed copyright in the special lettering of the ZX-80 keyboard and in the operating system and Basic contained in the ZX-80 ROM.

The case came before the Court on two days. On the first day, the plaintiffs sought an injunction to prevent Compshop and Product Launch, the promotions company, selling or advertising the MicroAce. An injunction is a kind of legal sticking plaster, applied by the Court to staunch the flow of blood until proper surgery can be done.

In the proceedings for an application for an injunction, too much weight cannot be placed on what the judge says, but in a case like this where the precedents are skimpy, any scrap of judicial wisdom is valuable.

Mr Justice Megarry said that he would not consider the question of copyright in the program in ROM because he "could not see it". He then granted Science of Cambridge an injunction over the keyboard copyright, quite reasonably it seems, since it appears it was a Sinclair keyboard protruding from a new box.

It is unfortunate that the ROM question was not argued and decided on the first day and was not considered on the second because the parties reached a settlement out of court.

To the microcomputing business it means continuing headaches. Until now, it has been assumed that computer software was subject to copyright — like the written word, drawn illustrations or music. In English law, as soon as you create any of those things, you have a copyright. In U.S. law, you have to add © and the date. Now it seems that this was an incorrect assumption.

Legal interpretation

The whole matter turns apparently on the meaning of the word 'writing' in the Copyright Act. The Act protects "every original literary work". "Literary work" includes any written table or compilation but is a computer program, when on disc, tape, in ROM or EPROM to be considered as 'writing'?

The interpretation section of the Act says: "Writing includes any form of notation, whether by hand or by printing, typewriting or similar process". That is both good and bad. 'Notation' looks good, since the representation of an ASCII 'A' by 0100001 in patches of differently-orientated magnetic domain is certainly notation and has the readability and general acceptance one would expect of a 'notation'. "By hand or by printing" sounds bad. Those processes typically produce marks that can be seen and distinguished by the eye. One certainly cannot claim that for magnetic media or EPROMs. You can see some kind of writing in a ROM — if it has the lid off, but not if it's in a computer.

Presumably, that is why the Judge said he would not consider the software question. If Parliament wished to extend the protection of copyright to invisible writing, it could have done so. If people are silly enough to produce invisible writing, they cannot claim the protection of the Copyright Act, at least in its present form.

The Whitford Committee Report on Copyright and Designs Law (HMSO, Cmnd 6732) decided that a computer program when written on paper was probably protected, and: "It may be that protection also extends to programs expressed in the form of punched holes and even to recordings on magnetic tapes and discs. But there is no case law and the position is uncertain".

It is no help that the music on a tape or a gramophone record is protected, even though it is invisible, because that is covered explicitly by another section of the Act.

Machinery or writing?

It is vexing that one could argue that the pattern of bits on a disc is a kind of machinery — as mechanical as the cogs and levers in Babbage's vast bronze analytical engine in the Science Museum — and ought, therefore, to be patentable. The Patent Office, however will almost certainly say that a pattern of bits on a disc, although novel, is a form of words and you cannot patent the contents of a piece of writing.

Software may be protected by the Act, as everyone thought it was. Unfortunately, there has never been a decision to settle the point, and in our system of law, there will not be a decision until someone takes a case to its conclusion.

So the matter rests. Until someone, at grave expense, carries a case through, or Parliament tackles this urgent problem, the whole question is open. It is a most unsatisfactory state of affairs. The rightful owner of software has to ask himself whether it is worth proceeding with a case that may make a lawyer's banquet and himself a fleshless skeleton. It will almost always be sensible to compromise.

When the number of computers in the world was numbered in thousands and the number on which any particualr piece of software might run in tens or at the most hundreds, this question didn't really matter.

Contractual obligations

Software could be protected effectively by contractual obligations. There was not much purpose in stealing it since there was nowhere to hide it. Now that machines are numbered in the hundreds of thousands — and soon in the millions — there is every point.

It is a matter of the greatest urgency that Parliament takes some action. Until it does, we will have to tolerate the possibilities of plagiaristic actions.

Our Feedback columns offer readers the opportunity of bringing their computing experience and problems to the attention of others, as well as to seek our advice or to make suggestions, which we are always happy to receive. Make sure you use Feedback—it is your chance to keep in touch.

Complete system

I HEARTILY concur with your editorial in the June, 1980 issue. I spent some time with traditional programming methods with a minicomputer and I am grateful I don't have to grind through that any more.

In those days, computing was not interactive. By contrast Basic is interactive, giving instant responses to commands and mistakes. You can interrupt a program, inspect or alter variables, edit instantly and the program cannot crash.

Compilers like Pascal are very slow to write, yielding little information about the progress of the program or its variables, needing a number of utilities to facilitate de-bugging. In short, Basic is not just a language but a complete programming system.

However, when you condense the issue from the prejudices, it comes down to economics. Basic is quick to write but slow to run, minimising the capital outlay in time/money to write the program. In a bigger system, doing the same tasks every day, and which must perform those tasks to maximum efficiency, the increased programming outlay pays for itself eventually.

For process control, I find the best system is to use assembly language, but with a good de-bugging aid. For automatic testing a good technique is to link Basic to machine language routines written in assembler — Hybrid programming.

David Sand,
Orwell,
Hertfordshire.

Language ideals

ONCE AGAIN, Peter Laurie has chosen to pontificate upon the ideal language for micros — editorial, *Practical Computing*, June, 1980. Starting from the premise that Pascal addresses problems irrelevant to programming on micros, he concludes that Basic is the only high-level language worth considering.

Surely anybody who has programmed seriously realises that the choice of an ideal language is not as simple as it may at first seem. There are almost as many ideal programming languages as there are languages.

If we must discuss Pascal, all that I would say is that it takes a fair time to learn to write clear Pascal programs, and during that period, Pascal doesn't suffer fools gladly. I also note that Laurie's proposed enhancement to Basic would make it more like Pascal.

Victor Rybacki,
London, SE23.

Nightmarish result

I HAVE just managed, without cheating and listing the program, to achieve a score of 2,120 in the game nightmare 6, beating the possible total.

Is this a record?

Darthy Bishop,
Oxford.

Sporting advice

I HAVE now been a subscriber to *Practical Computing* for one year. It is a pleasure to read every month — the variety and scope of articles are very good.

In the article on Intelligent Gambling in the May, 1980, issue, under an alternative method of storing data, the author mentions the slow speed of his program. I believe it would be faster if one notes that at every return from GOSUB 20000 one has to go through the 11 A$(. . .)=.

I would suggest the following modifications to an otherwise good idea:

```
400 A=0
410 as before
480 deleted                            ┐
500 to 520 (same as before)            │
522 A$(10) = "Tottenham 539"           │ same for all
523 GOSUB 20000                        │ 13 blocks
524 A=A+1 : IF A 10 GOTO 400           │
525 GOTO 523                           ┘
```

Having no computer to test it, I can only presume the program works as written, but with reference to SUBR 20.00, I feel unhappy about GOSUB with no return, as is bound to happen when Z$ = LEFT $ (C$,L).

Perhaps one would accumulate too many GOSUBs eventually. I suggest GOTO 20000, in place of GOSUB 20000, and change 20010 on Z GOTO 480, 580, . . . 1580.

I am no gambler, but I am willing to bet many will adopt this idea of storing data.

Donald Philippart,
Brussels,
Belgium.

Basic single-step

ACCIDENTALLY, I have discovered that Nascom II has a facility for single-stepping in Basic.

When Basic is running, not during input, type "ESC" (= SHIFT/ENTER). That will halt execution. A second "ESC" would return to immediate mode as described in the manual.

Instead, type "CONTROL/ESC" (CONTROL/SHIFT/ENTER) repeatedly. Each time, one Basic statement will be executed. So multiple lines will take multiple presses. Control/Shift can be held down and ENTER pressed to produce the single steps. To resume normal operation, "ENTER" on its own is typed.

During input, the above combination will produce a "[" character and will not single step.

I also have a hardware fault that only gives problems before the machine is warmed up. MID$(A$,I,1) returns the null string or has unpredictable results for the first 15 minutes of use. It crashes a program used to write to the top line of the string.

The program is:

```
10 A$ = "TITLE":REM PUT YOUR TITLE
   HERE.
20 FOR I = 1 TO LEN (A$)
30 J = 3017 + I :REM DEC ADDRESS OF
   TOP LINE
40 POKE J, ASC(MID$(A$,I,1))
50 NEXT
```

The error is caused by trying to find ASC(""). The routine has the advantage of not using the other lines of the display, unlike the Nascom version. Poking the VDU RAM doesn't produce any ill effects on my display.

David Green,
Nairobi,
Kenya.

Applications request

I AM attempting to compile a short book on microcomputer applications in the home.

I would, in consequence, very much like to hear from any readers about any applications they have devised for their equipment.

Ian Fraser,
Warrington,
Cheshire.

UK101 defended

I FEEL THAT Martin Collins levelled unjust criticism at the excellent UK101 in his review in *Practical Computing*, May. He stated that while typing lower-case, shift lock has to be pressed to obtain the special characters like ",&,', etc. That is not the case.

To obtain special characters, he needs merely to press the right-hand shift key, which acts as a double shift. Also, to obtain upper-case, rub out and return, he should use the left-hand shift key, which is a single-shift key. Of course, when in

(continued on page 44)

The desktop computer that thinks it's a mainframe

Compare these features with micros, minis or even mainframe computers. Then have a guess at the price of putting an Athena on your desk. We can guarantee that, even if you are already very aware of all the latest advances in multi-micro desk top computers, the answer will surprise you.

The Athena can be tailored for personal, educational, business and industrial users. It can stand alone or be connected to larger systems in a distributed processing environment. It is flexible and easily up-graded to meet changes in application requirements.

The basic system starts at £3,380. A typical configuration with 64K, integral dual floppy discs, 150 cps printer and software costs £7,954.

- **Multi-processing with intelligent buffered peripheral controllers**
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• Circle No. 155

(continued from page 42)
upper-case mode, both shift keys act as single-shift keys.

Readers might also be interested to know that a new monitor for the UK101 is now available — it allows cursor-control and editing facilities, and can save data on tape, improving an already excellent machine.

Alan Birse,
Clydebank.

Explanatory notes

I LIKE the magazine enough to be on my second annual subscription but practically every program is to some extent machine-dependent, different screen sizes require different PRINT formats, Basics differ and POKE locations particularly will have totally different addresses.

Could we have some notes in each article explaining such points? Then readers could translate the many excellent programs you publish for their own machines much more easily. Perhaps I feel this more than most as I have an Ohio Challenger and so have to translate almost everything.

As an alternative to notes in every article, could you publish a series of pull-out supplements giving details of different machines? By keeping them on file, readers could then look up the meanings of machine-dependent statements, screen addresses and lay-outs, etc. You could even couple these with your product reports.

Roger Beaumont,
Keighley,
Yorkshire.

QWERTY revisited

WITH REGARD to the QWERTY explanation by R Fawdry — Feedback, May, 1980. The reason for the lay-out of the typewriter keyboard, which goes back to the 1860s, is that once the operator had achieved typing at speed, the type bars became entangled with one another. To avoid that, a deliberate flaw was made in the lay-out of the keyboard, thus the letters used most often were re-sited as far as possible away from each other.

That had the effect of reducing the typists speed and the chance of type bars becoming entangled. The keyboard was named after the first six letters on the top line, QWERTY. The person to whom the credit went for QWERTY keyboard and the typewriter itself was Christopher Sholes, a newspaper editor in Milwaukee.

Keith Swainson,
Nottingham.

• Scholes' brother-in-law, a school maths teacher, designed the QWERTY keyboard to increase the speed of his typewriter. It was adopted as a standard after a much-publicised speed typing competition held just before the turn of the century. Tony Swainsberg, from Extel, has pointed out that 52 percent of the English language can be typed on the top row of letters. A simplified keyboard, it is claimed, could mean that a full-time typist, working an eight-hour shift would move her fingers only one mile in the day rather than 20.

Quirk of QWERTY?

CONCERNING recent comments on the QWERTY keyboard, is it any more than a coincidence that the longest word I can make from the letters on the top row of my typewriter is TYPEWRITER?

Matthew Bradwell,
Harby,
Leicestershire.

MisAdventure

ALTHOUGH I have a certain amount of sympathy with Lawrence Davis and his colleagues, Feedback, May, 1980, I was dismayed to see his letter published.

The whole essence of the game of Adventure is that one is venturing into the unknown. Even the questions he asked could open new areas of the cave to other people, while, if the answers were published, a great deal of enjoyment for a large number of people would be destroyed.

Graeme Thomas,
Weymouth,
Dorset.

PDP-8 appeal

352 SQUADRON Air Training Corps recently acquired an ancient, but working, PDP-8 to add to a Pet 16K micro already in use teaching cadets. DEC has been remarkably helpful in providing help and advice, but, of course, we eventually encounter the problem of cost.

Should any readers have manuals refering to any aspect of PDP-8, we would be delighted to hear from them. We are also interested in hearing of any surplus computer equipment in need of a good home.

We would, of course, be prepared to pay carriage charges or arrange collection of any documents lent for copying and for any equipment which your wife/managing director has been nagging you to get rid of for the last six months.

Finally, should anyone in the Burnley area be interested in seeing, helping with operating/pinching time on the above system, you are most welcome to ring me on Burnley (0282) 20009.

Graham Bird,
Burnley,
Lancashire.

Quick printer

IN TANDY FORUM of the May, 1980 issue, I note that Chess Ferrier says the quick printer is for the hobbyists. I do not agree. With a little know-how, I have managed to turn mine into a small word processor which allows me to write small notes to most of my business contacts, including the tax man. They all seem to accept the format I use and a lot of them are very keen to try it. The main point to my letter concerns the problems of cost saving.

I have at times fumed when I have read articles in computer journals about how much a small business has to spend to obtain micros. As a small business micro user, I can tell you that the money is well spent as far as doing the weekly books and the quarterly VAT return, but the micro in most business situations does not bring in any money, so the outlay must be reasonable. That is why I would love a large printer, but a quick printer will do for now.

David Lloyd-Jones,
Netherfield,
Nottinghamshire.

Delivery problems

I AM writing to you in the hope that the public airing of the subject of delivery might lead some of the hobbyist computer industry down a more efficient path to successful business.

While I am prepared to give the benefit of the doubt to the majority of firms who no doubt always deliver the correct goods on time, the consistent troubles we have had in ordering and taking delivery of software, literature and hardware from some firms put coincidence well beyond the realms of probability.

The only conclusions that I can draw are that firms often advertise goods which are either not in stock or not in production.

Because of the items I require for my work, I can raise an official order for goods and our ordering system is such that payment is made within 30 days of receiving the goods; no goods, no money. What of people who have paid *pro forma* invoices and can be waiting for goods for three months to a year after they have paid? How many telephone calls can they afford to make chasing up orders? With what confidence will they re-order goods from the same firm?

What is to be done? We have learned our lesson, and in future will stick to those firms who have provided a good reliable service. The extra cost is well worthwhile. As for software, it is quicker to order it directly from the U.S. if no U.K. alternative exists.

It has constantly amazed me that so many firms seem not to care whether they lose business or not. The customers ultimate sanction is presumably the cancellation of his order. I would advise caution in using that as a deterrent as it does not appear to work.

Much to my surprise many firms show no emotion at all if orders are cancelled and the only conclusion is that they must be happy to implement a take-it-or-leave-it policy and not worry about their customer relations.

While some companies obviously put to good use the systems they sell, many others still process all their work manually.

C Taunton,
Cardiff Royal Infirmary.

"If you want what's best for your PET, choose Commodore software."

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

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

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

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

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

NEW *BUSINESS SOFTWARE PROGRAMS ON DISK*

Commodore's Floppy Disk Unit and high-speed Printer, combine with the PET to form a complete system (ideal for running a business) for under £2,500.

Commodore also produce a growing range of business software on disk available from Official Business Software Dealers.

Business Information System – COMBIS £150 + VA .

Combis facilitates the storage and instant retrieval of all kinds of company records, from personnel files to mailing lists and printed address labels.

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Comstock provides an accurate, up-to-the-second and comprehensive stock position for as many as 1,300 products.

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Comword turns the system into an excellent word processor.

Payroll – COMPAY £150 + VAT

Compay is a new, comprehensive payroll package.

COMMODORE PETPACS

Over 50 Petpacs of programs are available (mainly on cassette) from Commodore Dealers.

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

TRAINING COURSES AND SEMINARS

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

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

PET USERS' NEWSLETTER

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

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Fujitsu hard discs move into Europe

ANOTHER Japanese company looks set to make its name heard in the U.K. — this time through the sale of Winchester technology hard discs. The massive Fujitsu corporation has recently signed a deal with the California-based Systems Industries (SI) giving them the right to sell the discs throughout the U.S. and Europe. This will be the European debut for Fujitsu disc drives and marks the entry of SI into the Winchester technology market.

The agreement covers the M2282/3/4 series of discs which will be sold in Europe as the 972/3/4. The drives offer access times of 6 milliseconds, track to track and 27 milliseconds average and contain storage capacities of 66, 132, or 165 megabytes of unformatted data. SI is claiming that a typical cost for the OEM user will be around $5,500 for 165 MB.

Managing director of SI(Europe), Pip Smith, says: "We are planning for European shipments of the Fujitsu drives of around 1,000 units during the first year of the agreement". He claims that Fujitsu is now the second largest manufacturer of Winchester technology drives. He adds: "Cutting data costs is critical. Typical costs of backing up a 300MB disc are in excess of £600. We believe the Fujitsu drives will provide comparative savings for disc users".

The U.K. subsidiary of SI is based in Woking, Surrey. Tel: Woking (04862) 5077.

Apple aims for Cork

MIKE MARKULA, the retired millionaire who provided financial backing for Apple Inc and is now its chairman, recently demonstrated the Apple III in London. He also announced that Apple is re-launching its attack on the European market by opening a new manufacturing plant in Cork, Eire. The new 43,000 sq.ft. plant should start producing Apple IIs by the end of the year.

At the same time Eurapple is being phased-out as the European distributor and when that has been completed, by the end of January, 1981, there could be some price reductions on all the Apple models.

Space Invader challenge

IN AN attempt to appeal to our baser instincts, Newbear Computing Store is organising a Space Invader competition for the MZ-80K. A prize of £50 will go to the highest authenticated score between now and Christmas. Newbear has also produced its manual for Sharp Basic.

Deep Thought developed

RESEARCH MACHINES is developing a 32-bit machine provisionally masquerading under the title Deep Thought. It is said to be a bit slice device using the AMD 2900 family.

It will have a 24-bit address line which means that it will address a touch less than a million memory locations.

ZX-80 and MicroAce settle their differences

IN A CASE not without precedents in the world of microcomputing, Compshop recently proposed to launch a microcomputer bearing a striking resemblance to the Sinclair ZX-80, even to the extent that the keyboard appeared to be identical. The kit was to be advertised at a retail price of £50 and would have been sold under the name of MicroAce. Kerr Borland's company, Product Launch, was to have handled the promotion.

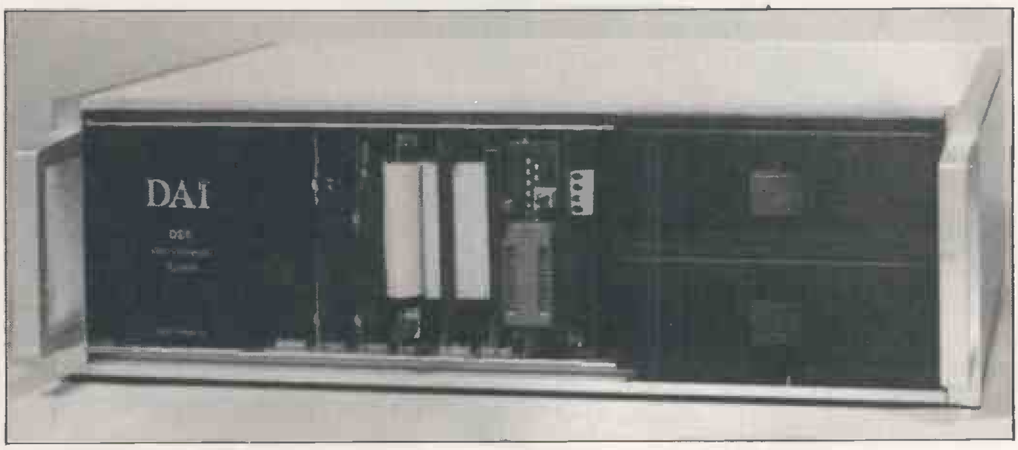
On May 23, Science of Cambridge secured successfully an *ex parte* injunction against Compshop and Product Launch which prevented them from advertising or selling the product on the grounds that the keyboard breached the Science of Cambridge copyright. The case returned to court on June 3 but was settled out of court.

Under the terms of the agreement between Compshop and Science of Cambridge, Compshop will have the exclusive rights to sell the ZX-80 kit in the U.S. using the name of MicroAce while Science of Cambridge will continue to sell the complete system. Compshop has agreed to pay Science of Cambridge royalties.

About 9,000 orders have been placed for the ZX-80 and there is a backlog in meeting the demand. Sinclair produced about 2,000 systems in June, hopes to produce 4,000 in July and nearly 10,000 a month by the end of the year. Compshop hopes to sell up to 50,000 kits in the U.S. while Sinclair aims to sell over 100,000 complete systems.

New industrial micro from Data Applications

The Data Applications industrial microcomputer has a PROM-resident DOS, up to 60Kbytes of RAM and a 2708 EPROM programmer card. The system is based on the DCE-BUS.



A NEW industrial microcomputer system, first launched by Data Applications at the Compec Europe exhibition in Brussels in May, is housed in a standard 19-in. Eurobox with two mini-floppy disc drives, and offers a disc controller card with PROM resident DOS, up to 60Kbytes of RAM and a 2708 EPROM programmer card.

It includes interfaces for a standard terminal, parallel printer and paper-tape reader/punch. The system is based on the DCE-BUS.

System software includes a text editor, macro assembler and a utility package providing debug function including program trace with automatic display of all CPU registers after each instruction execution. There is an automatic battery back-up.

NewBrain is latest hand-held machine to enter the field

ANOTHER entry into the hand-held computer market has been produced by Newbury Laboratories, the Odiham-based offshoot of the National Enterprise Board. Designated the NewBrain, the new computer will be released on to the market in September at starting price of £155 for a model (M) without an integral display, on battery back-up.

A more expensive version, the MBS, which includes an integral display and a re-chargeable battery back-up, costs £245. The model can be connected to a TV set and a wide range of other interfaces are available.

The system's software includes a full screen editor, a Basic compiler, operating system and a mathematical package which is accurate to 10 significant figures.

Modules under development include assembler, Cobol and Pascal and utility packages written in Basic and assembly code. Newbury Labs (025) 671 2910.

First true pocket computer

THE FIRST truly pocket computer which can be programmed in Basic has been launched by Sharp as the PC-1211. The earlier offering from Sharp, the MZ-80K personal computer, is now being marketed more aggressively as software and peripherals start coming on-line.

Peripherals now include the Sharp 5¼in. floppy disc units and a matrix printer.

System software includes an editor-assembler, a re-locatable loader and a symbolic debugger. H B Computers, of Kettering, has been appointed as the Sharp software agent and it will be publishing a catalogue of software shortly.

Sharp 5¼in. floppy disc drives.

Nascom calls in receiver

THE problems of surviving in the rapidly-growing microcomputer business have been well highlighted by *Practical Computing* in the past and it is a well-known danger that the company you buy from today may have gone out of business tomorrow leaving you stranded for parts and technical support. It is, however, particularly sad to have to report that one of our best known and successful manufacturers, Nascom, has called in a receiver. Several weeks ago John Marshal of Nascom announced that he was looking for a buyer to help support his investment plans after his backers, Grovewood Securities declined to inject any more capital into the company.

In June last year, Grovewood invested £500,000 in Nascom, shortly after the launch of the Nascom 2 which cost more than £250,000 to develop. Problems in securing supplies of EPROMs for the first Nascom 2 delayed the return on the investment.

380-Zs offered as prizes in DoI competition

THE DEPARTMENT of Industry, with the support of the Department of Education and Science, has announced a competition for schools with 100 Research Machines 380-Z microcomputers as prizes.

All secondary school headmasters have been contacted by the Department with details of the competition which closes at the end of July. Pupils have been asked to submit a project in whatever form they choose — essay, film, slides and so on — to describe how their school would best use a microcomputer. When the winners have been finally chosen, the Department of Industry will train the teachers of each successful school in the art of microcomputing. Entries should be sent to the Department of Industry, Room 326, Dean Bradley House, 52 Horseferry Road, London SW1P 2AG.

Dazzling the micromice

SOME of the entrants to the *Practical Computing* Micromouse competition are worried that, if the final is shown on BBC television, lights could upset their mice.

J E Noakes of BBC Television Outside Broadcasts, says: "If a television unit is used at the competition, the lighting will be tungsten and may be up to 150 candles, but most likely will be less at about 120fc.

"The colour temperature will be 3,200°K which should give you an improvement on the values in the table as a result of the shift towards blue. A film unit, however, may use either tungsten or HMI lamps and the lighting level may be up to 400fc".

The figures in the table will give you an idea of how the power is distributed between the wave lengths at a temperature of 3,000°K. The power at 560nm is taken as being 100.

Wave Length	Power	Wave Length	Power
300	1.36	800	219.63
400	17.52	900	237.74
500	63.09	1000	239.94
600	125.33	1100	231.41
700	181.68	1200	216.58

The Paris office of Euromicro 80 has circulated a questionnaire to all contestants in the 1980 competition. If you have been omitted from their list, please write to John Billingsley, Department of Engineering, Portsmouth Polytechnic, Anglesey Rd., Portsmouth.

NCC Anaheim report

THE 1980 National Computing Conference, held in Anaheim, California in May, was yet again a great success, attracting an estimated 80,000 visitors each day.

The most crowded stand at the show was certainly the Apple Computer booth, where, if you were good at pushing through crowds, you could see the new Apple III, the cause of a good deal of speculation for some time. The company has stuck with the versatile 6502 micro, as with the Apple II, but custom-designed LSI chips surround the processor, enhancing the instruction set, and enabling it to address up to 128K of RAM.

New version DOS

A built-in mini-floppy drive runs under a new version of DOS to give up to 126,976 bytes of storage.

The Apple III is obviously designed for the small business user. It is to be sold in packages including the machine, monitor, the new Apple Silentype thermal printer, and software including a Sophisticated Operating System (SOS), VisiCalc III, Mail List Manager, Apple Business Basic, a WP package, and other items.

The unit includes a contoured QWERTY keyboard with numeric pad, specialised cursor control keys, and two keys for normal and reverse video. Interfaces are built-in and include RS232 and Silentype ports. The display output to the monitor includes upper- and lower-case.

Apple II emulator

A useful utility capability on the Apple III is an Apple II emulator which enables the III to behave just like its predecessor, so that your existing software is not made redundant.

On one machine, a demonstration program divided the screen into coloured rectangles, across which horses galloped and birds flew. These remarkable demonstrations utilised the text mode of the Apple III — certainly an impressive machine. It should be available in the U.K. by the end of September.

Other products from Apple, new at the show, include Apple Pilot and Fortran. The Pilot system requires an Apple II or II Plus with 48K and one or two disc drives depending on the application. Packages are offered aimed at the CAI market, and allow graphics and music generation apart from the normal interactive capabilities of the language.

The Fortran package offers a version of the language which is ANSI Standard Subset Fortran 77, which provides significant additions to the previous 66 standard — known as Fortran IV. This version includes structured programming possibilities through expanded IF statements.

The new Apple III.

Fortran operates in the Apple Pascal language system, enabling Fortran, Pascal and assembler routines to be created into a single program. Additionally, Apple Fortran handles high-resolution graphics, sound, and control paddles. Fortran requires the language system plus 48K and at least one disc drive.

Thanks to Microsoft, you can now run CP/M on your Apple. The Z-80 Softcard from Microsoft enables you to run CP/M on the Apple and includes a 4MHz Z-80 processor, running at about 2.04MHz. Z-80 addresses are offset by $1000, so that the Z-80 sees CP/M programs at their correct locations without affecting screen memory. Entering card is simply a matter of booting the CP/M diskette. CP/M occupies 7K. Also supported by the card and supplied on another disc is the Microsoft ANSI standard Basic 5.0.

The APF Electronics new IM-1 Imagination Machine is low-cost, self-contained and, perhaps surprisingly, based on the 6800 micro. Apart from the Technalogics system, no other small machine is based on this processor.

The Imagination Machine is built into a sturdy plastic case with full QWERTY keyboard, built-in cassette machine which uses digital recording at 1200 Baud, sound synthesiser and speaker, and two hand-controllers with numeric keypads and joysticks. Built-in is a Basic interpreter, plus 9K RAM and 14K ROM, both of which may be expanded.

The screen format is 32 characters by 16 lines, with alphanumerics in three colour modes. Base-resolution graphics offers 64 × 32 with up to eight colours intermixed with alpha-numerics, while two high-resolution modes offer 128 × 192 in eight colours, or monochrome only with 256 × 192 resolution.

Basic keywords

Major Basic keywords may be entered with single keystrokes, and the unit includes an RF modulator. Software is available on cassette or in ROM cartridges. The IM-1 may be expanded with the BB-1, building block system, which offers four ports for peripheral-drive cartridges, including one such pack for a standard RS232 interface, selectable in eight baud rates from 110 to 9600 baud.

An 8K-RAM cartridge plugs directly into the machine for memory expansion, and a disc interface cartridge drives up to two standard 5¼in. drives. A 300-baud originate/answer, half- or full-duplex modem is also available. The floppy drives are standard SA400-compatible offering 72K per single-sided diskette, with standard IBM formatting.

Disc commands are built into the Basic interpreter cartridge. A 40-column serial thermal printer is also available. The IM-1 apparently is to be distributed in the U.K.

Impressive machines

Looking moderately like a new-type Pet but with a bigger — 80-column — screen format, the new 8000 series from Commodore was strongly in evidence on the CBM stand. The Pet name seems to have been dropped on the new equipment. Unfortunately, however, those impressive machines, complete with green-phosphor screens, were unsupported by documentation. An extensive range of 8000-series software, which includes WP and business packages, is available.

The 8000 series already includes a neat dual-disc package and printer. The DOS appears to have been re-written extensively with a number of very useful utilities, including a routine to copy or restore a corrupted file.

Triple-processor

On the Ohio Scientific stand, the triple-processor — Z-80, 6800, 6502 — C3 systems, ran various business packages and CP/M. Also on display were the Challenger C1 — Superboard II in a case — and the new C4. This machine includes full-colour displays of 16 hues, background and foreground including alphanumerics and graphics characters, with upper- and lower-case display of 64 characters by 32 lines.

The C4 is a development of the earlier C2 and, in keeping with Ohio Scientific policy, is both hardware — and software — compatible. The machine includes two RS232 interfaces, sound and C/A outputs and something like 50 add-on boards are available to handle more or less anything from discs — 5¼in., 8in. or hard discs — to D/A,A/D and power control systems from burglar alarms to room lights.

Now you can control your business for less than £2,500.

This could be your best investment opportunity yet. A complete computerised business system, including a Floppy Disk Unit, high-speed Printer and *Britain's best selling microcomputer* – the Commodore PET. All for under £2,500.

First Class Programs

A comprehensive range of first class programs is offered by *Commodore 'Business Software' Dealers*. These are available on disk from £50-£500. And they cover such applications as *Business Information, Stock Control, Word Processing, Payroll, Accounting* and *Mailing Systems*.

Service and Support

With over 10,000 PET computers installed in the UK, dealer support is growing fast. A nationwide network of 90 official *Commodore 'Business Software' Dealers* ensures that service and technical facilities are close to every PET user. Our dealers can even offer you a 24 hour on-site maintenance agreement.

Training and Instruction

The PET Business System is self-contained and simple to use. Should you require personalised programs or extensive installation training this can be arranged with your *Commodore 'Business Software' Dealer* who can also give details of official *Commodore Training Courses*. These include intensive 2 & 3 day workshops to train you to write your own programs.

For full details about the Commodore PET Business System, Training Courses, Programs, *and 'Business Software' Dealers*, simply fill in the coupon and post today.

To: Commodore Information Centre,
360 Euston Road, London NW1 3BL

Please send me details of the PET Computer Business Systems.

Name ______

Position ______

Company ______

Address ______

______ Tel. No. ______

If you have a particular application in mind please specify:

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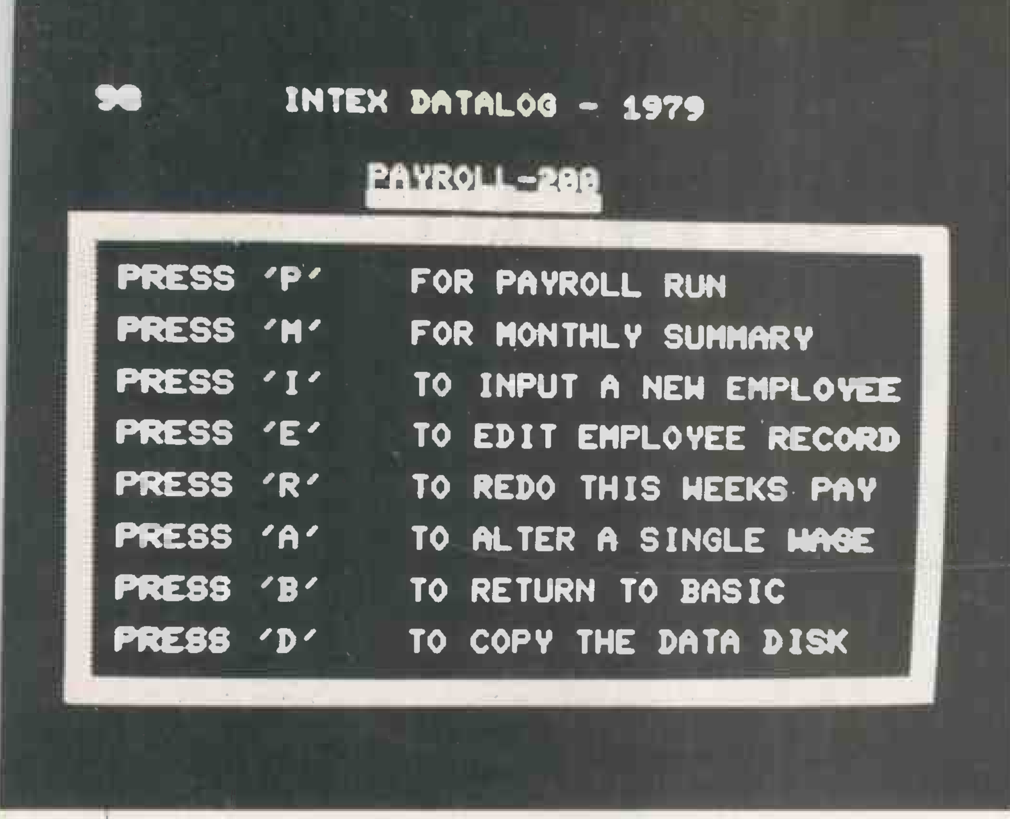


With the present glut of payroll systems, the search for the right package may prove a harrowing experience for the prospective buyer. To help him through that ordeal, Mike McDonald looks at Payroll-200, a package from Petsoft, which runs on the Commodore 3032.

Payroll-200 offers good value for money

by Mike McDonald

PETSOFT is a subsidiary arm of the Micro-ACT venture established by ACT in Birmingham. Julian Allason founded Petsoft and still directs its efforts to make it the leading supplier of software for the Commodore range of microcomputers. In addition to the weekly payroll package, Petsoft also offers purchase and sales ledger, stock control, and sales invoicing for the 3032.

Payroll-200 is a weekly payroll system for Commodore systems comprising a 32K Pet, printer, and dual mini-floppy disc drive of either Commodore or Computhink origin. The maximum number of employees using the Commodore 2040 or 3040 disc drives is 200 and the system is based on fixed-length records. The facilities offered by Payroll-200 are:

- A standard week facility to reduce data entry for weekly runs to only that information which has varied.
- Tax codes catered for are L,H,P,V,T, BR,NT, and prefix D and F codes on both cumulative and week one systems.
- Standard, reduced-rate, and zero-rate National Insurance contributions for non-contracted-out schemes.
- Global alteration of tax code values to allow for changes in legislation.
- Three wage rates — normal, time-and-a-half, and double-time for each employee with holiday, sick-leave, bonus, and adjustments routines.

Payroll-200 costs £50 and is supplied as an A5 wallet containing a single floppy disc which carries programs and a small neat operator's manual. The package comprises a suite of programs of which only two are accessible by the operator. They are a start-up routine for pre-formatting data discs to be used with the system and the payroll program which menu-drives the balance of the functions.

The master disc is always left mounted in the left-hand drive 1 and data disc in drive 0 while running. The start-up program is a simple disc-formatting facility which is run initially against a blank diskette.

The routine initialises the disc into 400 records and issues a series of status messages informing the operator of its activities — a measure to prevent error. Once performed, the start-up program is unlikely to be used again and the balance of use is via the payroll program.

Having prepared a data disc, the main program is loaded and run. The first activity encountered is a password routine which requires the currently-logged password to be entered. If the entry is incorrect, the Pet is re-initialised and the program lost. On correct password entry, the master menu is loaded and displayed and normal running can begin.

While the menu is displayed, a count-down begins which, if left, on reaching zero will time-out and program execution ceases. The user must then re-run the program and enter the password again to regain access.

It is an exceedingly useful routine which will stop any unauthorised users from interrogating the payroll if the machine is left unattended for any length of time. The standard of security in the system is very good. Programs are loaded directly to memory and are, therefore, not listable by the ordinary user.

We were able to break the system in the end but not without a good deal of peeking and poking on at a high level. It is extremely unlikely that any user will ever encounter any source code for this system, except by a rare accident. The suite of programs are also non-interruptable except by error-exit and user-exit routines.

The menu displays the more-commonly-accessed options with occasional routines, i.e., year end, budget changes shown in the operator's manual. Functions are:

Command Letter	Function
P	Weekly payslip production & reports
M	Monthly summary
I	Input new employees
E	Edit existing employee records
R	Re-do current payroll, re-run option
A	Alter a single wageslip
B	Return to Basic, program end
D	Copy data disc
Shift A	Annual re-start
Shift B	Budget amendments
Shift C	Change password
Shift L	List all details of employees

Shift items are not displayed as options on menu.

The two main functions in the payroll are the entry and editing of employee details and the production of weekly payroll with modification to individual details where deviation from a standard week has occurred. The first exercise was to enter the employee details into the system.

On entering the input program, a data entry form is displayed on the screen depicting an employee record card. All data is held in the one screen format and good use has been made of the Pet graphics to produce a highly-legible 'soft' document.

The user is prompted through each field by a flashing cursor and various options validated, range checked, and queried if excessive. The fields and each of their options are:

- a. Employee name — 20 characters' maximum. Letters spaces hyphens and dots are permitted.
- b. Hourly rate — hourly pay in pounds. Maximum entry 9.99.
- c. Normal bonus — lump-sum payment, maximum 99.99.
- d. Normal hours — standard week in hours, maximum 99.99 — confirmation request if in excess of 50.
- e. Annual holiday — total hours of annual holiday entitlement — maximum 999.99, confirmation request if in excess of 160 hours. That figure is reduced as holiday money is paid by the system.
- f. Tax code — only valid codes are accepted, i.e., L,H,P,V and T suffix/prefix D & F and NT and BR plus up to 4 digits numeric. Invalid codes rejected.
- g. Tax week 1? — yes or no reply to determine calculation of tax on a week-one basis or cumulatively.
- h. NI rate — choice of higher, lower, or zero rate (a,b,c) deductions for each employee.
- i. Pay method — C,T or Q for cash, credit transfer or cheque payment. Used by system for cash analysis and summary listings by payment type. Cheque and Giro print routines are not included.
- j. NI number — entry of AA999999A is permitted and re-formatted to NI standard form, i.e., AA 99 99 99 A.
- k. Gross pay TD — cumulative field for entry of new employee's previous earnings in current tax year. Maximum 99999.99. Can be adjusted if necessary.
- l. Tax paid TD — as for k. for cumulative tax year.

Once each field is either filled or return entered, the cursor moves on to the next automatically. Each field on the form has a field-identifier letter and each field may be accessed for editing or re-entry simply by entering the identifying letter at an appropriate point.

Incorrectly-typed fields may be deleted at the time of entry, and re-entered. Once a record is complete the user may input more employees, edit existing employee records, exit from the program or return to the menu. At the beginning of each new entry, the system requests a first pay-week number to be entered.

That number will determine when the system will begin to pay the joiner. If the number is less than the current week, backpayment will not occur. The program will allocate a payroll number to each new entry automatically on a first-free-number basis.

Entry to the edit routine requires the employee's number to be entered. Also at the edit stage, the user is given the choice of deleting employees from the system. Removal from the payroll does not occur until the next month-end is run. That keeps the summary totals correct, i.e., if the employee is paid for the first two weeks of the month. Payments are stopped from the time of deletion until the month end-run.

We were unable to establish if the space occupied by the deleted employee's record could be re-used as it proved difficult to complete a successful month end-run when records had been flagged for clearance. The program failed with a file-not-open error. It may have been due to a slight corruption on the program disc.

The information held on the employee record represents the standard week and assumes employees will, on most occasions, be paid on that basis. Week-to-week variations are catered for at the time of the running of the payroll.

The Payroll-200 package has been designed for use in conjunction with the tax-week year, ideally, but can be used on a calendar year. The payroll is run weekly by accessing facility P on the menu. The user is prompted for the current week number and is then offered the option of altering the standard details for each employee.

That is achieved by displaying each employee's name and payroll number and the user must opt for a standard payment, in which case the next employee is offered, or a non-standard payment. The program will then offer a data entry form for manual input of any or all of the following details:

a. Time, normal hours	in hours
b. Overtime, 1.5	in hours
c. Double-time	in hours
d. Bonus	in £s
e. Sick pay	in £s
f. Holiday time	in hours
g. Adjustment, miscellaneous	in £s
h. Contribution adjust NI	in £s

in this case entry proceeds to

1. Rate A contributions to date	in £s

(continued on next page)

(continued from previous page)

2. Rate B contributions to date in £s
3. New rate A to date in £s
4. New rate B to date in £s
5. Wage adjustments in £s

The operator may access any one field and can edit values on a similar basis to the employee edit routine. At any point, the alterations may be cancelled and a standard week chosen. Once complete, the system moves on to the next employee on disc.

Sequential vetting

The sequential vetting of each person on the payroll proved to be the only element in the system where we felt that an improvement could be made. The access time combined with internal-processing time meant that some time delay occurs between each display of eligible payees.

That turned the running of each payroll into a tedious routine, particularly if no modifications were required. On a weekly basis, that is not such a major consideration but a full payroll of 200 would certainly take in excess of an hour, assuming a standard week is applied.

Once details have been entered, the program proceeds on a batch run to produce wage slips, a cash analysis, and three summary reports. The summary reports are;

- Payslip summary A showing employee's number, employee's name, normal hours, overtime hours, double-time hours, basic pay, bonus, holiday pay, sick pay, and gross pay.
- Payslip summary B showing tax, National Insurance, deductions, nett pay, adjustments, paid amount, National Insurance employer, total National Insurance employee's name, and employee's number.
- Employee details to date shows employee's number, employee's name, gross, tax free, tax paid, National Insurance employee, deductions, payable, and National Insurance total.

Each of the reports lists the employees in sequential numerical order and are very simple in design. The payslips are more than adequate for detail and do not require detailed pre-printed stationery although a boxed format makes the slip more legible. Stationery is available from ACT.

Report information

There is no output for those employees to be paid by cheque or credit transfer, nor are they shown separately on any of the reports. Given that there will not be many users wanting this facility, it is not critical, but it would be advantageous if those to be paid in either manner were flagged on the reports to aid in the preparation of payments.

A highly-useful and well-thought-out feature provided is the ability to halt the payslip-print program at any point with a variety of options offered to the operator to cover most needs. An abort menu appears if printing is halted and the user may

a. Press 'R' to re-start all wageslips.
b. Press 'C' to cancel all data.
c. Press 'A' to amend one wageslip.
d. Press 'B' to exit from the program.
e. Press 'M' to return to the menu.
f. Press '*' to continue the print run, or Press a number i.e., X to reprint the last X wageslips.

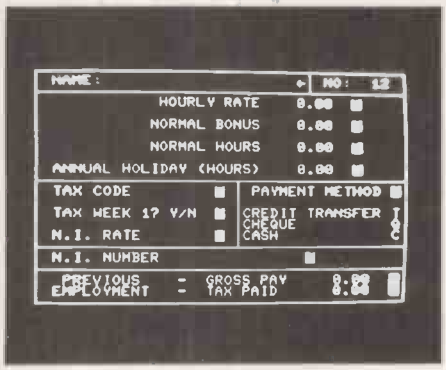
If abort mode is entered, the system finishes the payslip being printed currently before offering the options. According to the option chosen, the system responds with an appropriate message, i.e., please wait — aborting calculations.

Variable details

On amendment and exit, the system records those employees for whom slips have been produced and will re-issue them on subsequent runs. A complete abort will reverse all calculations and return control totals to their previous values.

Variable pay details have to be re-entered in that case. The re-do facility is for use with the amend option under abort, or as a rehash of an erroneous payroll run.

The month-end routine accessible from the main menu is a simple summary



routine which produces a tabular report showing; employee's number, employee's name, gross, tax, National Insurance employee, payable, and National Insurance total. It will also clear any employees whose details have been deleted since the last month-end run. The month-end routine is not geared specifically to the calendar and will report according to the interval since the last month-end.

The year-end is a clear-down facility which zeroises accumulated values for gross pay, tax, and National Insurance contributions. Each employee's details are displayed to the operator and any holiday time left over is shown with a request for the new number of holiday hours for each person. Each payee is dealt with and the system is ready to run for another year.

The list-employee-details routine is exceedingly useful and produces a full page of all details stored, weekly monthly and total-to-date values. The information is a summary of the payroll activity to date and, therefore, can be run infrequently. The routine prints details for all employees; there is no individual selection.

The password may be altered at any time through the menu option and the changed password may be either committed to disc or left in core for the day's processing.

A very important feature within the suite is the disc-copy facility and users are advised to make use of the back-up option each week. The beauty of the system is its simplicity. The working storage or data disc is always used as the master and the copy disc only as back-up. Should it be necessary to revert to the copy disc, this is in turn copied back on to the master disc.

Many other commercial packages base their operation on an old and new generation of discs which means that users must be careful to label discs properly and to operate a strict rotation system. The design of Payroll-200 means that the same two discs are always used and never dismounted in the course of normal processing.

Budget amendment

Due to the varying nature of governmental economic policy over the longer term, the very necessary ability to alter tax code values on a global basis has been provided. The budget amendment routine allows the user to enter values, positive or negative, to be applied to each of the four code types where that is permitted, i.e., H,L,P or V. Other code types can be altered through the edit employee detail option.

The standard of documentation is very high with a variety of sections covering not just the running methods but also details on amendments to cumulative fields and the implications of such actions; error conditions and corrective measures; and calculation methods used in the payroll.

The user is not permitted to alter the rate of taxation or National Insurance deductions without first consulting the authors who run an update service for such variations in legislation.

Conclusions

- **The standard of the software is far superior to many of the commercial offerings on the market, despite minor anomalies.**
- **For £50 Payroll-200 is good value for money for those with a small and simple requirement and where cash payments are the standard.**
- **The level of reporting is also simple and could do with a few minor improvements.**
- **Good use of graphics and design make data entry simple and secure through interactive forms.**
- **Payroll runs involve the operator in more time than is necessary but allow for simple modification of standard values for each employee.**
- **Security has been skilfully devised and applied.**

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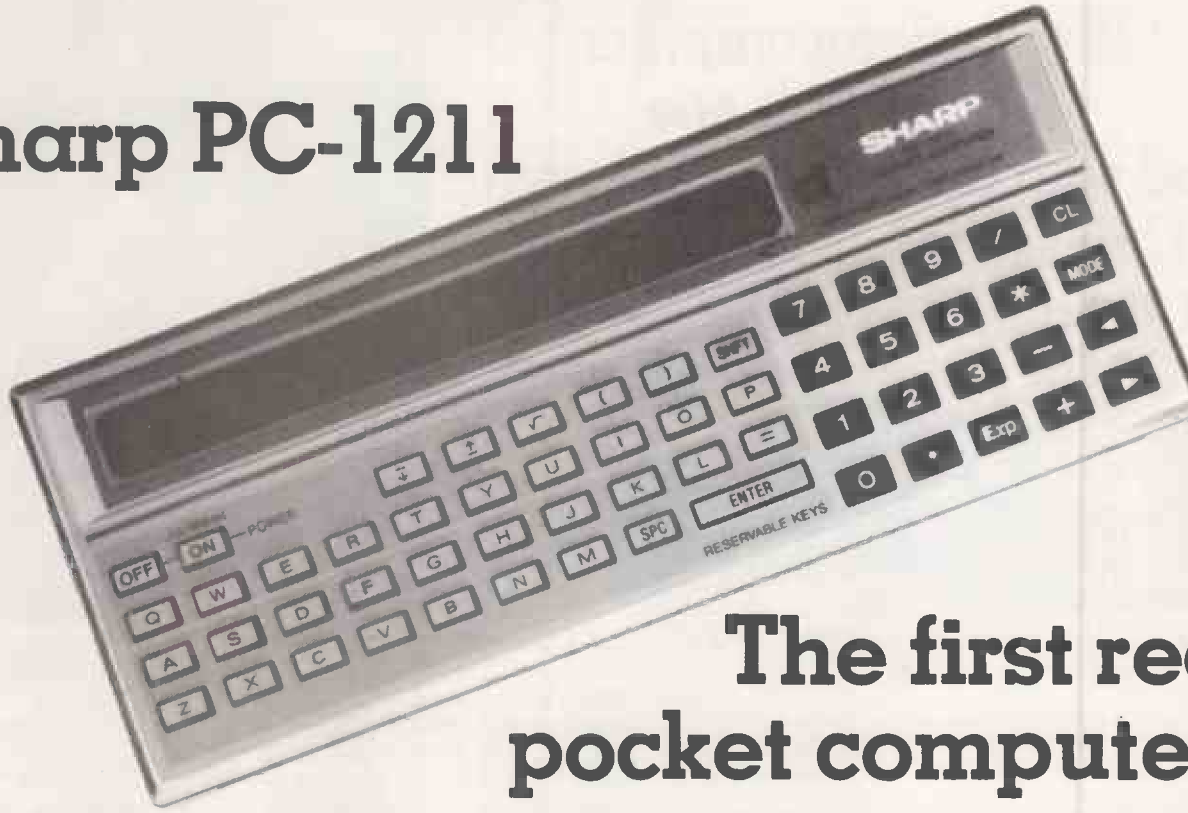


The first real pocket computer?

WEIGHING in at around 170 gm. and measuring a mere 175 × 70 × 17 mm., the contender for the title of the first genuine pocket computer has come forward in the shape of the Sharp PC-1211. To be perfectly correct, it has only almost arrived because this exciting little pocket marvel is not yet on the U.K. market. When it is available, it will retail for around £110.

At first sight, the instrument seems to be a conventional scientific calculator with a slightly oversize display. Closer inspection shows how wrong first impressions can be. The 57-station keyboard is fully alpha-numeric with the alphabet laid-out in standard QWERTY format — obviously scaled-down — and with a convenient pad of numerals and mathematical functions, + — * and /, on one side.

A shift key allows a useful range of punctuation as well as special functions, and there are a number of control keys allowing selection of operating mode, cursor control and edit operations.

Character font

The liquid crystal display consists of 24 character positions each built-up as a 7 × 5 dot matrix. The character font is limited to upper-case with numerals and punctuation. Characters are entered on to the display from left to right — conventional typewriter mode — and when the 24 positions have been filled, the single-line display scrolls from right to left until the maximum permitted number of characters, 80, is reached. At any time, the two horizontal cursor control keys allow back or forward spacing for editing, correcting or re-reading anything which may have been scrolled out of sight.

The computer has a memory capacity of 1,424 steps which seem to equate to bytes and a resident Basic interpreter containing 15 mathematical functions, 21 statements, six commands and six control statements — table 1.

In addition to that, the interpreter operates with 10-digit precision for the mantissa with a two-digit exponent. The computational limits range from 1×10^{-99} to $9.999999999 \times 10^{+99}$, positive or negative.

Basic interpreter

The interpreter approximates to a shortened form of standard Basic and can be used in a matter of minutes by anyone with a modicum of experience with Basic. It has some unusual features — a pause statement which is used as an alternative to print for repetitive printing of successive results.

That provides an option to the user of an automatically-stepping result or a displayed result which remains until the next result is requested by depressing the enter key. That feature is very necessary on a computer which has only one line of display, i.e., no vertical scroll.

The other novel feature is the ability to branch to a line defined with a label contained within quotes. For example, one could have the following two lines somewhere within the program:

```
50 IF A = B THEN "FINISH"
...........................
...........................
...........................
90 "FINISH" PRINT "FINISHED"
```

The feature is an extra and the usual method of branching to a line number or integer result of a function is also a standard feature of the new PC-1211.

Numerical variables exist as two forms which the manual describes as fixed memory and flexible memory. The former are the 26 letters of the alphabet which are defined in the usual way as A, B, C etc., but can be equally defined as A(1) to A(26). That is, variable B and A(2) are one and the same which allows one to refer to variable B as A(4 * SIN 30) just as one would an array.

The 26 variables are called fixed memory variables because their presence is always guaranteed, as opposed to the variables defined as A(27) and onwards which can exist only if sufficient memory is available — each of the latter flexible memory variables require eight bytes of memory.

String variables

Any of the fixed or flexible memory variables can be used to hold a seven-character string by inserting the usual dollar sign after the variable's letter. Note, A and A(dollar) cannot coexist. Although string variables exist, there is very little scope for their manipulation apart from rudimentary conversation.

The computer operates in any one of four modes which can be selected by a key. They are PROGRAM, RUN, DEFINE and RESERVE. The first two are self-explanatory but the latter two are unusual. As well as the operating modes, the computer can handle angular measurement in degrees radians or grads and these units can be changed on the fly by using the statements DEGREE RADIAN or GRAD in programs.

When the computer is set to RUN mode, it may be used to execute

IMMEDIATE instructions entered through the keyboard as if it were a conventional calculator. Complex chain calculations involving trigonometrical functions and several levels of parentheses are possible. The machine, of course, comes into its own when executing programs.

Program entry

Entering a program is simplicity itself — select PROGRAM mode, type in a line number and go ahead with Basic. At any time while preparing a line for entry, you can back-space the cursor to correct and, if you are lazy, you can enter abbreviated keywords which the interpreter translates and displays in full as soon as the enter key is depressed.

Once a line is entered, you can type a new line number and continue programming as if you were operating a conventional machine. Two vertical cursor control keys allow recall of lines behind or in front of the one being worked which, in conjunction with the horizontal cursor control keys, constitute a quick and powerful editing system.

The interpreter is very economic as far as memory utilisation is concerned — each statement is converted to a single byte code and only three bytes are used to define the line number which can be in the range one to 999. Thus the statement 10 FOR A = 1 TO 10 uses 10 bytes of memory. At any time, the command MEM will display the number of bytes of spare memory and the number of flexible memory variables to which it is equivalent.

Once a program has been prepared, the mode key should be depressed to bring the machine into the RUN mode and the command RUN entered. The program executes in the same way you would expect to see on a big brother machine. The only difference — and it is a major difference — is the speed. It is painfully slow. A few off-the-cuff tests showed that a single multiplication takes approximately 50mS and a SIN calculation 600mS. Quite clearly the internal hardware is calculator-orientated.

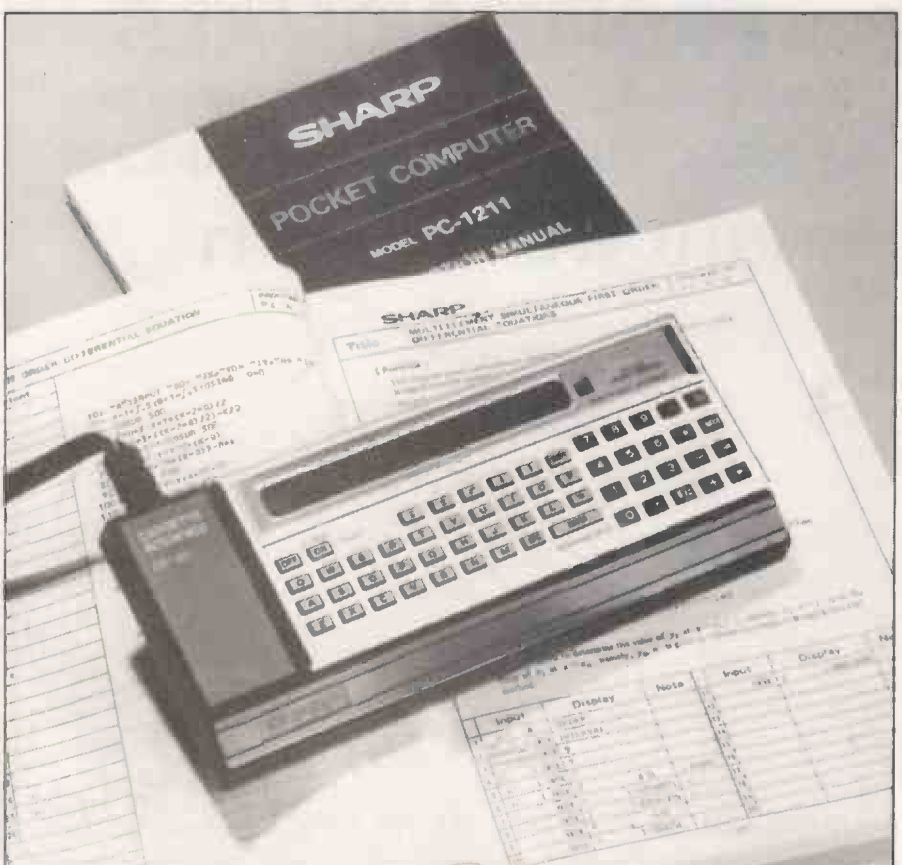
High precision

That is illustrated even more by the speed of straightforward interpretation without any significant calculation. An empty FOR NEXT loop takes approximately 230mS, a quarter of a second, per single step cycle. None the less, that should not be held against the machine. It is of extremely high precision and is definitely not a toy. Its application is scientific and for many applications its low speed will be unimportant.

When a program has been entered and run and the machine switched-off, the user should be ready for a big surprise. Switch the power-on again and type RUN. Low and behold, the original program is still contained in the machine's memory — even after power-down. This very practical use of low-standby-power memory is a spectacular feature of the PC-1211.

For dedicated applications a complex program can be typed in once and left inside the machine for as long as the batteries last in standby mode, that time is not quoted in the manual but must be quite significant because during normal operation the battery life is stated as 300 hours.

Another interesting point is that if the machine is accidentally left switched on for more than seven minutes without any operating taking place, it reverts to low-power standby mode automatically to conserve battery power.



Functions, statements and commands

Functions

SIN	COS	TAN	ASN	ACS	ATN
LN	LOG	EXP	√	DMS	DEG
INT	ABS	SGN			

Note: DMS converts decimal fractions of degrees to minutes and seconds. DEG converts degrees minutes and seconds to decimal fractions of degrees.

Statements

LET	INPUT	PRINT	PAUSE	USING
GOTO	IF	THEN	GOSUB	RETURN
FOR	STEP	NEXT	STOP	END
BEEP	CLEAR	DEGREE	RADIAN	GRAD
AREAD	REM			

Note: PAUSE is a repeating PRINT statement; USING formats a PRINT statement by specifying decimal places etc. BEEP sounds an internally-generated audio tone.

Commands

RUN	DEBUG	CONT	LIST	NEW
MEM				

Control

CSAVE	CLOAD	CLOAD?	CHAIN	PRINT #
INPUT #				

Note: All the CONTROL statements are associated with the tape I/O operations.

Error codes

Apart from its speed I had no quarrel with the Basic interpreter — there did not appear to be any bugs and all deliberately-introduced error conditions were suitably flagged by one of the six designated error codes. Its 10-digit precision makes it valuable for sophisticated mathematical and scientific applications.

It was, however, rather surprising that no provision is made to generate random numbers. Probably as a result of memory limitations it is only possible to nest four levels of subroutine and four FOR NEXT loops but for the types of calculations to be undertaken by such a machine, that is probably of no major concern.

The disadvantages are more than outweighed by other useful features, for the scientist, the DEFINE and RESERVE operating modes would prove most attractive. The DEFINE mode assumes the role of running a program from any starting line — identical to the use of GOTO as a command on a larger machine.

Where it differs is that any of 18 keys on the keyboard can be designated as corresponding to any 18 line numbers

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contained within a program. That is done by using the key's character as a label within quotation marks immediately after the line number in question. When operating in DEFINE mode it is necessary only to press the shift key and the appropriate designated key to run a program from that pre-defined line number.

It is, therefore, possible to have up to 18 reasonably complex programs residing within the machine's memory at any point and any of them can be run on demand simply by depressing the appropriate key. Coupled with the power-down memory protect, it is a very powerful feature for applications requiring complex repetitive calculating — for example, surveying or structural design.

The RESERVE mode allows one to use any of the same 18 keys to call a previously defined function, expression, statement or constant. For example, if the function

4 * 3.141592654 * R∧3/3

is required several times, it is much easier to type it once and then reserve one of the selectable keys for it.

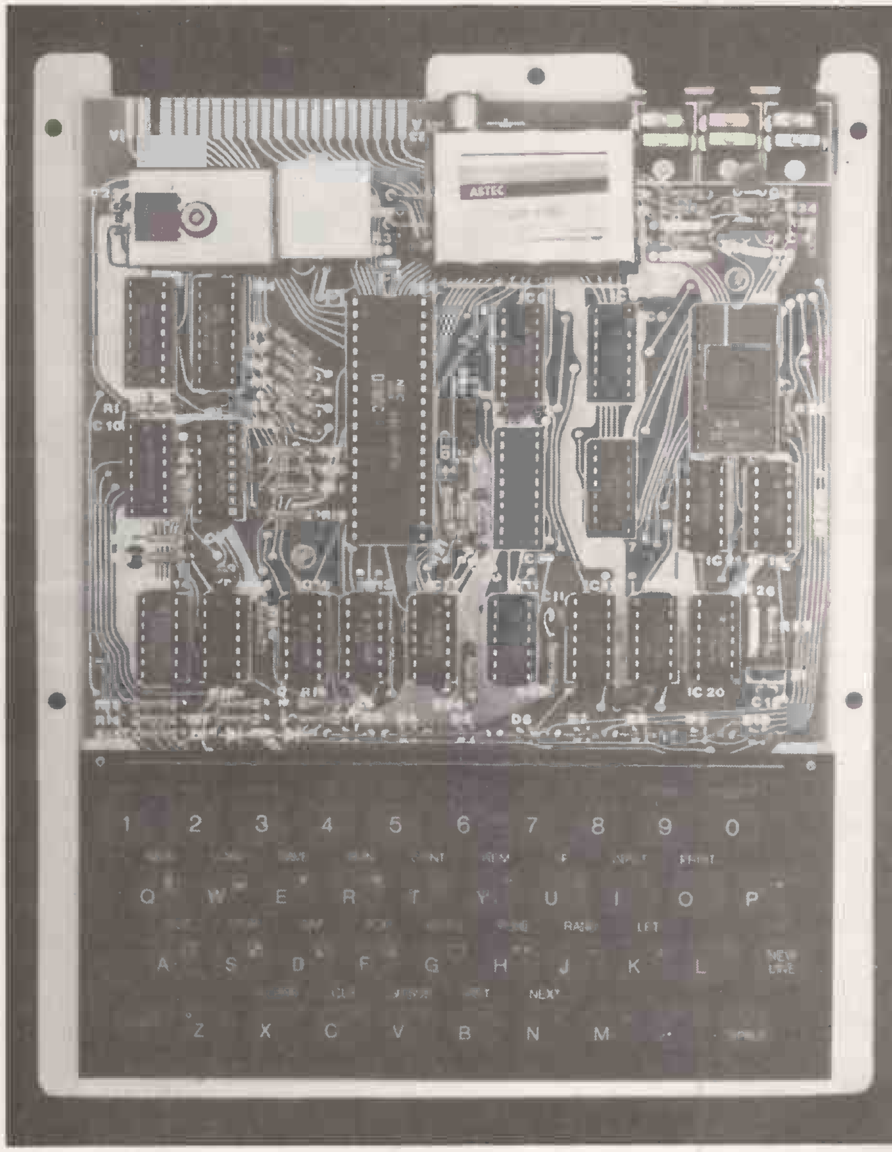
Whenever the function is required it is necessary to depress only the key in question and the whole function is entered as a single operation. As with the rest of memory, the reserved keys maintain their designations even during power-down.

The 100-page instructional manual is well presented and easy to follow — even though it is sometimes necessary to re-read a few sentences which have suffered in Japanese-to-English translation. A comprehensive applications manual is also available which contains 128 fully-documented programs — mainly of a scientific nature but 10 games have found their way into its pages.

Conclusions

- **The PC-1211 is an impressive little machine.**
- **If it does materialise at the expected price of £110, it will be good value for money to someone who has the right type of application.**
- **Although it is small and easily mistaken for a calculator, it is powerful and is not a toy.**
- **Those who want a fun machine might perhaps think twice before going for it — it is slow and the display is not really suitable for games.**
- **For the scientist, development engineer, designer, statistician or mathematician, it is a first-rate instrument.**
- **It needs to be seen and used for real applications to appreciate its versatility.**
- **The more it is used, the more impressive its features become.**

Inside the Sinclair ZX-80



A MASSIVE advertising campaign heralded the arrival of the new personal computer from the Sinclair stable and in its wake, many wonder to what extent the claims made for the system are valid in terms of power and potential.

The device is available either in kit form or ready-made. The system under review falls into the second category and was complete with power lead and coupling cables for connection with the aerial socket of a standard television set and 3.5mm. jack leads for a cassette recorder.

The power lead has a 3.5mm. jack at one end and a rather bulbous 13A, three-pin plug on the other which contains the gear necessary to produce the 9V at 600mA which the unit requires. On opening the box, it was good to find that it had been designed to facilitate instant computing.

First impressions

The computer measures approximately 215mm. × 175mm. × 400mm. overall height and my first impression, which proved to be wrong, was one of fragility — the keyboard end tapers to a mere 7mm.

Photographs of the case design and, in particular, of the keyboard give totally the wrong impression — it is much smaller than expected, with the keys on the typewriter-style keyboard on 14mm. centres.

Supplied with the hardware is a substantial, 128-page book, entitled ZX-80 Operating Manual. It contained the inevitable loose errata sheets, one of which offered extra advice on the use of a tape recorder. The presentation of the book is first class — glossy, full-colour cover and clearly-laid-out, well-printed pages throughout with a strong, spiral wire binding. A quick look through the first two chapters confirmed that it was just a matter of plugging-in and switching-on.

To start the unit required the insertion into the socket at the back of the computer of the aerial lead to the television and the 3.5mm. plug of the power lead. There are three sockets, all identical in appearance. The sockets had designations beneath the case which were difficult to see but the manual assured me that no damage would be done if I plugged into the wrong one.

The automatic power-on, re-set worked perfectly and on tuning to channel 36, I obtained a clear screen with a strange-looking black cursor containing a reversed-out letter K in the bottom-left-hand corner. Excitement took over and without further reference to the manual, I decided to plunge straight into Basic. That was a mistake.

Cunning firmware

Because of the novel method of entering keyword statements and the automatic syntax check as you enter a line, strange, but interesting, things happen. Most of the keys have three options associated with them. In an unshifted condition, they produce upper-case characters while "Shift" will give a range of graphics and punctuation. The third option is produced by a fiendishly-cunning trick in the system's firmware which recognises when the syntax requires a statement word, e.g., LET.

In my ignorance, I quickly typed in 10 LET A=123. The screen flashed each time I hit a key but at that stage I attributed it to a bad TV connection. When I checked my message on the screen I saw 10 ? (S)ET=123. The "S" in brackets refers to a reversed-out S on a black square. Having established that the machine was alive and producing communication — even though it was rubbish — I reverted to the instruction book to learn the error of my ways.

Immediately after a line number is declared, the system expects to see a statement and is waiting for the key associated with that statement to be depressed. I had spelt LET in full but what I should have done was simply depress the key "K". The full word LET then appears miraculously on the screen in the correct place and with perfect spelling. The reversed-out "S", which I had seen, signalled a syntactic error.

Unusual method

It took an hour or so to become used to the unusual method of entering through the keyboard but I never became accustomed to the screen flashing each time I hit a key — it was not a loose connection but another example of clever design. The Z-80 microprocessor is servicing the television-display refresh constantly in real time and only breaks-off to poll the keyboard during a quiet period — presumably during field blanking.

If no key is depressed the system monitor quickly returns to maintaining the display. If you depress a key, however, the system has to start "thinking" and momentarily ceases to service the display — hence the flicker which in some cases can cause poorly-adjusted television sets to lose synchronisation for a second or two.

During long calculations, or where loops are involved, that can be very disconcerting as the whole screen goes blank for as long as the calculation lasts. An extra disadvantage is that the screen will not scroll.

If you run a program which produces more than a screenful of text, the system defaults when the bottom line is reached. The only way of overcoming the problem is to build a software line-counter into the program and go to an INPUT loop every 22 lines. The INPUT then has to be followed by a CLS, screen clear, statement before the program continues.

It would seem that the only routine which can run while maintaining a steady display is a keyboard input loop. For the same reason, it is not possible to produce animated displays, say, for games, by memory-mapping the display with POKEs. If more information was given on system timing in the manual with the addresses of the supervisory subroutines, that might be possible.

Practical reality

Although the concept of a software-controlled display is very clever and economic, I found the practical reality of it rather limiting.

The ZX-80 Basic has 34 permitted statements, functions and commands including three rudimentary string functions together with PEEK, POKE, USR and EDIT. EDIT is versatile and very easy to use, allowing access to any line in a program for simple amendment. Coupled with the cursor control keys, it is very powerful.

There was nothing unusual about any of the statements but I did note a bug or two. For example, if REM is followed by a blank line, the interpreter does not skip the line in question but interprets REM as STOP and the program terminates.

A more annoying problem is that while the statement FOR A = 7 TO 1 is accepted as syntactically correct, i.e., a downward stepping loop but note there is no STEP function, it is not interpreted. There ought to be either an error flag or a negative step.

A frustrating point is the difficulty of BREAKing from a keyboard input loop — particularly if a STRING input is expected. The normal BREAK key will not function under those conditions and the manual is not much help apart from suggesting one switches-off — thus losing the program.

It is possible to escape using the devious trick of entering a numerical function, e.g., 12345 * 12345, which will exceed the maximum permitted integer value. It is surprising that the problem is not catered for in the firmware. Alternatively, it should have been easy to use the Z-80 NMI, non-maskable interupt, to perform a soft re-set if an extra key had been provided.

Control commands

Rudimentary PRINT formatting is possible but there is no TAB and it is not possible to output cursor control commands through the PRINT statement. The interpreter will allow only one statement per line.

The usual arithmetic operators are present but "Not Equal To" is noticeable by its absence. I found that surprising and a nuisance. To perform a branch on an inequality, it is necessary to say "IF NOT A = etc. ." That is unusual and it might be rather difficult for a beginner to see the logic of a statement of this type.

It is possible to GOTO a function as an alternative to a descrete line number; i.e., IF A = B THEN GOTO (A + 3) * 10 and it is useful for streamlining programs. Yet I take issue with the comment on page 47 of the manual which claims that this is unique to the ZX-80. Many Tiny Basic interpreters have this facility.

Having established that there was some very clever firmware inside the device, I wrote a program to investigate further using PEEKs. Some interesting facts emerged. The firmware PROM appears to start at address zero and occupies the bottom 4K of memory but when I looked at the bottom of the next 4K block expecting to see RAM, I saw the monitor repeated again — and again and again.

Address economy

Altogether the monitor appears to recur four times in the bottom 16K of memory. That indicated economy in address decoding and rather than waste time peeking to discover what was what, I decided to refer to the back of the manual — which I found decidedly unhelpful.

Although one is initially encouraged by the comment in the manual that it is possible to enter one's own machine-code programs, it is a major disappointment to discover it does not tell you how to reserve RAM space or, for that matter, where the permitted RAM space is likely to be

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located. After speaking to Jim Westwood at Sinclair, a little more light was thrown on the problem and I managed to write some machine code at about Decimal address 17000 — somewhere between the top of the display buffer and the bottom of the stack.

The address decoding limits the memory capability of the existing system to a total of 8K, comprising the on-board 4K PROM sitting at the bottom and a possible 4K of RAM starting a quarter way through the Z-80 maximum potential at the 16K point. That explains why the extension memory card contains 3K which I felt on reading the advertisements was an unusual amount.

With the on-board 1K of RAM, that completes the addressing capability of the machine as it stands. I am told that Sinclair has something up its sleeve to enable further memory expansion if it is considered necessary.

Tape interface

Having become used to the system, I decided it was time to try the tape interface using SAVE and LOAD. The comment "Good Luck" at the end of the relevant section of the manual did not fill me with confidence, but undaunted, I continued. As a legacy of various unhappy experiences with tape I/O problems, I have a very good-quality, stable Marantz Superscope model C205 cassette recorder which might not be typical. The SAVE operation went like a dream, but, try as I might, there was no way I could move the data back into the computer.

I tried every possible combination of recording levels and source impedances on playback to no avail. Again, I was handicapped by the manual which gave no technical data about the levels the system expects to see; it talks only of microphone inputs and earpiece outputs.

That area is always a weak link with small micros and as much information as possible ought to be given for those who might experience trouble. I regret I had to throw-in the towel in the end. I am sure the loading system will work because the manual says it will but interfacing to my tape recorder — which I thought was a good one — was a disaster.

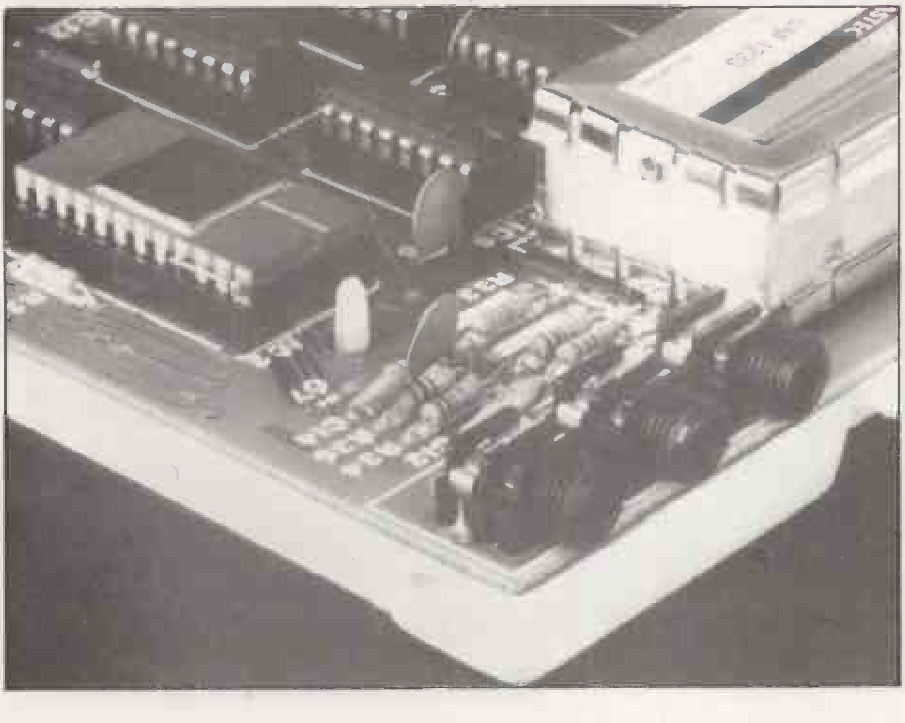
Little information

When faced with a situation involving a computer which works but does not do all you wish of it, it is always useful to be able to revert to machine code to do bug analysis, but there was no way I could discover why the machine refused to accept my tape input. I would have liked to patch a simple routine calling the tape input routine and then displaying the input data, byte by byte, on the display.

I was unable to do so because no information is given to identify the locations or nature of the utility routines, and even if it had been, it would have been of little use because the machine will not display while it is processing. I know that it is expecting a quart from a pint pot, but I feel it worth mentioning because it may indicate a severe limitation of application for those who are interested in low-level programming.

An initial glance at the plastic facing of the keyboard brings back recollections of the MK14 but I must say it is a vast improvement. It seems to be electro-mechanical and relies probably on a metal foil, separated from contacts on the PCB by a thin insulating film with apertures in requisite places.

I found it best to use single-finger operation because there is no two key roll-over, i.e., if you type too quickly and hit a second key before the first is released the second character is not entered when the first finger is removed. Another reason for opting for single-finger operation was the fact that you cannot be certain that touching the designated area will cause an entry — a slight roll of the finger tip is required.



Positive action was needed on some keys which were prone to double-up the entry — probably due to hesitation in removing the finger coupled with the very thin insulator. Having made this complaint, I must admit that data entry was easy and light to the touch. The low speed of single-finger poking is compensated by the speed generated by the automatic spelling of the keywords.

Natural curiosity overcame me — I had to look inside. Without question the quality of the hardware design is beyond reproach. The double-sided PCB contains 21 integrated circuits plus a 5V regulator on a heatsink — which, incidentally, can become very hot — an Astec UHF modulator — even Sinclair has not been able to do better than this sturdy and reliable workhorse — the three jack sockets and about 25 to 35 assorted Rs, Cs and diodes.

Spacious and neat

The keyboard is integral to the PCB. The lay-out is extremely neat and tidy and, considering the size of the board, is remarkably spacious. IC sockets are used throughout and all components are designated clearly by silk screening on the board. With reasonable care, anyone with soldering knowledge could construct it.

The thing which surprised, and impressed, most was the lack of many specialised ICs. The only ones of any major consequence were the Z-80 itself, the two 2114s providing 1K of RAM and 4K PROM.

When one considers the I/O functions the system supports — VDU, tape and keyboard — with this minimal amount of hardware, one has to take off one's hat to both the hardware and software designers.

A 44-pin edge-connector at the rear of the board carries all the necessary address, data and control lines for system extension. There did not appear to be any buffers on the address or data busbars but as the system is unlikely to be expanded by more than one extra board, it is of no real consequence.

An interesting feature of the hardware is the absence of a separate character-generator ROM for the display. All the data for defining the picture-point patterns of the characters are contained within the same PROM which holds the system firmware.

I counted approximately 140 characters which represent 10 graphics symbols and the usual alpha-numerics and punctuation which were repeated in black on a white field, normal display mode, and also white within a base rectangle of black.

Apart from the cursor, the only way of

obtaining the inverse-field characters is through the firmware, using PRINT CHR $. The graphics are very simple but, none the less, practicable and with careful thought could be used to produce reasonable resolution pictorial displays.

I use the word reasonable carefully because the advertisements I have read refer to high resolution. In my understanding, high resolution refers to single picture-point resolution — fine lines — which are not possible on the ZX-80 because each character is produced in Pixel form, i.e., the screen display is made up by stacking individual character cells together side by side or on top of each other as is the case with many single-board computers. The display consists of 23 rows, or lines, of characters and there are 32 characters per line.

Simple style

I have already touched on the production quality of the manual but I think it worth saying a little more about its content. The introductory chapters on Basic were excellent and there was obviously a conscious effort to keep the writing simple.

There were also a large number of worked-example programs, some simple and some significant, like a random dice display using graphics. Most were well illustrated with flowcharts and designed to highlight use of specific statements.

Like all attempts to telescope a programming course into a few pages of the printed word, it accelerated rapidly but on the whole was readable and, I would have thought, for middle-aged teenagers upwards.

Where I thought the manual became decidedly confusing was in the appendices. An attempt is made to define the memory map in Appendix II but no addresses are given until one turns to Appendix III which gives those of the primary system variables in RAM. It was only after hours of reading and re-reading and cross referencing the two sections, that I began to see what was going on and even then, things were not perfectly clear.

I appreciate that it is a very difficult subject to explain but the manual hints that it is possible to use POKEs to write one's machine-code programs and run them with USR. It says that to do so, one should have a detailed understanding of the ZX-80.

That is very true, but I regret to say that the manual falls very short of giving one this detailed understanding — much more ought to have been said about the system firmware, particularly about the input and display routines and their timing. I would also have liked to see something said about the expansion-connector pinning and PORT addressing.

Without the detailed information, the machine is definitely limited to operating in Basic.

From an educational point of view the manual, taken together with the hardware, is good for people who wish to understand the rudiments of programming in Basic but, be warned, do not expect to learn much about how computers work from it.

Conclusions

- **In kit form at £79.95, the ZX-80 is very good value for money but because the sacrifices made in designing to a price, the £100 for a ready-built model may be less advantageous.**
- **It is a beautifully-designed machine especially for use as an educational super-toy.**
- **Its price will be attractive to teachers and PTAs.**
- **It will certainly help to bring extra keyboards within the range of young fingers, provided there are enough television sets available.**
- **Yet my experience of computing in schools suggests that it may not have the capacity to handle the sophistication required by examination courses.**
- **A hint is made that the purchase of a system could be classed a business expense but I think its business applications may be limited, not least because of its integer-only Basic. In certain cases, a good, programmable calculator might be much better, more convenient and quicker to use in the office.**
- **Many people will find interest and satisfaction from owning a ZX-80.**

Birth of a system

For the non-technical reader and the computer adept alike, Mike Hughes traces the progress of a new British microcomputer, the Transam Tuscan, from initial conception through the tribulations of development to its commercial launch.

THE STORY begins in February, 1979 — about six months after the successful launch of the Triton computer. Our experience with Triton showed that there was a great need for a general-purpose, single-board micro with full documentation both for hardware and software.

We now know that the concept of the single-board computer is very sound and has had success because of its convenience and its cost-effectiveness. With good documentation, open-ended design, ease of expansion backed by extensive software support, there were orders to be won by the right kind of computer offering applications ranging from home computing to industrial process control.

In those areas, Triton proved most successful. Once Triton was off the ground, thoughts turned to a second system. We had gained considerable experience from the first machine, particularly in areas which affect marketability.

Reputation essential

To keep a customer happy and to maintain a good reputation, it is essential to deliver the goods on time. Once delivered the product must be reliable, there must be ample back-up for the customer in the event of technical difficulties and there has to be active software development.

Transam had invested heavily in stocks to ensure fast deliveries and, by February 1979, had recruited and trained hardware and software specialists. That expertise centred, of course, on the 8080 microprocessor — the Triton central processor. It was against this background that discussions about a new system evolved.

The first problem was whether a new system should supersede the existing Transam product. That it should take the place of the remarkably successful Triton seemed unthinkable at the time. It was quickly decided that we should aim at developing a system which would be marketable alongside Triton. It would either have to fit into another market gap or offer positive advantages over other single-board computers.

Market gaps are very difficult to find in a competitive world and many weeks of investigation and discussion followed. Should we go down-market and compete with mass-selling MK14s, go up market and become involved in expensive small systems, or try and break new ground with an original concept?

At the time, the micro market could be split into roughly three zones. At the bottom end, there were low-cost evaluation kits with prices up to about £100. The middle range contained personal computers with prices ranging from £100 to £500. There was considerable overlap between the two zones depending very much on what firmware was supplied with the machine.

The third zone started at £500 and continues upward into the thousands. It could be said that there was overlap between these two zones but, in practice the lower-priced business systems were decidedly limited in their ability to support the applications involved.

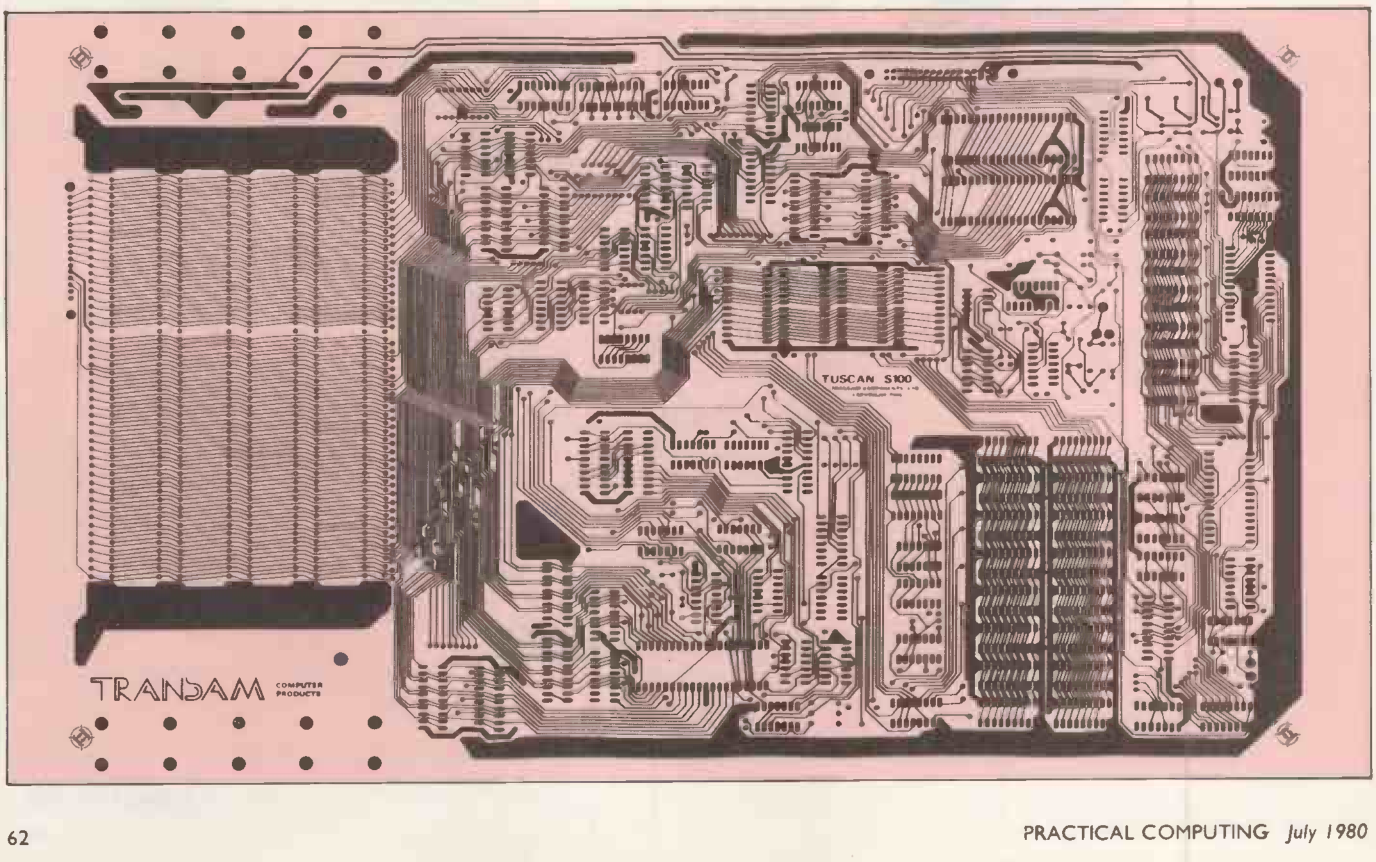
Business systems

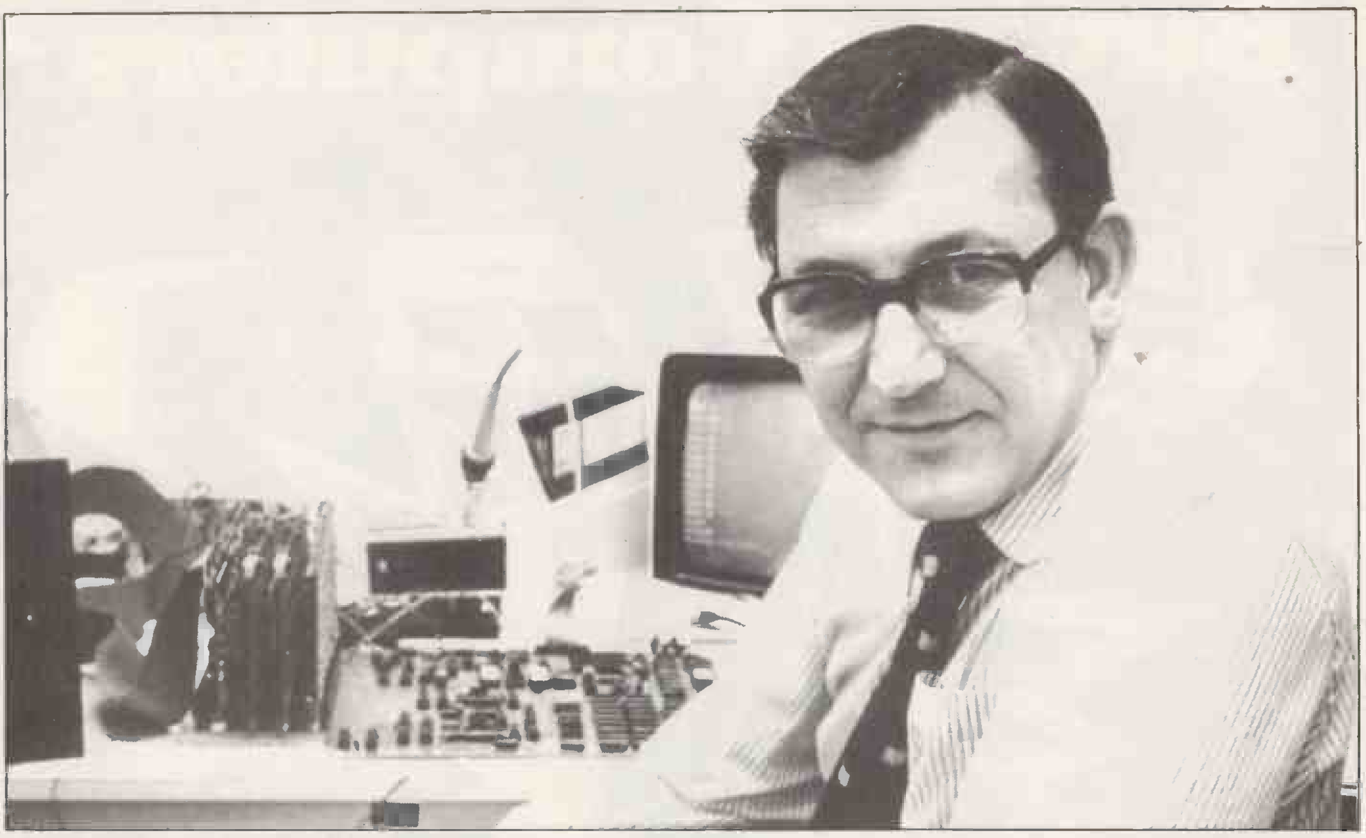
An ideal business system requires a disc operating system built into its fundamental hardware to make it acceptable for office use. That meant that for serious business work the price bracket would have to start at £1,000.

I thought that we ought to go down market. I had played with an MK14 and, although the hardware was splendid value for money, it did not seem compatible with the market at which it was aimed — beginners.

I remember suggesting a powerful miniature single-board machine with resident Basic and a minimum chip count — just sufficient memory to provide satisfaction but with no way of expanding above about 4K. It would sell for around £100.

The attractions were that it could be developed reasonably quickly and we could use a Z-80 to help with chip minimisation while still making use of our existing 8080 firmware. A few modifi-





Mike Hughes, designer of the Transam Tuscan.

cations would, of course, be necessary to benefit from the more economic instruction set of the Z-80.

On reflection, however, the limitation of such a design would be that, while an ideal starting point, it would be very difficult to expand once the inbuilt limitations were reached. That would render it useless for serious applications — one doesn't stay a beginner for long.

The middle zone of personal computers contained the world's best-selling micros. Based on the single-board concept, they offered expandability, good Basic interpreters and some form of cassette or disc interface. However, closer investigation revealed weaknesses in their designs — especially for further expansion.

Design limitations

Apart from the very expensive, most lacked versatility and did not have sufficient hardware information and support to allow the user to apply them in any areas other than in those the manufacturer intended.

In addition, the software and hardware were tailored for the individual microcomputer and were not interchangeable between systems from different manufacturers.

The more expensive computers from this top zone offered compatibility and performance in terms of software; disc operating systems such as CP/M were accepted widely. The user could configure the microcomputer to his own hardware requirements with the aid of a standard bus structure, e.g., the S-100 format. That permitted interchangeability with other manufacturers' circuit boards.

Their problem was that to obtain a good expandable system, the user would have to spend a good deal initially — a minimum of one S-100 processor card, one video card, one I/O card, one 8K RAM card, one 8K EPROM card and a motherboard to hold them — not to mention the associated power supply.

This meant that the domestic or amateur user would be unable to afford a system which could be expanded easily and conveniently to provide, for example, vector graphics, speech synthesis, floppy disc control, standard disc operating systems and the facility for programming in several languages.

Computers which were inexpensive enough to appeal to the amateur had limited potential for real business use; systems which were capable of catering to the needs of the most exacting user would involve considerable expense initially and, therefore, did not attract the very small user.

After many meetings and pints of coffee, we began to form a picture of a single-board computer which would provide a sound, expandable base with no practical limit to the facilities available. The single-board would have to be a system capable of supporting all that is desirable on one-board machines.

It would have to be housed neatly in such a way that any further extensions would not require too many bits and pieces attached with ribbon cable.

There would certainly have to be an option offering an extended form of Basic resident on the main board and sufficient memory. For small-scale development work and educational use, adequate provision for spare input/output facilities was needed and there would have to be an on-board video display unit.

We then asked, in what respect does this differ from what is available? The answer was simple — apart from plenty of spare I/O, not very much.

Important events

About about the same time, several important events rapidly crystallised our ideas. We had, by this time, adopted the CP/M disc operating system for Triton and Transam was well advanced in its development of an extended Basic as well as its Pascal compiler. More importantly, the S-100 busbar was finally standardised in the U.S.

Although we had previously considered the S-100 busbar, we had discarded it as an expensive and not-very-reliable way to build a system. The S-100 bus standard from Ithaca Intersystems was originally imprecisely defined and different manufacturers' boards were incompatible. However, earlier this year, the American Institute of Electrical and Electronic Engineers (IEEE) published a definitive standard for the bus. Devices that adhere to it, as the Tuscan does, should work together.

Now with the accolade of an IEEE specification, there was quite clearly going to be a wealth of interesting peripheral boards developed to this precise standard.

Whatever one feels about standard S-

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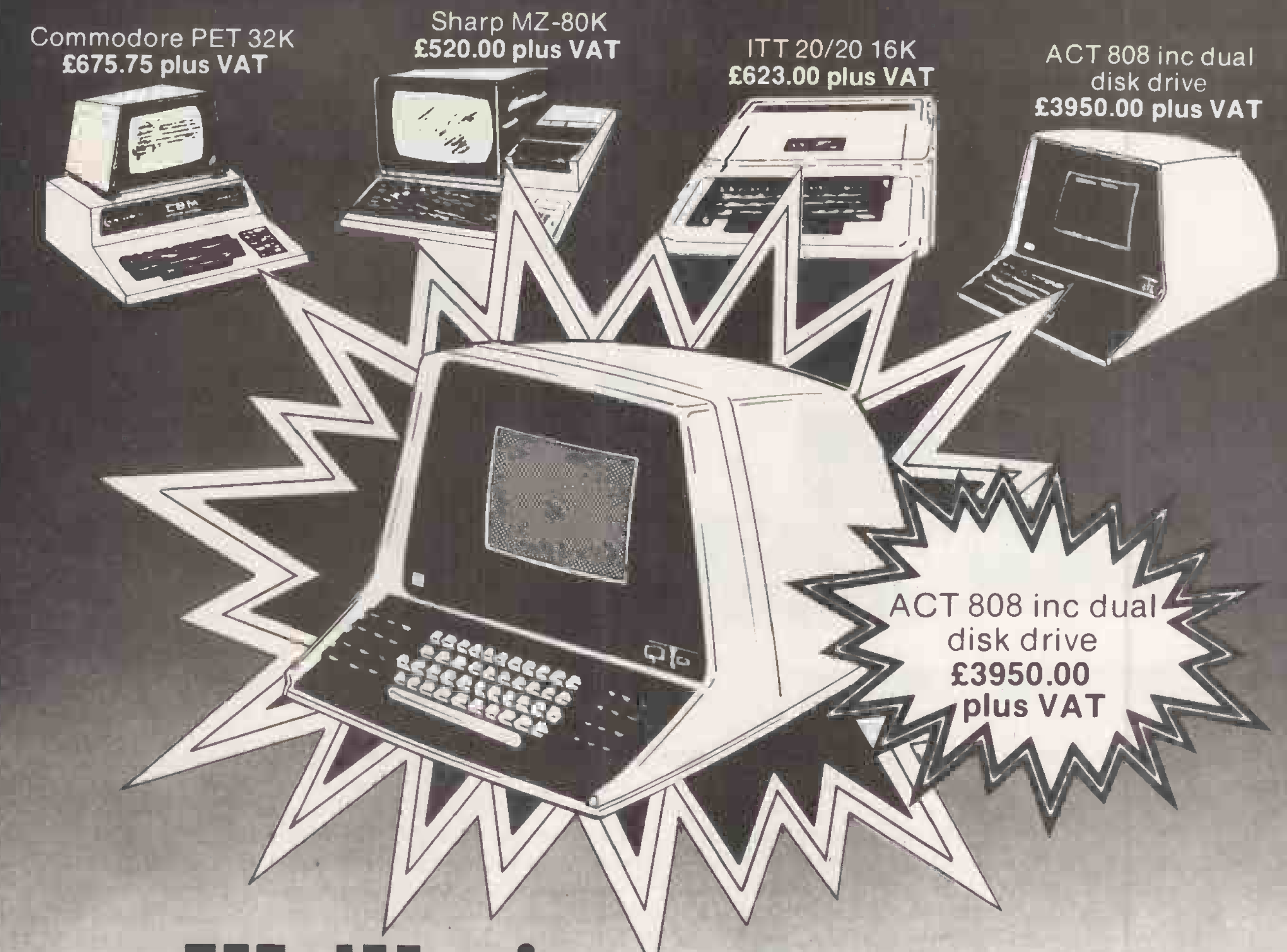
Buying Computers?



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(continued from page 63)
100 cards, one has to admit that their generous area, 10in. × 5in., allows plenty of scope for sophisticated plug-in options, disc controllers, ROM, RAM, memory-mapped, high-resolution VDUs, speech synthesisers, digital-to-analogue and analogue-to-digital converters. It is also a very handy size for enthusiasts to use to build-up their own breadboards.

Enormous potential

The only problem was that all the S-100 systems we had seen required the CPU itself to be on an S-100 card which ran against our idea of a single-board computer. We had prepared a rough lay-out sketches of our embryonic single-board system — to see the size of board and we suddenly realised that they were all roughly 10in. square.

I remember Nigel Stride casually holding a 16K S-100 memory card against my sketch saying: "Why don't we extend the board a few inches and build the S-100 bus on to the end"?

It was obvious — using modern, high-density memory chips and some compact design work, it ought to be possible to build a self-supporting, single-board computer with an integral S-100 busbar which would be no larger than our existing Triton main board.

The potential of a system based on this concept would be enormous. The single-board could be built in modules, depending on the degree of sophistication the user required — or on his pocket — and with four or five S-100 cards added. With a few peripherals such as printers and disc drives, we had the makings of a system which would be suitable for applications ranging from Mastermind to bridge design, or Chess to Satellite Navigation — not to mention stock control, word processing, dental records, vetinary accounts and the like.

Furthermore, the system would be self-contained, needing only external devices like printer, disc drive, display screen and a tape recorder. It might even be possible to build a disc drive into the system's cabinet.

There were still a number of fundamental decisions to be made. What type of microprocessor chip should we use? What ought the on-board memory configuration to be? What type of memory — static or dynamic? What kind of on-board VDU? To what extent should there be provision for spare I/O? What sort of disc operating system should we be designing for? To what extent should we provide resident firmware options as opposed to disc-originated software? What standard should we adopt for modulated serial output?

Having arrived at the idea of a single-board with integral S-100 busbar, we had to decide on the microprocessor chip. That was comparatively easy. Since we had a wealth of experience with the 8080 and a large amount of proven 8080 firmware in our own stable, our thoughts immediately turned to the Z-80.

It would be sad to turn our back on the trusty 8080 but the increased computing power, wide acceptance, low price and ready availability of the Z-80 made it the prime candidate. Furthermore, we would be able to use all our existing machine code programs written in 8080 code, on a Z-80 system because, the Z-80 is upwards-compatible with the 8080.

That means that the Z-80 will do exactly the same things as an 8080 when it is fed with the same binary, or hexadecimal, operation codes. The Z-80 will also do far more by making use of extra codes and sets of instructions.

It is a big help to be able to use existing firmware for development because one is not confronted with the ghastly chicken and egg problem when testing out a prototype — if the system did not respond at switch on, we would know we had a hardware problem and no nasty bugs lurking in the test programs.

We only wished to use 8080 firmware for development purposes — the final Tuscan system firmware makes the best possible use of the full Z-80 instruction set.

We had already looked, in some depth, at other eight-bit microprocessors, but with software- and CP/M-compatibility in mind we chose the Z-80. This, combined with the firmly established S-100 busbar, would make Tuscan one of the most versatile low-cost computers available.

Interface problems

As the man who would have to do the design work, I was somewhat concerned about interfacing a Z-80 chip to the S-100 busbar of the IEEE specification. For the benefit of those new to the computer scene, the S-100 busbar is a set of 100 signal and power lines which carry electrical information from place to place within a computer system.

Wires on the busbar carry signals like addresses, data, control information interrupts, status information and mundane things like clock pulses and re-set lines. All microprocessors require and produce such signals but there are variations in their logic and timing in different devices.

The S-100 busbar was conceived originally with the 8080 chip in mind and the Z-80 does not produce the same type of control signals. That meant I would somehow have to make Z-80 signals simulate those from an 8080 chip. Doing it was not so much the problem — given a bucketful of integrated circuits and unlimited time and space almost anything is possible. Yet would it be practicable to provide all the encoding circuitry necessary to convert to S-100 standard and leave sufficient room on the board for all the other facilities we had in mind? This was a problem to be investigated in the future when design work started in earnest.

We considered the memory system. Obviously there had to be a significant amount of ROM for firmware, as well as random access work space on the main
(continued on next page)

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board. Furthermore, the ROM would have to sit at high memory addresses with RAM starting at address zero to enable us to operate under CP/M with disc drives.

We considered that for a long time because the decision had to be made on the basis of board space, the availabilty of devices and the size of resident firmware we thought best for those who would not wish to go beyond a single, main-board system.

Power supply

We also had to consider the power supply we would be able to provide for the main board. Ideally, we wanted to operate with a single +5V rail and ground and we nearly succeeded.

It is virtually impossible to put on paper the permutations of arguments we went through on this subject: should the RAM be static or dynamic — there are big cost advantages with dynamic as well as speed and packing density but it is rather difficult to trouble-shoot when things don't go according to plan? Should we use easy to obtain 4K RAM chips or the more elusive, and very expensive, 8K chips? What benefits would we obtain if we used RAM chips which were pin-for-pin-compatible with EPROM chips? Should the ROM be in the form of 1K, 2K or 4K chips? The latter would give best packing density but would make the modular approach to building in firmware more expensive for those who only wanted a system with a monitor.

In true British tradition, we arrived at what we felt to be an excellent compromise. We would provide 8K of static RAM for on-board work area and 8K of EPROM organised as four 2K chips. The RAM would be organised as eight pairs of 1K × 4-bit devices.

As the memory is the most expensive single part of the computer, that would give those with shallow pockets a small system which would not cost too much but would, nonetheless, be a powerful machine which could be expanded without fuss or bother. It was a formula which had proved highly successful on Triton.

For those with less restraint on spending, a 16K machine is not to be sneezed at and the 8K of EPROM would adequately hold our extended Basic plus a modicum of supportative firmware. A system configured thus would vie with other single board systems on the market.

In considering the memory, we also had to take into account the VDU. It was tempting to make this integral with memory to allow the flexibility of a memory-mapped display but it would have entailed a considerable amount of logic to allow this to be switched-in or out as desired — or re-located to new areas as memory space was used up for other purposes.

We had also learned, from Triton, that the use of a dedicated VDU control chip can greatly simplify design and uses less board space. We also had in mind that many people might wish to use our proposed S-100 bus to add a sophisticated VDU controller card of their own choice.

By using a dedicated chip operating as an output device — just like any peripheral — it would be easy for the whole of that section of the board to be left unassembled, if the user wished. We, decided therefore, to provide a very simple and straightforward on-board VDU which operated through an output port. Those who wanted to use a high-resolution memory-mapped S-100 VDU could use the on-board, 8-bit parallel output port for something else.

Although the VDU was to be simple, it would have to suit most practical applications — particularly those for business The character font, therefore, had to be practical and sensible. It would have to contain full upper- and lower-case characters as well as sufficient graphics for drawing forms.


The Transam Triton is the forerunner of the Tuscan.

For special applications — particularly foreign languages work — there should be sufficient flexibility to allow character fonts to be designed to customers' specifications. We decided, therefore, to use a simply-encoded EPROM to contain the character picture point patterns. Being erasable, that can be changed to suit any application.

We needed 1,024 eight-bit bytes of memory to contain the necessary information and the obvious choice of chip was the 2508, the single-voltage rail version of the popular 2708. As this chip is produced in relatively low volume, it is inordinately expensive for its size, so for economic reasons we decided to use a 2708 and accept that we would have to provide a limited amount of +12V and —5V to drive it. With hindsight, this was not too much of a problem because we had, in the end, to provide +12V and —12V for the RS232 interface.

One has to remember that, as yet, there had been no positive steps taken in formulating a detailed design and estimates of the board space available were based solely on experience and a feel for the way the concept was developing. I was particularly worried when we came to discuss the various I/O functions which were desirable.

Because we were using a Z-80, there was considerable pressure on me to use some of the good Z-80 family peripheral chips like the programmable I/O device and the serial I/O chip. Because we had opted to go for the S-100 busbar, all the available control signals would be encoded into 8080 format and it would have taken a fair amount of extra logic to put things back to normal for the benefit of Z-80 PIOs and SIOs.

We could have interfaced the on-board I/O with the Z-80 before the S-100 encoding system but this would inevitably have meant we would encountered DMA problems if we were to use the S-100 full set of memory access (DMA) options.

I breathed a sigh of relief when the discussion veered towards the relative costs of conventional I/O versus PIO and SIO devices. It was obviously going to be much more economic to use conventional latches and UARTs and they would more than adequately provide for most I/O contingencies.

A lesson we had learnt from Triton was the importance of providing sufficient numbers of spare I/O ports for the enthusiastic experimenter or for applications requiring hand-shaking operations. We would have to make as much use as possible, space permitting, of I/O decoding. I am happy to say that apart from Transam specifying a bare minimum of I/O facility, I was left to my own devices for this part of the board.

Feasibility study

The essential items required were a serial RS232 input and output — to interconnect with standard peripheral terminals — a parallel input port for an internal keyboard, a modulated serial I/O for use with tape recorders or communications systems and, of course, an output port for the on-board VDU. In practice, we managed a good deal more.

The bare bones of the system had now been defined — albeit on the backs of envelopes and scraps of coffee-stained paper. The date now was April 1979 and everything depended on a technical feasibility study to decide how many of the general specifications could be translated into practical reality. The problem was now well and truly mine and I was not happy. I became even less happy when I started the initial PCB lay-out. The essence of the problem was to cram the contents of five normal S-100 cards into two — the Tuscan board is about the size of two standard S-100 boards. These five were: 1 × Z-80 CPU card; 1 × 8K Static RAM card; 1 × 8K EPROM card; 1 × video display card; 1 × I/O card.

I would also have to group the various busbar rails into the logical sequence required for the S-100 bus and provide slots for five extra cards to be added as optional extras.

If this could be done, we could have a conventional S-100 system and a saving of several hundred pounds.

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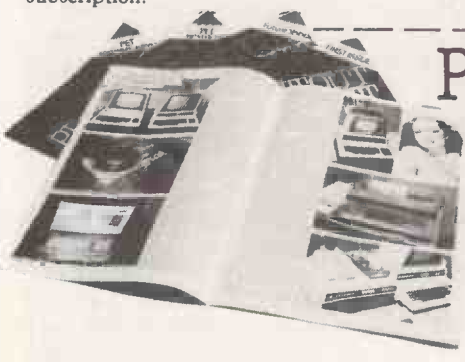

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• Circle No. 162

Call it a draw

by Michael Abbott

The supermarket's sliding doors parted with a sigh to admit the stout figure of Michael George. He slipped through the entrance into the claustrophobic bustle of Saturday-morning shoppers and eyed with distaste the sign in front of him: "Shoplifters beware — we always prosecute".

It was no idle threat. Remote-control cameras panned lugubriously to and fro over the figures intently plucking goods from the shelves; a bland ingratiating female voice, announcing the day's special offers, sawed at his consciousness like a blunt razor.

George pulled a trolley from the serried ranks and, gazing glassily at the list made by his wife Sarah, began to fill the trolley with the week's requisites. He glared at his fellow shoppers with disdain, wincing at each nerve-jangling crash of their trolleys and hating them for their indifference. Outwardly, this silver-haired, slate-eyed gentleman, notwithstanding his pained frown, was one of the crowd as he stood in line with his toiletries and groceries; but the exterior masked the turmoil of the Scorpio.

He was yet to show his sting; but the opportunity would soon be on him. Above the check-out, the remote cameras still swung tirelessly back and forth with apparent indifference.

At County Constabulary Headquarters, two investigators stood behind an operator in the computer room. Its air-conditioned serenity was their coulisse, and a practical one at that; for here, the world outside was subordinate to a computer keyboard. More by virtue of his forceful personality than rank, Superintendant Walsh was the department gnomon, round whom lesser personalities revolved with the insignificance of shadows. He read aloud from his report sheet:

"Michael David George. Age, 47. Freelance technical journalist and author of several books on the subject of the abuse of technology".

Walsh looked-up. "Should be an interesting chase", he said.

"Chase or case"? his colleague enquired.

"Chase, I think, Colby. Mr and Mrs George have vacated their humble dwelling place, it seems".

Walsh's small obsidian eyes were deep-set and not to be defied.

"Let's not fool around, Colby. George is not your average naïve citizen. I want the Window — just Plymouth to start with".

The operator began calling establishments via his communications terminal.

At the Cross Street intersection, traffic-monitoring television cameras mounted at various high vantage points watched the changing traffic flows. At Municipal Traffic Control, all the key junctions throughout the city could be seen on one flickering bank of monitor screens. A console operator tore off a teleprinter message and handed it to his superior.

"It's the law again, Bill, they want remote-control patch-through".

Soon, a bank of television screens at the police station sprang to life, repeating all traffic-monitoring pictures. Walsh had control of their direction. At the busy junctions no-one noticed the sinister sight of lofty cameras swivelling to scan not only the traffic, but the crowds on the sidewalks, too.

British Rail received instructions to hand over control of all its platform and other passenger-monitoring systems, and one department store and supermarket after another allowed the police to see who was shopping on their premises. More banks of television screens at police headquarters lit up to join the shimmering throng.

Walsh had just put down the telephone receiver after requesting Councillor McChesney to the Video Room.

"He'll be here in a few minutes, he's with the Commissioner". Walsh then zoomed in with a supermarket camera to single-out a man waiting at the checkout till. A man with two shopping trollies.

"Colby, isn't that George"?

"Looks like his mug, sir. If he turns round we'll know".

"McChesney will know. This might be him now", said Walsh.

Michael George had moved up the queue. Now with only one person in front of him, he noticed a nearby camera still aimed at him.

"That's George", McChesney said firmly. "You wouldn't think he could kill, to see him standing there with his shopping, would you"? he queried.

"I would", Walsh commented. "There's going to be more of this kind of thing; decent people hitting back". He took the communications microphone.

The woman in front of George insisted on paying for her groceries with cash; it was not a contemporary form of payment and took far too long for George's peace of mind. Two plain-clothes policemen entered the store. George knew who they were by their arrogant stroll against the tide of people using the exit. He abandoned his shopping and sidled through the crowd towards the staff exit.

A series of alleyways eventually led him back to the high street where he regained his sense of direction. To return to Sarah's car, he needed first to cross the railway line. His wife would want to know what went wrong, but he had no desire to panic her. In his mind, questions competed for precious thinking time. Would the police have all details of Sarah's car? Of course they would. Might he have only off-line use of his credit card? The police invariably suspended the personal finance of an outlaw.

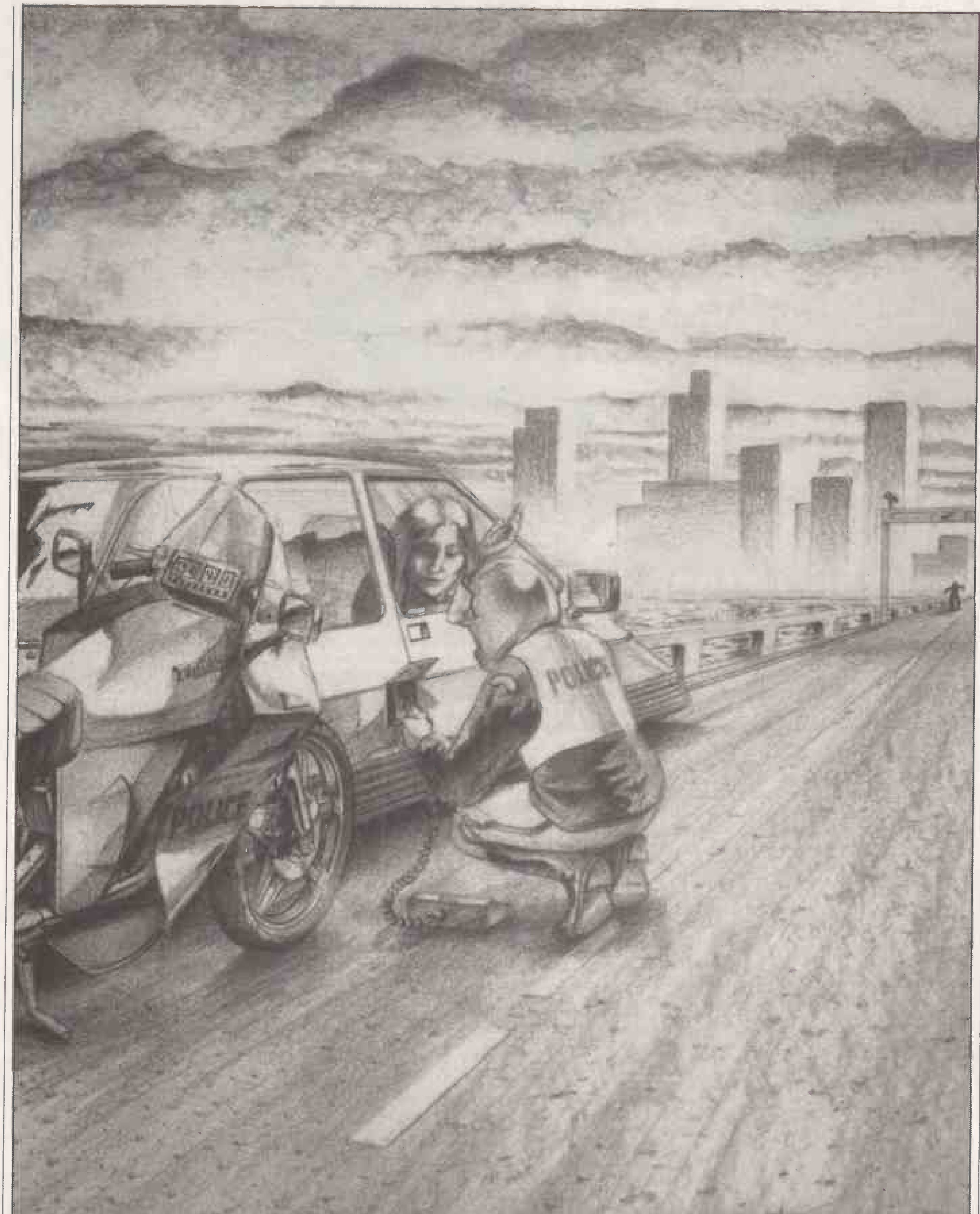
"We've lost him", Walsh said calmly, "but it's purely ephemeral, isn't it sergeant"? he added, signalling the controller to switch in further closed-circuit monitors.

McChesney pointed to one. "There he is"!

As George crossed the railway, he noticed a remote camera mounted on an adjacent footbridge. It followed his progress over the level crossing, and so he began to run. Dodging bus-queue cameras and the police, he once again found himself disorientated among unfamiliar back streets.

Sarah knew something had gone wrong. Despite instructions to the contrary, she started her car and began to drive round looking for her husband. The car fitted with a radio-telephone, which meant that Michael might ring her and arrange a rendez-vous, so that they could be clear of the city and on their way to Scotland. Her husband had been swallowed up in the poor back streets of the city where not only were all cameras attacked, but frequently outsiders too. Every public telephone booth was a windowless steel cube, vandal-proofed so

(continued on page 71)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• Circle No. 163

(continued from page 68)

that only paid-up 'Phonekey' holders could gain entry. Alert to the hazardous environment, George moved briskly along to a riverside park.

Councillor McChesney wanted to know what Superintendent Walsh intended to do.

"You've lost him", the councillor said. "I hope you didn't want him to escape".

Walsh aimed his narrow eyes at McChesney like a double-barrelled gun.

"If you can fault my thoroughness, you do so. I intend to do everything I can to bring George in, but if that's not enough, then good luck to them both. Men on the run with their wives is something new to me, Councillor. If I had my way I would employ police resources elsewhere, like investigating municipal corruption."

"What is that supposed to mean, Walsh"? retorted the councillor. "George is a murderer. He killed a colleague of mine in cold blood".

"Suspected of", Walsh interrupted. "A jury will decide, not you. Anyway, this city might be a happier place without Councillor Skinner". He switched his focus from McChesney back to the video bank, and wondered if he had said too much.

"Consider yourself on record as having said that, Superintendent Walsh".

Sarah thought she could see Michael on the opposite riverbank. She accelerated along Bridge Approach in her powerful hybrid car, but this behaviour attracted the attention of a police motorcyclist, who flagged her down halfway over the bridge. She told the constable her driving licence was at home, and as he booked her for speeding, the man who looked like her husband disappeared into the distance.

The officer opened a flap in the side of her car.

"Look, officer", Sarah said nervously, "there's no need for evidence from that thing, I plead guilty. I'm in a desperate hurry".

"It's your hurry that concerns me, lady".

The constable found the black box recorder. Fitted to all private vehicles by law, and originally conceived to provide crucial data about serious accidents, the microprocessor-based device now served primarily as an indisputable back-up for police prosecutions.

The figure on the esplanade had encountered the distant profile of a police patrol car and about-turned, drawing closer again. Sarah verged on panic, for the policeman held a digital read-out unit which he connected via an umbilical cable to the black box. Michael had previously switched number-plates on the car to fool the police, and unfortunately, the first thing to be displayed would be the correct vehicle registration.

Recognising his wife on the bridge, Michael George appreciated what was happening and raced up the stairs to the roadside about 100m. away. He then stood there idly until a car drove up and leapt in front of it.

With perspiration blurring his vision, he threw himself towards another vehicle approaching in the opposite direction. The objective was to cause a shunt — and it worked. Tyres screamed and two cars collided with a thud of tinkling glass. He then slipped out of sight down the subway stairs to the other side of the road.

The police officer looked up and shut the recorder housing flap.

"You'll receive a summons", he told Sarah, and left.

She jumped into her car and slammed the door. The passenger door slammed simultaneously as Michael joined her.

"God, where did you spring from"? she asked.

"Never mind. Just get going".

On the road

Michael told Sarah to drive to a car-hire company on the outskirts of town, and quizzed her about their regulations, knowing that she had hired from them herself.

"On the weekend rate", he asked, "didn't you say you had to return the car before their office opened in the morning"?

Sarah confirmed this: "That's right. There was no need for me to go inside because they made up the bill to my credit card number. They told me to leave the car around the corner with ignition key in".

"Good". Said Michael, "then we can fit ourselves up with a nondescript car. Our future may depend on it".

Indeed, there were two unattended cars outside the hire office before opening time.

"A Lee Electric 160C", he said, "that's good because there's more of those on the road than any other car. You stay in this one Sarah and follow me".

Soon they pulled up outside the local newspaper offices. Michael ran back to Sarah's car, asking her to telephone the hire company. He took the receiver.

"Hello, I'm the chap who hired your white 160C, registration DUK 6145E. I should like to extend the hire period by another 48 hours, if I may. It was due in this morning".

"I'll just look into it sir, can you give me your name please"? a girl replied.

Michael was prepared for this difficulty and interrupted her.

"Hello, hello, can you hear me"? he shouted repeatedly, winking to Sarah. He behaved as though they had been cut off, and then, speaking loud enough to make sure the hire girl overheard, he said:

"I think I've been cut off. I'll have to ring back".

The girl at the company called out to her assistant, "Who's got the white 160C"?

"Mr Dankworth", was the reply.

When Michael rang back, he said apologetically:

"I'm sorry, I got cut off just now. Is that the same person I spoke to"?

"Ah, that must be Mr Dankworth again", she replied. "It is alright to keep the car for another 48 hours — I checked".

Michael replaced the receiver.

"We now have a car totally unconnected with us", he told Sarah, "and which, unlike a stolen car, will not be reported missing for at least 48 hours".

Sarah followed Michael into the newspaper office, unsure whether or not to admire her husband's cunning. It was one of the most technologically-advanced provincial newspapers in the country. Classified advertisement copy could be dictated direct on to a video compositor, and be seen in print in as little as ten minutes. Laser-etched litho plates could be transposed automatically from an idler roller without stopping the press.

Michael inserted a request for a courier to drive Sarah's 'Hybrid Assailant' from Plymouth to an address in Brighton.

Sarah pulled her husband to one side.

"I can see the point in us taking off in that car out there, but why do we need to send my car to Brighton? We don't know anybody at the address you gave".

"No, but the police might expect us to travel that way, since I have a brother near Brighton. They'll be watching all possible bolt-holes".

Sarah's pretty face reflected the fact that she was some fifteen years younger than Michael, and also that she was bemused.

"I'll explain everything once we're on the road, but right now we have to hang around here until the advertisement appears".

Michael had arranged with the desk clerk to allow replies to his advertisement be taken on the copy-desk telephone in the waiting room.

"Why can't you tell me what you are up to now, Michael"? Sarah asked.

"Because we are not alone, and because it will take time to make you understand. The police have the means to watch us all the time, and I'm not talking about those street cameras either".

The decoy

Within an hour the telephone rang. After some discussion, the applicant wanted to know how and when he would receive payment.

"It's not that I don't trust you, Mr George, it's just that I don't know you, if you see what I mean? I do a lot of this casual work and I've been caught out before now".

"I've got your details", said Michael.

(continued on page 73)

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• **Circle No. 164**

(continued from page 71)

"I'll arrange for a credit transfer at my Brighton bank branch. It's quite near the delivery address. After that, I'll drop the car in to you".

He was in no position to make any such payment available, for he knew the police would have a real-time monitor on his bank account.

Michael drove the Assailant to the courier's home while Sarah parked the 160C around the corner.

"Nice car", said the young man.

"Sure", Michael responded. "Feel free to open her up on the motorway, she really flies. Very rewarding to drive".

"About the main part of my reward"? he asked.

Michael needed to bluff convincingly.

"It's not that I don't trust you, Mr Gates, it's just that I don't know you, if you see what I mean"?

They both laughed before Michael continued.

"So I've arranged for your credit pick-up at this bank". He handed over a piece of paper.

"This way I shouldn't have to worry about you taking payment and then dropping my wife's car. The manager will require the ignition keys before authorising payment; he's a friend of mine, you see. I'm sorry to be like this, but I've used casuals before and I, too, have been caught out".

"That's OK", said the young man. Michael leaned in through the Assailant's window and lifted the radio-telephone receiver.

"Now, if you have any doubts you can ring the bank manager for confirmation".

Mr Gates emitted an uncomfortable cough and declined the offer.

The 160C made far less progress on such a long journey than Sarah's car would have done, but at least they could share the road with motorway police uneventfully.

Sarah switched off the radio and insisted on an explanation for all the skull-duggery.

"Your car will not affect things unless the weather clears up", he told her. This was no help at all.

"I don't see how it acts as a decoy", she said. "The police will spot my car, pull it over and find out what you've done; then they'll know we're using a different car. Whey could we not simply have left it down a side street"?

"We need petrol", he said abruptly. "We shall be running on batteries only".

Sarah's bewilderment increased as they sped past the filling station which had obviously been the reminder about petrol in the first place. The car left the motorway by the next slip road, near Carlisle.

"We need a backwater station where the pumps take off-line payment. Otherwise, when the vending machine interrogates my account to see if I've got enough to pay, the Plymouth police will know exactly where we are. The road-blocks would be up before we left the garage. If we're really lucky, we might find somewhere that takes cash without suspicion".

"If we have to use your card, darling, how will you know if it's on-line or not"? Sarah enquired.

"I know one little trick that works. Enter the card upside down. If the machine says 'CARD EXPIRED' it's off-line; if it says 'CARD INSERTION ERROR' it's the on-line type".

Walsh turned to Inspector Colby who had just reported Michael George's abandoned car in a multi-storey car-park.

"I've been stupid. I had all units looking for George's car, without giving a thought to his wife's. Alert all units to a blue Assailant and give the registration details".

He relaxed his vigilance of the video monitors, and looked hard at Colby. Colby replaced the telephone receiver, and retorted: "Everyone's on our backs to return control of these closed-circuit televisions now, sir".

Walsh broke his gaze with a frightening jump.

"Do it. We've missed the boat; they'll be out of town by now".

"Things may not be so black, Super", Colby said, and handed Walsh a weather report. "It should be clearing up in the next few hours. We might be able to squeeze in some satellite time before nightfall".

Re-fuelled, and back on the motorway, Sarah sighed with relief as they crossed the border into Scotland.

"Now," she said, "you were telling me about our decoy".

"The police, my sweetheart, have a geo-stationary satellite over our heads, just waiting for those clouds to go away".

Sarah looked concerned.

"I did tell you about it. If you remember, I wrote an article on the thing for the technical press. The law use it to watch Britain's roads, among other things. That satellite can observe traffic congestion, the progress of abominable loads, and under certain conditions, the movement of individual vehicles on the open road; so long as the vehicle concerned is reasonably distinguishable".

"Surely it can't see much from that height"? Sarah asked.

"On a clear day, the on-board optical equipment would be able to see the newspaper headlines right over your shoulder".

Sarah squinted at the clouds.

"Not a good thing it's cloudy, then", she said. "Our decoy wouldn't have had any effect, but I can't believe they use that thing to spy on people anyway".

"Officially they don't use it that way; only for forest fires and road problems, but I do not believe the police would resist the temptation to use it in a chase".

"My God, to think that thing could see us in the garden last summer; you really should have told me", Sarah said in horror.

"So you see darling", Michael continued on his own train of thought, "even on a brilliant day we could never be singled out from all the other white 160Cs on the road. A blue Assailant moving fast down the motorway, however, is another matter".

"Like our friend Mr Gates", Sarah added.

"The crafty swine" Superintendent Walsh said in a soft behumbled voice. The Portsmouth police had intercepted Gates in Sarah's car.

"He knows all about us, doesn't he Colby? He could have fixed up that Brighton decoy remotely, and much more quickly using teletext, but he went to a local newspaper. He knows how we've got things wired".

"Do you think we'll catch him"? Colby asked.

After a thoughtful pause, Walsh said with a jolt:

"What kind of a question is that? We'll need the satellite, though, this guy is a technician".

He reflected on something which Colby once said, 'that the police would be lost without the sat'. This observation haunted him. It seemed to be true. He spoke again with optimism.

"We may not get the necessary clearance, Colby, the Commissioner doesn't like it. Political terrorists yes, but common criminals, that contraption's too busy. We may have to rely on good old-fashioned techniques".

Colby handed Walsh a copy of a magazine article.

"The Commissioner should read this, then. It's by our friend George and it features the sat'. What he doesn't actually know, he guesses with disturbing accuracy".

"So", Walsh pondered, "the Brighton decoy was meant for what George calls the eye in the sky, not a patrol car. I would bet your life on something Colby".

"Thank-you, sir. What"?

"George will have nicked a two-a-penny car, the best place to hide, after all, is in a crowd".

Colby's face cockled.

"So we're looking for a Ford Obus or a 160C".

"Maybe a Talisman", added Walsh. "If any of these models has been knocked off in the Plymouth area in the last 24

(continued on next page)

This was one region the satellite seldom saw.

(continued from previous page)
hours, I want all the details''.

Colby retreated to a keyboard.

''Oh, and Colby'', Walsh shouted, ''Any of those models hired as well''.

The 160C wound its way high into the misty prehistoric-looking mountains of the western Highlands, where heavy, bruised clouds took no heed of the general weather forecast. This was one region the satellite seldom saw.

Head against the glass, Sarah awoke from a doze.

''I hope this friend of yours is ready to sail. I take it he knows you could face the death penalty''?

''No sweetheart, but he's reliable, he's a friend of old; primary school in fact. It's a friendship formed too early to source on the National Records Computer with any luck. We haven't seen each other since I was a bachelor''.

With details of stolen cars, Colby made enquiries at the newspaper office where Michael George placed his advertisement. On his return he found Walsh back in the computer room staring mawkishly at a blank VDU.

''I think I've unearthed something, sir'', Colby said. ''A white 160C was seen outside the newspaper office at the time George placed his ad. A clerk took the telephone number from the hire sticker in its rear window''.

''A hired car then''? Walsh said. ''Did you follow it up''?

''I did sir, and a most peculiar thing happened''. Colby went on to explain the trick played on the car hire company.

''It must have been our man'', Walsh ventured. ''I would expect something more refined than a straight car-theft from George''.

Colby pressed some buttons, and a map of the U.K. appeared on a large wall screen.

''It was taken with a full tank, Super, so, if his journey was long enough to require re-fuelling at all, and assuming he wouldn't stop for petrol until it became necessary to minimise the risk of us picking him up, I think it might be worthwhile checking the petrol stations in this area''.

A coloured band appeared across the map, stretching from Carlisle to just south of Newcastle-upon-Tyne.

''That's how far a full tank would take him is it? It's all tenuous though, Colby, they might stay south''.

''Might do, sir, but it's worth checking. I would make for remote parts if it was me''.

''If he knows about the sat', he won't attempt flying out of the country, but he may well use a private boat''.

Walsh thought carefully.

''I'm damn' sure he'll take his wife and himself out of the U.K. He could resume his attack on our so-called police state from some Third-world country with total freedom, but he doesn't have a boat of his own, does he''? He was thinking aloud.

Walsh took a seat at the console.

''Friends'', he muttered. ''Friends with boats''. He looked up at Colby's questioning face. ''Go on then, check the filling stations in that suspect area of yours''.

''Yes sir. I'll have to go up there personally to check through the off-line stations''.

McChesney entered the room as Colby left. After some minutes looking over Walsh's shoulder, the word 'SEARCHING' came up on the screen.

''What's that''? McChesney asked.

''I'm conducting a data-string search'', was the reply. ''The National Records computer is going to furnish me with every possible friend of George's. It'll create a list of everyone George ever worked with or went to school with, going right back to kindergarten. When it's done that, it will refer to the temporary data store to extract more information. This time it'll create a file of all boat-owners who at present have deep-draughted vessels registered as docked at any sea-access mooring in the country. When it's done that'', he continued with mock fatigue, ''the machine will compare every person in the first file to every person in the second, and if any one person is in both, it could be bingo''.

''We could do with one of these gadgets'', McChesney snorted.

Man on the quay

Against a background of choppy grey water, the Georges' car pulled into the quay car park at Fort William, where Michael's friend, Andrew Bell, awaited them anxiously. They were beckoned aboard his luxury cruiser, stopping briefly for introductions, for Andrew had never met Sarah.

''You're lucky I happen to be back in this part of the world, Mike'', Andrew rasped, his Highland accent alive and well. They went below to discuss their journey and the visibility forecast. It seemed they could be well clear of the mainland before emerging from cloud cover.

''We're to cast-off soon'', Andrew told them. ''We can be away faster with the powerful tides in these lochs on our side''.

When Walsh learned of Michael George's stop at a service station near Carlisle, as far as he was concerned the detective work was complete, for the name Andrew F Bell glowed in soft fluorescent green on the VDU before him. Details of his boat, and its present mooring, accompanied Bell's name. Walsh arranged to fly to Scotland immediately.

The cruiser's roof roared with the driving rain, almost drowning its occupants' voices. With Sarah in the galley helping Andrew's shipmate, an attractive Jamaican girl, Andrew's eyes began to twinkle with curiosity. Without actually sporting a beard, he was as near to a traditional rugged Highlander as one could get. He glanced upward.

''This'll keep that satellite of yours minding its own business''.

He then leaned forward confidentially.

''Am I allowed to ask what it is you've done Mike''?

Michael began to explain. He described his 200 acres of untouched Devonshire countryside, with his custom-built house at the centre. It had taken everything to secure the land.

''I did it to stop the rolling barrage of housing'' he said. ''The builders, who incidentally comprise most of the local council, are turning Devon into one big housing estate, like they did to Dorset. I had an animal sanctuary on my hands. All the wildlife of the area was being driven into it. It's a great pity you never saw my place Andy, it was quite something''.

''You say 'was', Mike''?

''They finally hit me with a compulsory purchase. I received less than market value, and now, my house is in the middle of a red-brick jungle. Any land not yet built on is cluttered with dumped cars and screaming kids''.

''It's a good thing you're out of the country Mike. Buy yourself a boat. My garden is anywhere in the world almost'', Andy commented.

''That's not why I'm leaving Andy, I killed someone. Councillor Skinner. He was the prime mover behind it all, and when things got really rough, he offered to ease up, but the conditions were an insult to my wife. I don't want to go into any more detail than that, Andy''.

Andy nodded. ''I would have killed him myself''.

''He made the offer while I was there'', Michael continued. ''I just lost control and struck him. I should have bottled it, he was just being antagonistic because he envied me my wife, but unlike everything else, he couldn't take her away from me''.

Andrew put his hand on Michael's shoulder.

A stranger on the quay assisted Andrew in casting off in the evening twilight. As he waved goodbye, the helper spoke.

''Did I see Michael George on board''?

Andrew raised an eyebrow but said nothing.

''I'm a fan of his'', the helper said. ''Read most of his work on the abuse of technology''.

The cruiser throbbed softly into the darkness as the stranger stood close to the edge and shouted one last message.

''Tell Mr George not to worry, I did it without the satellite. Tell him we can call it a draw''.

The stranger entered a telephone booth and made a call.

''Colby''? he said, ''Walsh here. We hooked a red herring, I'm afraid. I'm coming back on the next flight''.

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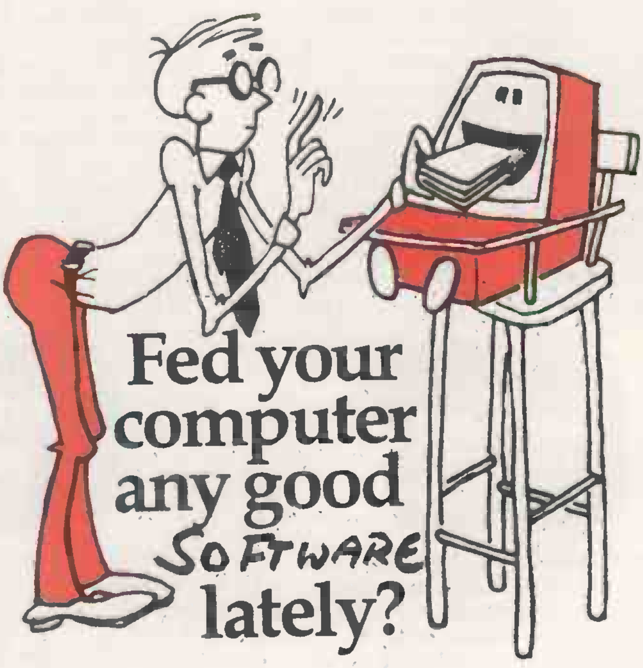

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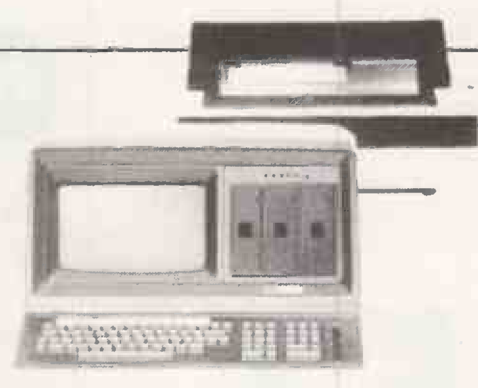

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• Circle No. 167

Contemporary look at a new technology

by Martin Hayman

PRESTEL HAS already made its public debut to a fanfare of publicity which included advertisements in the major daily and business papers. It is now available as a public service — strongly aimed at the business user — and it is confidently predicted that by the end of the year 50,000 sets will be in operation.

The vast majority of these will be dumb terminals — TV sets with a Prestel interface, intended to supply the user with on-line information. The next development, as argued by Peter Sommer — *Practical Computing*, May, 1980 — is likely to be the introduction of the intelligent terminal which will not only store pages in its memory — making for more relaxed viewing, particularly for the domestic user who has to pay for his telephone-line time without the possibility of setting it against tax — but also have the possibility of storing programs for future use.

Huge stride

Down-loading telesoftware, as the buzz-word describes it, is clearly a huge stride into the future for the microcomputer enthusiast. It is likely to cut costs of software enormously and makes instant, error-free programs a reality. It also brings the physical transmission of programs into line with the modern world.

What could be more antiquated than copying a program on to disc, then packing and mailing the disc through the Post Office? It doesn't make sense, and the instant relevance of down-loading telesoftware has already been demonstrated to us by the phenomenal number of accesses to the *Practical Computing* page of Apple software — available on Prestel page number 45631.

Yet for the public, all that seems a little esoteric. Unhappily, the computer still invokes the image of a semi-human hunk of machinery which can be handled only by a highly-trained and super-skilful technological priesthood.

Greater potential

Those fears will doubtless disappear as the generation of computer-wise adolescents comes of age, along with the technology at a reasonable price in every home, but for the present the TV screen is the only familiar reality. That is why the proponents of broadcast teletext feel that their system has more potential in the home than Prestel.

Ideally the broadcast and land-line Videotex systems should be compatible and complementary, although as we shall see, there are some problems to overcome. The major advantage of broadcasting software is that it provides the possibility of intelligence at the terminal without the need for the user to tackle a new 'tool'.

All he needs is the TV receiver — the processor in production models will, of course, be in the box rather than as an add-on module — and the existing remote numeric keypad. For many of the computing operations which people are likely to wish to perform in the home, numeric will suffice, though there is, of course, no reason why an alpha-numeric keyboard should not be used for more complex operations.

The applications envisaged for broadcast software include assessment programs for items such as tax and mortgage payments and possibly social security benefits. The advantage claimed for that kind of calculation is complete privacy. Obviously any data, personal or otherwise, which you are inputting can go no further then the set with which you are working. Other forms of calculation would include complex but specific routines such as assessing the most efficient form of central heating in a home.

Education is an area which is already receiving attention within Oracle. It is claimed to be especially suitable for telesoftware implementation and the Department of Industry has already funded a project to be run under the supervision of the Brighton Polytechnic department of computing to the tune of £15,000. ITV and BBC are both involved in the project which will put 10 Mullard telesoftware receivers into schools around the country.

It is also regarded as something of a pilot study to check what kind of language would best suit telesoftware. One point John Hedger of Oracle makes is that the choice of Basic for the Brighton project, though by no means definitive, is certainly not arbitrary. Brighton is seen as a field trial, a way of evaluating possibilities rather than a definitive implementation. That is currently rather a ticklish point since a great deal hangs on the outcome.

It is clearly desirable that teletext and Prestel should be compatible, and programs machine-independent, but there are several systems in use throughout the world and there are obviously large commercial interests at stake. France, Japan and Canada are all interested in telesoftware although U.K. exponents claim still to have the most hands-on experience.

The second major problem which the broadcasting authorities face, and more specifically ITV, is that of making a profit. ITV would not be behind such a large investment project if they did not believe there was a commercial future, and Hedger told me that the whole operation was market-driven. Yet one wonders if this is a case of optimistic thinking.

Popular games

In Hedger's demonstration at Viewdata 80, the brief mortgage calculation program was provided by the Nationwide Building Society, which would clearly be expected to pay for the privilege of using its name. Would the same, for example, apply to that most popular sector of Prestel — games? More likely the providers would do everything in their power to inhibit such developments.

Who is going to bother with buying a video game if you can down-load and copy a new game every evening perfectly legally, if the system operates in the same way as the MCPS-authorised licence for copying gramophone records? For this reason ITV has every reason to hope for the possibility of obtaining a licence for paid-up advertisements.

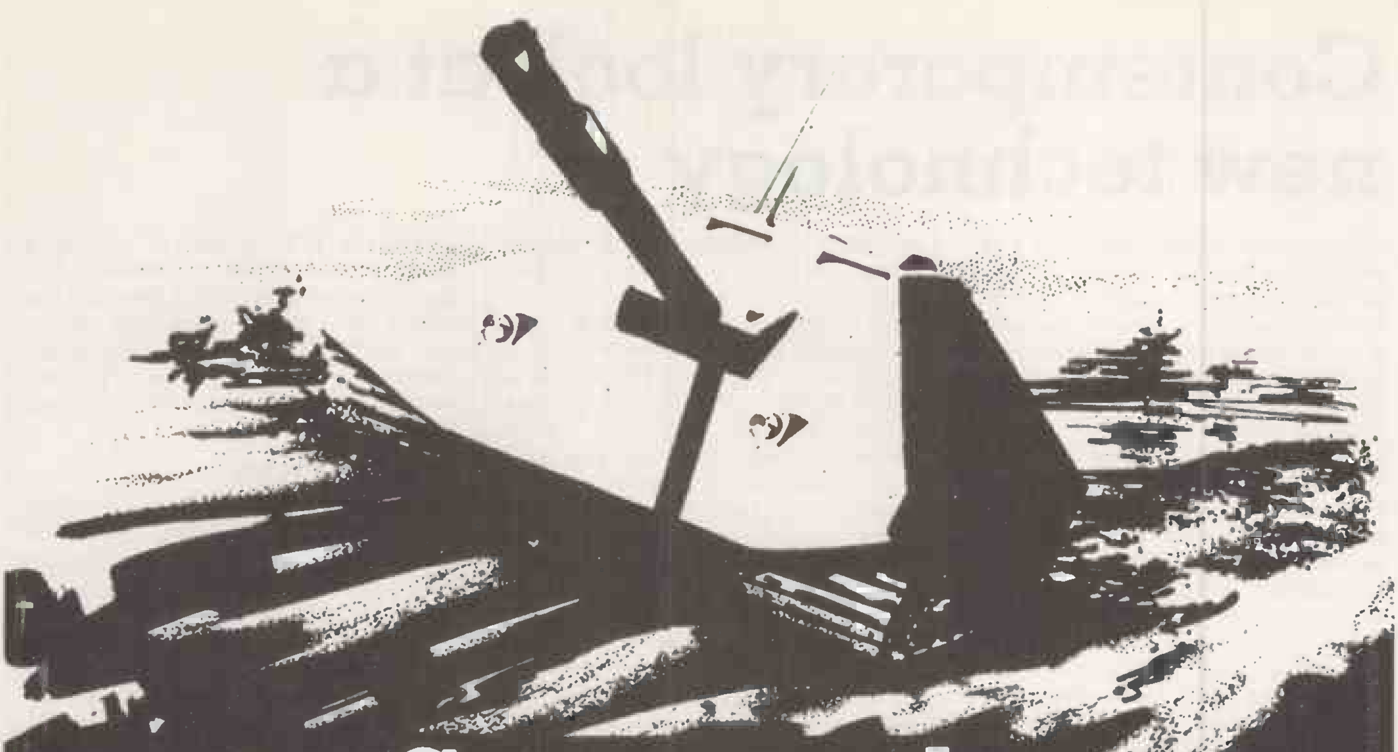
Where does all that leave the microcomputer manufacturers? Some, like Technalogics and Hi-Tech, have already made a rapid entry into the market, but as Hedger says: "They are not going to stand by idly and watch telesoftware take over".

Plug-in options

He foresees plug-in telesoftware options — bluntly, an aerial socket as a data grabber. Why bother to patch in updates on financial programs when you have the thing debugged and ready-to-run by simply adding an aerial?

Of course, where broadcast telesoftware and the intelligent TV loses is in the interactive possibilities of landlines. To Hedger's mind that means that the two can usefully dovetail. He envisages for example, a colour advertisement on the box, with surf and palm trees, for an exotic holiday.

The advertisement gives a teletext reference to the travel agent and you look it up, maybe with a short routine to find the time and price which best suits the enquirer. Once he has found the holiday in that location which corresponds to his means and his free time, he makes his reservation and pays the advance money by credit transer on Prestel which itself is shielded from a deluge of enquiries by the buffer effect of the teletext enquiry procedure. All this, without moving from your armchair.



Supertank

A blow-by-blow account of the writing and playing of a battle game.

THE WAR had not lasted long. The computers had seen to that. Salvoes of missiles had crossed the sky in almost ritualistic fashion; counter-measure had opposed counter-measure until the ultimate weapon had breached the enemy's defence and wiped-out his nerve centre.

A strange hush settled on a scarred landscape and the victors emerged from their shelters. The celebrations were short-lived, however, since something else was also emerging — the final retaliation.

From an artificial cavern deep in a mountain, safe from the prying eyes of the spy satellites, rumbled the monster tank. As it rolled across the devastated plains towards the home territory of the victors, a frantic intelligence-gathering exercise sought-out its dread secrets. When they were revealed, they brought little comfort.

Nuclear device

The tank carried a nuclear device of hitherto-unrealised power. It would be detonated when the tank reached a secret destination, deep in the heart of the land, selected by the on-board computer which controlled all the functions of the mighty tank.

Supertank, for such it had been nicknamed, was driven inexorably forward by hundreds of nuclear-powered engines, and only deviated from its chosen path to avoid one of the many deep craters left by the war.

Nor was it defenceless — hundreds of missile launchers bristled from its outer hull and would be brought to bear against any hostile force the computer detected.

The only way to prevent this final tragedy of a tragic war was to stop Supertank — not only stop it, but destroy it utterly, since the computer was programmed to detonate the bomb if it sensed that all opposition has been destroyed.

Desperately, the defenders assessed the meagre resources left to them. Only a handful of missile sites were still operational and added to these was the remnants of one missile tank squadron. These mobiles, as they were known, were pathetically small and weak compared with Supertank, but they were more manoeuvrable; they could dart in, attack, and then withdraw to a safer distance.

by Bob Merry

If all else failed, their crews had orders to ram Supertank. That meant certain destruction, but the resultant explosion of their remaining energy piles would cause some damage to the monster's engines. Would this desperate defence be enough to save the remnants of a once over-proud humanity?

That, then, is the scene set for the game of Supertank, a wargame for one player against the computer. Because of its length, I had to split the game into two programs to implement it on my 8K Pet and in these two articles I shall describe the two programs and discuss some of the lessons and techniques I learned during their development. Firstly, let me acknowledge the inspiration I have derived from playing various wargames, but most notably, in this instance, I was influenced by Ogre, a game from Metagaming.

Design criteria

Having played games like this, I was keen to attempt something similar for the Pet. I started by setting myself a number of design criteria and it may be helpful to review these here:

The game map should occupy as much of the screen as possible to allow reasonable movement of forces.

The map should contain some terrain features, however simple, and they should vary from game to game. That adds variety to the game and prevents identical games occurring.

The defender should have control over the initial deployment of his resources, so that different strategies can be tried. Again, that adds variety to the game.

There should be two types of defensive unit — one fixed and one mobile. Each of them has its own characteristics and their use increases the tactical and strategic choices which must be made.

The starting point of Supertank should not be revealed until after the defence is deployed, forcing the defence to cover a wide range of possibilities. The final target is to be kept secret until after Supertank reaches it and then the defender is to be given one last chance.

As a further contribution to variety, the number of defenders should vary, within limits, from game to game.

Having decided on the criteria, it was obvious that the game would probably not fit into 8K of memory. I would have to split it into two programs and the first decision was where to make the split.

The game fell into three main segments — the instructions, the initial deployment of forces, and the game itself. With the benefit of hindsight, it is, in fact, just about possible to put the instructions in one program and have the active parts of the program on their own.

However, at this stage I had little idea of the final requirements of the program and, in any case, felt that spare space in the second program would enable me to add further refinements to the program later. Besides, making the split after the defenders had been deployed and most of the variables established would involve techniques which I was keen to master and I decided, therefore, to adopt this approach.

Data storage

We shall discuss the problems encountered in using the ability of the Pet to load one program in the space used by another, while retaining the variables from the first program, in the next article.

The next decision concerned the method of storing all the details shown on the map. I had decided to use the first 20 lines for the map, leaving the bottom five lines for input and message requirements. That gives a map area of 40 × 20 which was reduced to 39 × 19 to include a guide to the X-Y co-ordinates along two edges of the map.

My first plan was to keep all the points of the map as elements in arrays in memory and my first efforts were directed along these lines. It soon became clear, however, that this approach was impracticable, as there were 741 points to be recorded and each element in the array needs seven bytes or more.

That would leave very little space for a reasonable program, but how could I carry forward all the required details without using too much memory? In the end, I hit on the obvious solution — one which used the 1K of memory not needed for the program or its variables — I used the screen as my means of storage.

Once the map has been set-up in the first program, it stays on the screen while the second is being loaded. Great care has to be exercised at all times to ensure that the screen is not scrolled by any of the messages which appear at the bottom of the screen.

Now let us consider the program itself. Table 1 gives a list of the principal variables used. Lines 100-990 contain the instruction sequence and are fairly self-explanatory.

Most lines of print start with a cursor down to give double spacing and improve readability. At the end of each page, the program waits for a key press before clearing the screen and continuing.

It is not completely idle during this period, however, as the key-press subroutine also runs through random numbers while it is waiting, ensuring that the sequence of random numbers for the game will be different every time.

Line 1010 sets-up two strings containing cursor-right and cursor-down instructions. They are used to access any point on the screen, using such instructions as

PRINT LEFT$ (AC$,X) : LEFT$ (DN$,Y)

Line 1020 sets the number of defending mobiles, MN, and artillery units, AN. It also stores the values of Supertank's engines, SM, and firepower, SF. The line has a great bearing on the balance of the game.

When you first play, you may well find that Supertank is too powerful, but after

List of main variables

MN	Number of mobiles
AN	Number of artillery units
N	Total of units; MN + AN
SM	Supertank's engines
SF	Supertank's firepower
MM(MN)	Mobiles 'engines; 1 to MN
MF(MN)	Mobiles' firepower; 1 to MN
MX(MN)	Mobiles' x co-ordinates; 1 to MN
MY(MN)	Mobiles' y co-ordinates; 1 to MN
AF(AN)	Artillery firepower; 1 to AN
AX(AN)	Artillery x co-ordinates; 1 to AN
AY(AN)	Artillery y co-ordinates; 1 to AN
TX	X co-ordinate of target location
TY	Y co-ordinate of target location
SX	Supertank's x co-ordinate; initially 1
SY	Supertank's y co-ordinate

you have refined your tactics, you will discover that it can be beaten. The values given here are ones that I hit on after the initial play-testing, but now I find I can usually beat Supertank at these levels.

By changing the values of SM and/or SF more powerful versions of Supertank can be fought. It is also a simple matter to include a short program giving a choice of enemies — that is left for you to implement.

After the number of units available have been displayed in lines 1030-1040, the program forms arrays containing the appropriate number of segments for storing movement factors, firepower and position for the defending units — 1050-1060.

Lines 1070 and 1080 are used to print co-ordinates along the top and left-hand edges of the map and the terrain features are added. They are simply craters, represented by an asterisk, and prevent movement by either side. Defending units cannot be placed in these spaces.

That simple terrain feature was forced on me by the use of the screen as the means of storing the map, since once the feature is obliterated by another unit moving through it, it would be difficult to restore it to the display.

Once the map is drawn, the player can enter his units on the map. First he places the mobiles. That is done in lines 1120-1180 and consists of entering the co-ordinates X,Y of the point on the map.

Most of this section is concerned with checking the idiot factor. Line 1140 checks that the values entered are within the allowed limits, calling-up the error message in subroutine 1330 if they are not.

Subroutine 1360 calculates the screen memory value of the desired point and this location is checked in 1150 and 1160 to see if it is already occupied by a crater or another unit.

Error messages

The appropriate error messages are in subroutines 1340 and 1350. If all is well, the unit is placed on the map. It is represented by the reverse number of the mobile. Its position is also stored in the appropriate cells of arrays MX(I) and MY(I).

Subroutine 1310, called in line 1130, clears the bottom five lines of the screen and sets the cursor to the start of the twenty-first.

Lines 1200-1240 perform the same routine for the artillery units. Line 1250 sets the secret destination for Supertank and that is checked to see it is possible for Supertank to occupy it — it cannot if the destination is already occupied by an artillery unit or a crater.

Finally, Supertank is placed at random in the left-hand column of the map, but not in a crater of course, its symbol is printed, the bottom of the screen cleared and LOAD "GAME" is ordered.

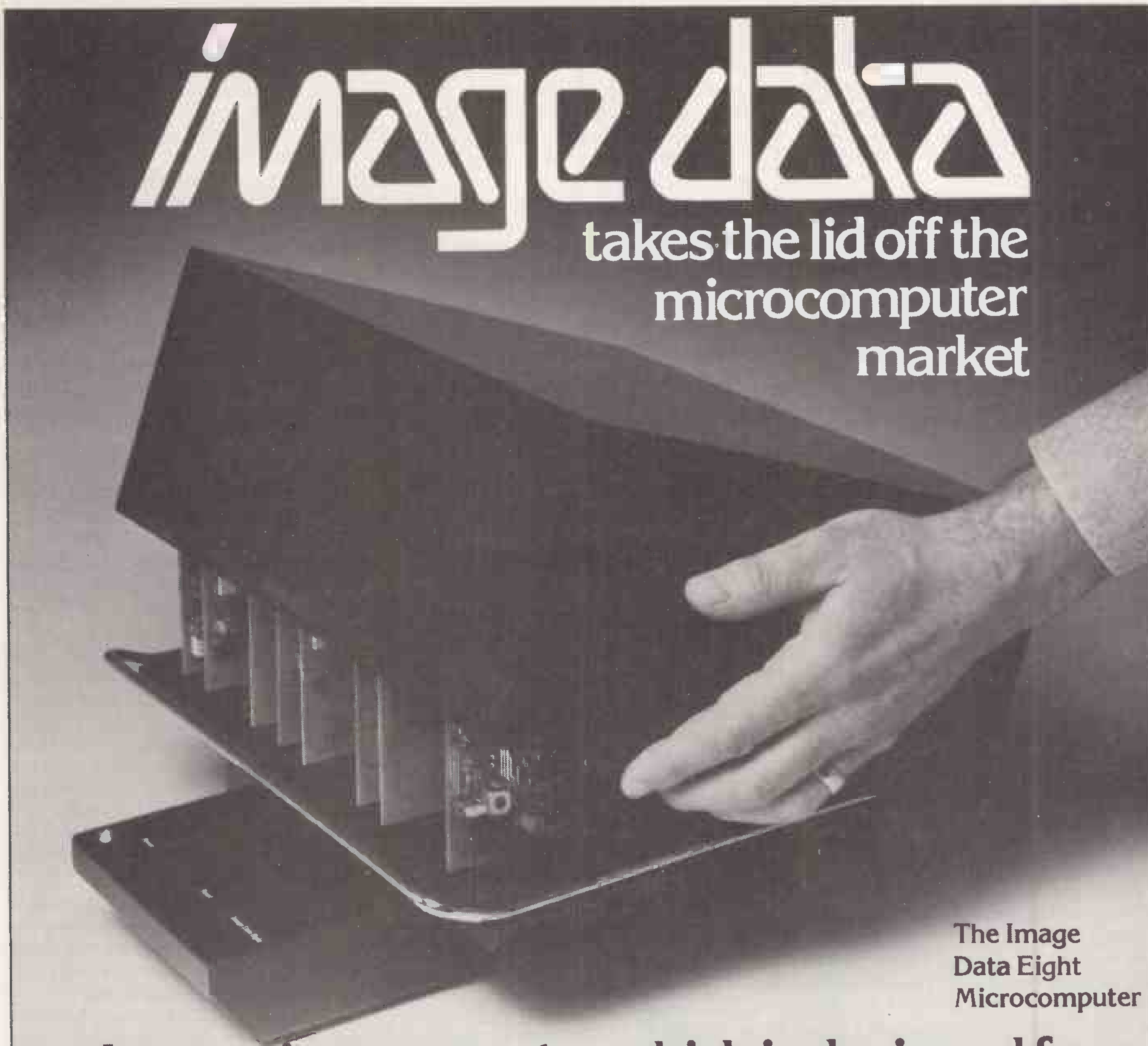
That places "GAME" into the same space as this first program which means that "GAME" must be the same length or shorter. All the variable values we have derived in this first program remain in memory and can be used by the second program.

The map with all its details stays on the screen and it is necessary to clear the bottom of the screen since, if the cassette has not been left in PLAY after the first program, the message "PRESS PLAY ... etc." will appear, followed by OK which can cause scrolling.

The next article will discuss the game itself, but I will conclude with a few suggestions with which you may care to experiment when you have tried the program in its basic form.

I have already mentioned the possibility of altering the balance of the game by playing with the values of SF and SM. You could also try different values of MM(I), MF(I) and AF(I). The terrain could play a different role if the craters were more dense.

That can be achieved by reducing the value 97 in line 1100. These are just a few possibilities and I hope you will find a few more. *(continued on page 83)*



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• Circle No. 168

(continued from page 81)

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100 PRINT"               SUPERTANK"
110 PRINT"THIS PROGRAM CONTAINS THE INSTRUCTIONS"
120 PRINT"AND THE SET-UP SEQUENCE FOR THE GAME OF"
130 PRINT"SUPERTANK. IF YOU DO NOT WANT TO READ"
140 PRINT"THE INSTRUCTIONS, PRESS 'N'. PRESS 'Y'"
150 PRINT"FOR THE INSTRUCTIONS. AFTER EACH PAGE"
160 PRINT"OF INSTRUCTIONS, YOU CAN PRESS ANY KEY"
170 PRINT"TO CONTINUE":GOSUB1290 :IFR$="N"THEN1000
180 IFR$="Y"THEN200
190 PRINT"PLEASE PRESS 'Y' OR 'N'":GOTO170
200 PRINT"THIS IS SUPERTANK:"
210 PRINT"IT MAY NOT LOOK MUCH, BUT IT IS REALLY"
220 PRINT"QUITE POWERFUL. IT HAS A FIREPOWER OF"
230 PRINT"200 MISSILE LAUNCHERS AND USES 300"
240 PRINT"ENGINES TO MOVE ITS GREAT BULK. AS WELL"
250 PRINT"AS THIS, IT CARRIES A POWERFUL NUCLEAR"
260 PRINT"DEVICE, WHICH HAS BEEN PROGRAMMED TO"
270 PRINT"EXPLODE SHORTLY AFTER SUPERTANK REACHES"
280 PRINT"A SECRET DESTINATION, DEEP INSIDE YOUR"
290 PRINT"TERRITORY. YOUR MISSION IS TO STOP IT"
300 PRINT"AT ALL COSTS!!!":GOSUB1290
310 PRINT"YOU WILL HAVE BETWEEN 6 AND 10 MOBILE"
320 PRINT"MISSILE TANKS AND 3 TO 5 FIXED ARTILLERY"
330 PRINT"SITES. THESE HAVE A FIREPOWER OF 10 AND"
340 PRINT"30 MISSILE LAUNCHERS, RESPECTIVELY. LIKE"
350 PRINT"SUPERTANK, THE EFFECTIVENESS OF THE "
360 PRINT"WEAPONS REDUCES WITH RANGE. YOU WILL"
370 PRINT"NEED TO MOVE YOUR MOBILES QUITE CLOSE"
380 PRINT"TO SUPERTANK IF YOU ARE TO HIT IT OFTEN"
390 PRINT"ENOUGH TO STOP IT. YOU WILL BE GIVEN"
400 PRINT"THE CHOICE OF AIMING AT ITS ARMAMENT OR"
410 PRINT"ITS ENGINES. YOUR AIM WILL BE COMPUTER"
420 PRINT"CONTROLLED.":GOSUB1290
430 PRINT"THE MOBILES CAN BE MOVED UP TO 3 SPACES"
440 PRINT"AT A TIME. MOVEMENT IS CONTROLLED BY THE"
450 PRINT"KEYPAD:       7 8 9"
460 PRINT"               \|/"
470 PRINT"              4-5-6"
480 PRINT"               /|\"
490 PRINT"              1 2 3"
500 PRINT"PRESS 5 TO STAND STILL. NEITHER YOU NOR"
510 PRINT"SUPERTANK CAN MOVE INTO A CRATER(*), BUT"
520 PRINT"MUST STAY IN CLEAR TERRAIN. WHEN YOUR"
530 PRINT"ENGINES ARE DESTROYED BY SUPERTANK'S"
540 PRINT"FIRE, YOUR MOVEMENT WILL BE REDUCED. YOU"
550 PRINT"HAVE 30 ENGINES ON EACH MOBILE AND NEED"
560 PRINT"A MINIMUM OF 5 TO MOVE.":GOSUB1290
570 PRINT"IN DESPERATION, YOU CAN RAM SUPERTANK."
580 PRINT"THIS WILL DESTROY YOUR MOBILE, BUT CAN"
590 PRINT"DAMAGE SUPERTANK'S ENGINES AND, PERHAPS,"
600 PRINT"SLOW IT DOWN. SUPERTANK IS PROGRAMMED "
610 PRINT"TO MOVE TOWARDS ITS SECRET DESTINATION"
620 PRINT"AND WILL RAM ANY MOBILE THAT GETS IN ITS"
630 PRINT"WAY, ALTHOUGH ARTILLERY SITES ARE TOO"
640 PRINT"BIG TO RAM. IF IT RAMS A MOBILE, IT WILL"
650 PRINT"DESTROY THE MOBILE, BUT WILL ALSO HAVE"
660 PRINT"SOME OF ITS OWN ENGINES DESTROYED.":GOSUB1290
670 PRINT"THE ORDER OF MOVES IN THE GAME IS:"
680 PRINT"   1)YOU MOVE YOUR MOBILES"
690 PRINT"   2)YOU ATTACK WITH EACH UNIT IN TURN"
700 PRINT"   3)YOU CAN MOVE AGAIN"
710 PRINT"   4)SUPERTANK MOVES"
720 PRINT"   5)SUPERTANK ATTACKS"
730 PRINT"SUPERTANK DIVIDES ITS FIREPOWER EQUALLY"
740 PRINT"AMONG ALL YOUR UNITS THAT STILL HAVE"
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(continued on next page)

(continued from previous page)

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 750 PRINT"EITHER ENGINES OR MISSILES. AS YOUR "
 760 PRINT"UNITS ARE DESTROYED, MORE OF SUPERTANK'S"
 770 PRINT"MISSILES CAN BE AIMED AT THE SURVIVORS!":GOSUB1290
 780 PRINT"ONCE SUPERTANK REACHES ITS DESTINATION,"
 790 PRINT"YOU WILL HAVE ONE LAST ATTACK IN WHICH"
 800 PRINT"TO DESTROY ITS REMAINING ARMAMENT AND"
 810 PRINT"ENGINES. IF YOU FAIL, THEN THE BOMB IS"
 820 PRINT"DETONATED. SHOULD YOU IMMOBILISE SUPER-"
 830 PRINT"TANK, BY REDUCING ITS ENGINES TO LESS"
 840 PRINT"THAN 10, THEN YOU MUST ALSO DESTROY ITS"
 850 PRINT"ARMAMENT. IF YOU RUN OUT OF FIREPOWER"
 860 PRINT"BEFORE THIS IS DONE, THE BOMB WILL STILL"
 870 PRINT"EXPLODE. NOTE THAT RAMMING SUPERTANK "
 880 PRINT"WILL NOT DESTROY MISSILE LAUNCHERS.":GOSUB1290
 890 PRINT"NOW YOU WILL BE ASKED TO PLACE YOUR "
 900 PRINT"UNITS ON THE MAP. THIS WILL BE DONE BY"
 910 PRINT"ENTERING COORDINATES IN THE FORM X,Y."
 920 PRINT"X IS THE NUMBER OF SPACES HORIZONTALLY"
 930 PRINT"(RANGE 2-39) AND Y IS THE NUMBER OF"
 940 PRINT"SPACES VERTICALLY (RANGE 1-19). "
 950 PRINT"THE COMMA IN THE ENTRY IS IMPORTANT."
 960 PRINT"ARTILLERY UNITS ARE SHOWN AS A, WHILST"
 970 PRINT"MOBILES ARE IDENTIFIED BY NUMBER-E.G. 5"
 980 PRINT"YOU CANNOT PLACE ANY UNIT IN A CRATER(*)"
 990 PRINT"OR IN THE LEFT-HAND ROW(X=1)":GOSUB1290
 1000 PRINT"PLEASE WAIT WHILE THE MAP IS DRAWN"
 1010 AC$="":DN$=""
 1020 MN=INT(5*RND(1)+6):AN=INT(3*RND(1)+3):N=AN+MN:SM=300:SF=200
 1030 PRINT"YOU HAVE";MN;"MOBILES AND";AN;"ARTILLERY"
 1040 PRINT"UNITS":FORI=1TO2000:NEXT
 1050 DIMMM(MN),MF(MN),MX(MN),MY(MN),AF(AN),AX(AN),AY(AN)
 1060 FORI=1TOMN:MM(I)=30:MF(I)=10:NEXT:FORI=1TOAN:AF(I)=30:NEXT
 1070 PRINT"":FORI=1TO39:PRINT"";LEFT$(AC$,I);RIGHT$(STR$(I),1):NEXT
 1080 FORI=1TO19:PRINT"";LEFT$(DN$,I);RIGHT$(STR$(I),1):NEXT
 1090 FORI=1TO19:FORJ=1TO39:R=100*RND(1)
 1100 IFR>97THENPRINT"";LEFT$(AC$,J);LEFT$(DN$,I);"*"
 1110 NEXTJ,I
 1120 FORI=1TOMN
 1130 GOSUB1310 :PRINT"ENTER COORDINATES(X,Y) OF MOBILE #";I
 1140 INPUTX,Y:IFX<2ORX>39ORY<1ORY>19THENGOSUB1330 :GOTO1130
 1150 GOSUB1360 :IFPEEK(R1)=42THENGOSUB1340 :GOTO1130
 1160 IFPEEK(R1)<>32THENGOSUB1350 :GOTO1130
 1170 I$=STR$(I):MX(I)=X:MY(I)=Y
 1180 PRINT"";LEFT$(AC$,X);LEFT$(DN$,Y);"";RIGHT$(I$,1);"":NEXT
 1190 FORI=1TOAN
 1200 GOSUB1310 :PRINT"ENTER COORDINATES OF ARTILLERY #";I
 1210 INPUTX,Y:IFX<2ORX>39ORY<1ORY>19THENGOSUB1330 :GOTO1200
 1220 GOSUB1360 :IFPEEK(R1)=42THENGOSUB1340 :GOTO1200
 1230 IFPEEK(R1)<>32THENGOSUB1350 :GOTO1200
 1240 PRINT"";LEFT$(AC$,X);LEFT$(DN$,Y);"A":AX(I)=X:AY(I)=Y:NEXT
 1250 TX=INT(10*RND(1)+30):TY=INT(19*RND(1)+1)
 1260 IFPEEK(32768+TX+40*TY)=42ORPEEK(32768+TX+40*TY)=129THEN1250
 1270 SX=1:SY=INT(19*RND(1)+1):IFPEEK(32768+SX+40*SY)=42THEN1270
 1280 PRINT"";LEFT$(DN$,SY);"":GOSUB1310 :PRINT"";LEFT$(DN$,19);:LOAD"GAME
"
 1290 R=RND(1):GETR$:IFR$=""THEN1290
 1300 RETURN
 1310 PRINT"";LEFT$(DN$,20);:FORK=1TO199:PRINT" ";:NEXT
 1320 PRINT"";LEFT$(DN$,20);:RETURN
 1330 PRINT"ILLEGAL VALUE";:RETURN
 1340 PRINT"NOT IN A CRATER!";:RETURN
 1350 PRINT"SQUARE OCCUPIED!";:RETURN
 1360 R1=32768+X+40*Y:RETURN
READY.
```

• Circle No. 169

• Circle No. 170

Curing administrative ills with computer treatment

Duncan Scot looks at how microcomputers can be used by family doctors, assesses some of the packages on the market and reviews the moves by the Royal College of General Practitioners and the British Medical Association to set the standards to which medical packages will have to conform.

AS A PRIVATE doctor, with a practice in London's Wimpole Street, Barry Grimaldi has fee-paying patients from all over the world. As a self-employed man, he is always seeking more efficient ways of running his surgery. Installing a computer seemed an obvious way to reduce paperwork.

"I knew that some U.S. doctors were using small computers", says Grimaldi, "but the first inkling I had of the kind of computer on the market was from looking in the shops in London's Tottenham Court Road". Grimaldi bought his first computer, a Pet, from the Byte Shop and, after a few weeks in which he taught himself some Basic, started to devise a program for his practice.

Private doctors work on very different lines from the family doctor employed by the National Health Service, mainly because of the way they are paid. The family doctor is paid a standard fee according to the number of patients who are registered with the practice and not according to how many patients have to be treated every year.

Patient records

Grimaldi, on the other hand, not only decides which patients to accept for treatment, although he is obviously unlikely to turn any away, but is paid according to the treatment which each patient requires. On average, he deals with about 1,000 patients each year and keeps records on at least 5,000 who have received treatment or who might have to be recalled for check-ups.

The requirements Grimaldi set for his own system were that it should be able to store records on all 5,000 patients and process those records to provide a detailed analysis of, for example, the number of patients being treated for a certain condition. Each entry would have to include a code with which the system could analyse the practice workload. Unlike a doctor in the National Health Service, Grimaldi has to keep detailed financial records and invoice all his patients.

In the early stages, a multi-terminal system seemed to offer the best solution. He planned to have one terminal in his surgery, with which he could study his patient records, and another in his secretary's office. In a part exchange deal with the Byte Shop, he returned the Pet and bought a 48K North Star Horizon, a Volker-Craig VDU and a small Anadex matrix printer.

The first set-back was when Grimaldi discovered that not only were there no medical packages which he could adapt for his practice but that it was not possible, as he had assumed, to buy a selection of subroutines which he could string together to make his program. He could not even find someone who could offer him a standard file-handling package; Grimaldi ended up writing the entire program himself.

The full program is stored on one 5.5in. floppy disc and falls into two parts; the medical files and the financial files. When the program is run, the following menu is displayed:

1 Patient files
2 Medical report
3 Accounts
4 Transactions
5 Enquiries
6 Billings
7 Reports
8 Security

The medical files, items 1 and 2, are stored on another 5.5in. floppy disc. The other items refer to the financial-control routines.

The patient files include details of the name, age, sex and address of each patient and are followed by a short narrative of the patient's medical record. Each patient can be identified, via a short code, by age, sex, complaint or by treatment. These codes are used for a detailed sorting of patients to identify any category he might require.

"One simple example", explains Grimaldi, "is when I need a list of all the patients over forty who are due for a check-up for breast cancer in August. Now I simply specify all the codes in which I am interested and the computer will print-out a list of all my patients with that combination of codes. I can then write to those patients and remind them that they are due for recall.

"Eventually, I should be able to make the computer write all the letters. Before I had the computer, it used to take my secretary hours to check through a manual age/sex register and select all the relevant cards".

Dr Barry Grimaldi.

As yet, Grimaldi uses only one terminal and has doubts about whether a multi-terminal system would offer any additional advantages. "The system has proved very useful in other ways", says Grimaldi. "The notes I keep on my patients are far more organised as I have to keep my observations to the point to fit them into the space". As a final bonus Grimaldi has now been approached by a software publishing house which offers to adapt his program for other microcomputers and sell it throughout the U.K.

Specialist interest

The market for a package like Grimaldi's is probably limited to private doctors with some specialist interest. Every National Health Service family doctor has to deal, on average, with about 2,500 patients of which about 10 percent call on a regular basis. About one third of the 26,000 family doctors, or general practitioners (GPs), in the U.K. work in group practices with total patient lists of up to 10,000. Few microcomputers could offer sufficient capacity to store narrative records for such a large number.

Some packages have been written specifically as a way of introducing computers to this kind of group practice. One of the best known has been written by Ipswich GP, David Meldrum. Based on a 32K Pet and using cassette storage, his package is now marketed by Medicom, an offshoot of Adda Computers in London.

As in Grimaldi's system, every patient is given a code but no other details are kept on the system. Patrick Dixon of Medicom points out that the system can work only if a detailed manual record is already kept. When a doctor sees his patient, he has to write a brief record and allocate the patient an appropriate code. The practice secretary will then enter all the codes at the end of every week.

According to Dixon, the analysis of the codes on the Pet can yield valuable medical information. In Meldrum's practice, when it was discovered that the practice trainee had not treated any patients for diabetes, the practice workload was re-distributed to give the trainee the experience he lacked.

"There are many other advantages", says Dixon. "One can keep an accurate monitor of all the high-risk or elderly patients treated, analyse the practice workload by age, sex, doctor or disease; analyse disease patterns and associations and prescriptions. Eventually, one should be able to collect a good deal of useful information on how successful new drugs have been".

Detailed records

Another attraction of the system is that doctors can keep detailed records of all the services such as vaccinations and the fitting of contraceptives, for which they can claim extra money from the Department of Health and Social Security. This works in two ways. Doctors can identify those patients who are due to be called in for one of the services and they can then keep a detailed record of the number of claims they should submit.

The Medicom practice monitor package is sold for around £1,300 and has now been accepted on the Commodore list of approved packages. It will also, shortly, be available on disc. Medicom plans to release a number of other packages later this year.

One is a disc-based system on which doctors can keep a list of every patient registered with a practice for the specific purpose of identifying patients who can be called in for those services of preventative medicine for which the doctor can claim an extra fee.

The Royal College of General Practitioners recently formed a working party to study the medical systems on the market and offer doctors some advice on how to choose one suitable for their practice. Professor Metcalfe of the Department of General Practice at the University of Manchester, and a member of the working party, believes that it will be some time yet before the majority of GPs can be persuaded to use microcomputers.

Cross-indexing

He points out that although the College has long recommended the use of manual cross-indexing systems, only a few doctors have accepted the need. "Most doctors do not keep effective records anyway", he says. "They are taught during their training about how to write down medical observations but they are taught nothing about information handling.

"When I ran my own practice I was regarded as being slightly nutty as I kept detailed manual records for all my patients. Most doctors can't see the rewards of this kind of system, even in terms of patient care. It is normally regarded as some kind of research tool".

The British Medical Association shares this view but is eager to go further and establish some hardware and software specifications which doctors can follow. The man behind these moves is BMA under-secretary, Dr John Dawson, a keen computer hobbyist. At his instigation, the BMA has decided to commission a £21,000 study, by Scicon, to do the fundamental systems analysis.

Dawson agrees that the initial problem is to persuade GPs to keep good manual records. "I certainly do not think that at this stage we will see doctors keeping narrative records on computers", he says. "Most applications will involve the computer doing its work in batch form, with the practice secretary typing in all the data. It is more cost-effective and it does not require more work by the GP.

"I do believe that it is important to spend a long time deciding how one is going to use a computer. I know of one practice which spent nearly 18 months studying their working habits, before deciding they did not really need a computer. But the result was a positive one in that they revised and modernised their methods of record keeping".

Within a few years, Dawson hopes that doctors will be able to offset the cost of buying computers by claiming the investment back from the DHSS, as long as the equipment falls within the BMA specifications.

"In the longer terms", he says "it will obviously be important for doctors to have access to some common source of information on items such as new drugs and their side-effects.

"I would also like to see a way in which we could collect information from GPs all over the country so we can analyse the national trends". Prestel could be an ideal medium for this kind of information and Dawson expects that the guidelines, when they are finally established, will require doctors to choose microcomputers which can be interfaced to the Prestel network.

Encouraging sign

The well-established software houses have not proved keen to tackle this market, partly because the potential rewards are insignificant when compared to the more straightforward business applications. It is, however, an encouraging sign for everybody that the professional bodies are beginning to face some of the challenges presented by the microcomputer and are showing some willing to promote its use. If the BMA can persuade the DHSS to reimburse the cost of buying computer systems, the temperature of this particular market will certainly rise quite sharply.

Lee Morris, Dr Grimaldi's assistant, with the North Star Horizon.

Important for its uniformity

What is probably the most important single piece of software in the world of micros, CP/M, is used widely but, apparently, little understood. Peter Laurie details its functions and its significance.

CP/M STANDS for Control Program/Monitor and does roughly that for machines with 8080 or Z-80 processors and discs and now, 6502 CPU. It may seem strange that a disc-operating system should be so important but CP/M handles all the underlying accesses by the computer to the screen, the printer, the discs and the tape-reader or punch. In many ways, what appears to be the computer or the language at work in a CP/M system is actually CP/M itself.

What does a disc-operating system do? There are many available, usually something or other DOS. They are, of course, usually compatible only with a specific machine. There is no point trying to run a disc created under Apple DOS on a Tandy, or one from Cromemco on a Research Machines. So, what is special about CP/M? The answer is that wherever you find it, it acts, or should act, in exactly the same way.

In a world of many machines, CP/M imposes some welcome uniformity. Whatever the maker's name on the box, if your machine runs CP/M, it ought to run all CP/M software, providing the discs are formatted in the same way — the standard is 128byte, soft-sectored. From the commercial point of view that is extremely important.

Standardisation

Since CP/M is mounted on so many machines — some say that 75 percent of all micros with discs use it — it means that a large market exists already which can be serviced by the same software. When, as it is also said, there are 20 million small business systems in the world, CP/M will give access to a truly gigantic market.

The only other approach to uniformity is at machine level. The problem there for the independent software supplier is that he is at the mercy of the hardware manufacturer. New ROMs, new operating systems can suddenly destroy his market. CP/M is supported by so many manufacturers that this fate is most unlikely to overtake the software supplier who uses it.

CP/M is a large and complex piece of software which can be approached on at least three levels: the day-to-day user, the machine-code programmer who builds it into his programs, and the system builder who adapts it to run on his specific machine.

Let us look at the face it presents to the ordinary computer user. He switches-on the machine, inserts a disc into the drive and presses 'B' for boot. A piece of firmware in ROM runs and loads the CP/M core into memory where it remains while the computer is running.

The user can now load a high-level language or a program and go to work on whatever he wants, or he can make use of the various utilities CP/M offers directly. The program in core will respond immediately to five commands:

DIR — the most used, names the files held on a named disc.

ERA — erases named files. If you want to be rid of a series of files, like PICT1.BAS, PICT2.BAS, you can say: ERA PICT?.BAS. If you have a series like FRED.TXT,FRED.REL, FRED.PRN,FRED.COM — the debris from an assembler session, you can say ERA FRED.* to dispose of them all.

REN — re-names a file n 'name'.

SAVE — copies n 256byte blocks of memory from location 100Hex on to disc and calls the file name.

TYPE — prints a named file on the screen, or on the printer if you do Ctrl P.

Access methods

CP/M thinks that any other command you type in is the name of a file which it will try to load and execute. It has some more programs on disc which you can access in this way:

STAT — reports the free space on a disc, or if you give it the name of a file, will report how many bytes it holds.

PIP — (peripheral interchange program) copies files from one place to another. You can use it to merge several files together, or, more often, to copy files from one disc to another for back-up or distribution.

CONFIG — sets-up printer type and speed to work with the printer you have.

MOVCPM — re-adjusts CP/M for your memory size.

SYSGEN — creates CP/M on a new disc. You have to PIP the utility programs, such as PIP itself, but you can often do that by saying PIP *.COM since they are all command files.

ASM — loads an 8080 assembler.

LOAD — creates an executable disc file.

DDT — loads and runs a debugger.

ED — loads the text editor.

So, CP/M gives considerable power over raw files — they can be moved, erased, loaded from memory, typed and measured. Familiarity with the system at that level is essential for anyone who uses a CP/M machine.

At the next level, CP/M offers a fairly simple, standard way of interfacing with screen, keyboard, discs, printer, ports and the rest of the outside world at machine-code level.

Broadly speaking, for machine code you load a control number which tells CP/M what you want to do in register C, and a character in A or an address in DE and jump to 5 Hex, the CP/M entry point in the base page. In this way, one can write to the screen, disc or printer and so on, without having to know anything about the internal organisation of the particular computer you are using.

Disc file access is neat. Each file has a file control block (FCB) in memory which is set when it is created. Blocks for existing files are loaded from disc when the machine boots; FCBs for files which are created during program execution are formed in memory and copied to disc when the file is CLOSEd.

That scheme has good and bad points. The good one is that a CP/M file can consist of sectors spread all over the disc. The numbers of the sectors used by a file are held in the FCB, so it is very easy for CP/M to use disc space intelligently.

File A may be written on to sectors 9, 16, 26, 43. You erase it by erasing its FCB and those sectors become free, so file B, which is at sector 52, is written next on to sector 9 and so on. All this is, of course, transparent to the user. All we see is that there is no problem in erasing and rearranging disc space.

The bad thing is that if you fail to close a file — either because of carelessness or because of something like power failure — you lose the data in it because you have lost the sector directory. The data is still there, of course, on the disc but it is very tricky to access it. It would be advantageous if CP/M copied the FCB to disc for every alteration.

Conclusions

- **CP/M offers a real promise of substantial standardisation. That standardisation will create a big market and hence encourage some really useful software. A new version appeared last winter. It allows files to be write-protected in CP/M rather than a high-level program and gives some other, more sophisticated, file-handling facilities. Version 2 is compatible with earlier releases.**
- **A more interesting product is MP/M, a multiple-user system.**
- **However, since processors are now so cheap compared to peripherals, it seems unlikely that multiple use will go the way it did on mainframes, with many terminals attached to a single processor.**
- **Instead, it is much more likely that many complete microcomputers will be interfaced to a few expensive peripherals, MP/M may not enjoy the same success as CP/M.**

An eye to the future with computer vision

Judging from current trends, it seems that computer vision will play an increasingly major role in future robot-control systems. Mark Witkowski reports on the latest developments.

SIGHT IS the primary sense used by people for a multitude of tasks; the same is also becoming true of robots. Television cameras have been interfaced to computers for many years now. These and images from other sources such as digitised medical X-rays, biological slide preparations, satellite data, bubble-chamber photographs and others have shown that our own visual processes are far from trivial.

Vision offers many advantages over other types of robot senses. A picture can be acquired relatively quickly and unlike force or touch sensors, it leaves the work-piece undisturbed.

It offers many types of information about the scene viewed, recognition of objects and about their position and orientation. Vision can be used by a robot to search its environment for an object which is needed, to provide feedback to guide a manipulator or vehicle in some complex task.

Checks can be made to verify that a task is proceeding satisfactorily and that it is completed correctly. Furthermore, the data used is understood readily by the human user.

The essential problem in robot vision is to take a digitised image, which may be nearly 250,000 bytes of data and reduce it to something useful, such as: "it's a con-rod, located at X and Y, with an orientation of theta degrees".

Clearly such a massive data transformation is going to proceed in several stages, the algorithm for each may be very complex. Usually picture data is a matrix of numbers, each of which represents the brightness of the image at a particular point in the scene.

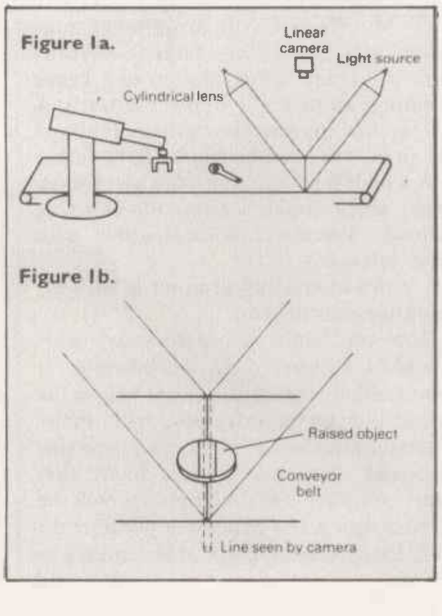
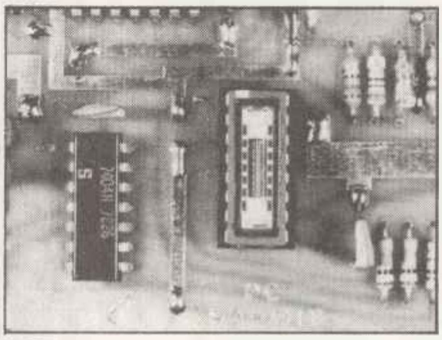


Figure 1a.

Figure 1b.

Robot images are seldom less than 64 by 64 in size. Below that, the image is degraded by the digitisation process, and is, usually limited to around 256 by 256


Picture 1.

due to the computation time required to process so much data.

Furthermore, each image point, or Pixel, will be digitised to a certain number of grey levels. That might be a simple binary image or one containing 256, 8 bits, different brightness levels. Imaging devices are usually solid-state photo-sensitive arrays of matrices, or standard Vidicon tube cameras.

Picture 1 shows a 64 × 1 photodiode array which are scanned using external clocking logic. The output from each light-sensitive diode is digitised and stored in computer memory in turn. Photodiode arrays up to 1,024 diodes in length are available.

They are particularly useful where the object to be viewed is essentially flat and moving, such as items on a conveyor belt. The CONSIGHT-1 system at General Motors is an example, figure 1 — Holland, Rossol and Ward, 1979.

Solid-state imaging matrices are manufactured both using photodiodes — the IPL 2D1 device is 64 by 64 diodes, manufacturer's literature, Integrated Photomatrix Ltd — and light-sensitive, charged coupled devices CCD.

The CCD201 is a 100 × 100 device — manufacturer's literature, Fairchild — which has been used in a number of robot projects. New solid-state units are being introduced and should soon be available in broadcast resolutions.

Solid-state cameras are smaller, lighter, consume less power and are more robust than their Vidicon counterparts. Some care is needed if they are to generate pictures with many grey levels — they are prone to uneven sensitivity across the picture, though that can be corrected by compensating circuits — Green, 1980.

Drive circuits must be calibrated carefully if their full dynamic range is to be usable. As the photo-sensitive array is manufactured precisely, there is little distortion of the image. In high-resolution applications the linearity of scan in Vidicon-based cameras may be a problem.

Vidicon cameras are used where high resolutions are needed, from 256 × 256 to 1024 × 1024 Pixels, often to eight bits of grey level. Each digitisation of a 512-Pixel line from a standard 625-line television camera must be completed, including storing the resulting data in about 100 nanoseconds.

As that is considerably shorter than the cycle time of most mini-and micro-computers, the normal technique used is to store a single line of the picture, which is user-selected, in a fast buffer and later read into computer memory through a parallel interface or DMA device at a more leisurely rate.

Picture-frame capture-times vary considerably according to the hardware design and computer system used, but in every case the picture must remain stable

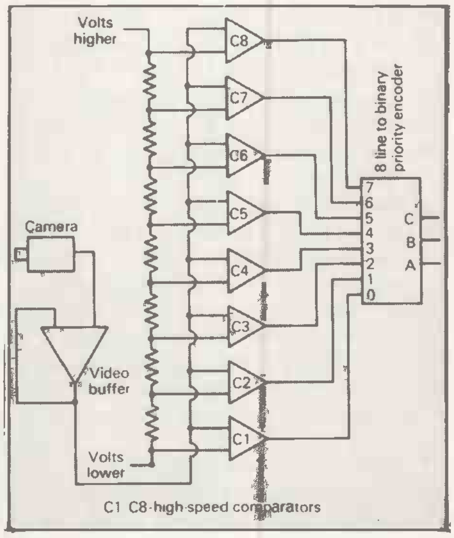


Figure 2.

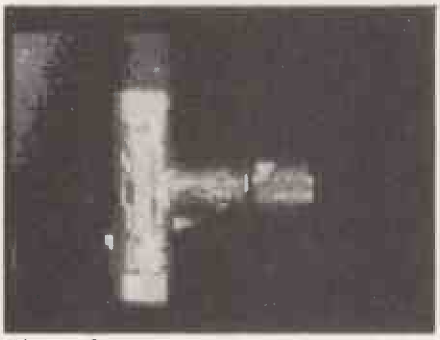
during the whole of the acquisition phase. Picture-input times vary from four to 205 seconds for a 1024 × 1024 image — manufacturer's literature, Hamamatsu Ltd.

If rapid data capture is of prime importance, it is possible to digitise and store a complete picture in one frame-time, about 40mS, for later processing by a host computer — manufacturer's literature, Microconsultants Ltd and Taylor, 1977.

Picture data signals represent a particular problem for analogue-to-digital conversion systems. The techniques mentioned in part three, ramp and successive approximation, are too slow. Figure 2 shows the principle of the fully-parallel flash 'a' to 'd' converter, capable of converting an analogue voltage into a binary number in less than 40 nanoseconds.

Each of the eight voltage comparators, C1 to C8, are fed with a different voltage from the resistor chain. The video waveform goes to the other input of all the comparators. None, some or all of the comparators will be active, according to whether the voltage at the resistor-divider chain input is greater or less than that of the video signal. The larger the video signal the more comparators will be switched on.

The outputs of all the comparators are



Picture 2.

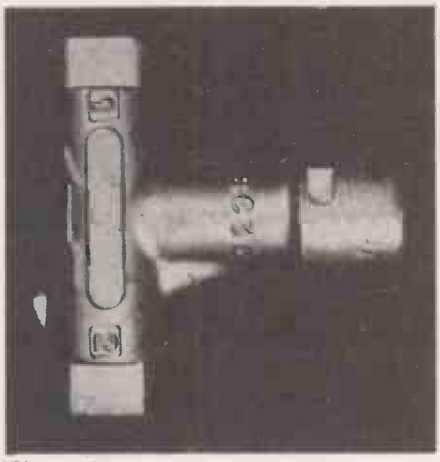
fed to an eight-to-three-line (binary) priority encoder. The three-bit result shows the highest comparator to be switched on. Flash 'a' to 'd' converters are available in both module form, up to eight bit, 50nS conversion — manufacturer's literature, Date Ltd — in which the conversion takes place in two four-bit stages and as integrated circuits.

The chip contains the resistor chain, 255 comparators, a 255 to eight-bit priority encoder and latch — manufacturer's literature, TRW LSI products. A number commercially-available television-to-computer input systems are reviewed by Onda and Ohashi (1979).

Figure 3 shows a simple form of visual inspection which could be used to check castings and the like during manufacture. Only if all the uninverted photocells, C, D and E, are lit, and the inverted ones, A and B, dark, will the output indicate that the part is usable.

The casting has to be held in a precise position for the check to work — it is a simple form of template matching. Kirsch, 1979, describes how a laser beam is passed back and forth round an object, using mirrors to test it during manufacture.

Uno *et al.*, 1979, use template-matching techniques on the output of a CCD image to attach water hoses to test water pumps during manufacture. Hale and Sarago,



Picture 3.

1975, used a template-matching process to align printed-circuit lead pads ready for automatic drilling.

Template matching works only if the object is very nearly aligned with the sensor. Different techniques are required to locate and identify work-pieces.

Picture 2 shows a brass blank during manufacture, digitised using a 100-by-100 CCD solid-state camera. The output is digitised to four bits with a flash 'a' to 'd' converter. In the system, used pairs of four-bit Pixel values are stored in a single eight-bit byte of an 8K memory block on a 6800 microprocessor.

The memory block is isolated from the processor bus logically for the frame duration — about 20 mS — while the picture is loaded into a 5K portion of the memory. When frame capture is complete, the picture appears in the microcomputer memory space with no interruption of processing. Picture 3 shows the original item.

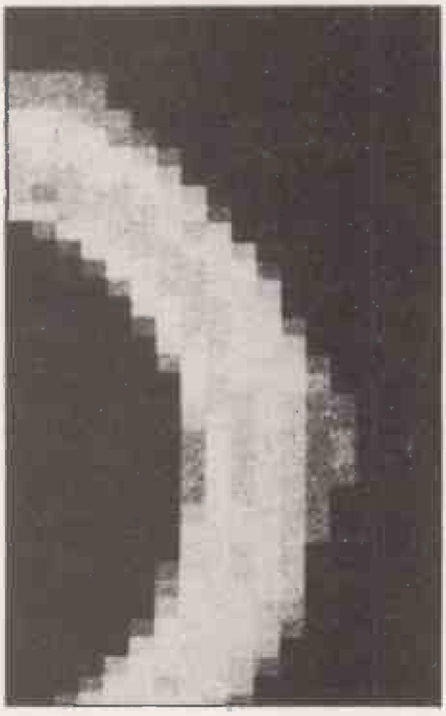
Only a few industrial robot systems use any grey-level information. The picture is pre-processed so that a binary image is formed. If the light intensity of any Pixel is less than a certain threshold, it is taken to be dark, otherwise it is taken as light.

A silhouette image is formed in which useful information about the object and any hole in it is contained in the size and shape of its overall outline. Obviously, great care must be taken with the lighting of the object. Shadows on the background or badly-lit recesses in the object could change the apparent shape of the image completely.

Picture 4 illustrates the potential problem with silhouette algorithms. The image is a section of a hexagonal nut, the background clearly dark and the nut light. However, the Pixels on the boundary are various shades of grey, caused, for the most part, by light from both the light and dark regions falling on the same photosensitive element and being averaged together.

If the binary threshold is, therefore, set high, many of these grey points will become black and the area and perimeter of the object will appear to shrink. Similarly, if it is set low, they will be taken as white and the object expand.

Great care is, therefore, needed for the lighting and camera aperture settings which should remain constant during and between sessions. Camera calibration may also involve showing the system grey step cards to determine the threshold point. There are also software calibration



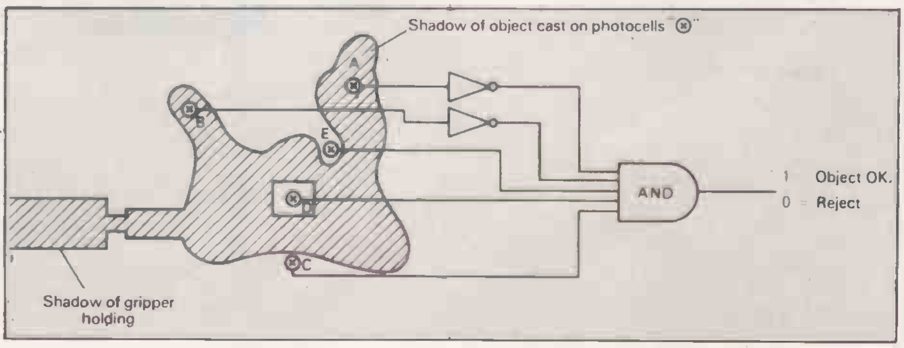
Picture 4.

techniques using histograms of the grey levels to determine the settings needed.

Several industrial robot systems, or at least prototypes, process binary images. Saraga and Skoyles, 1976, have a system to sort small objects delivered in a random orientation from a bowl feeder, to be picked-up by a three-degree-of-freedom

(continued on next page)

Figure 3.



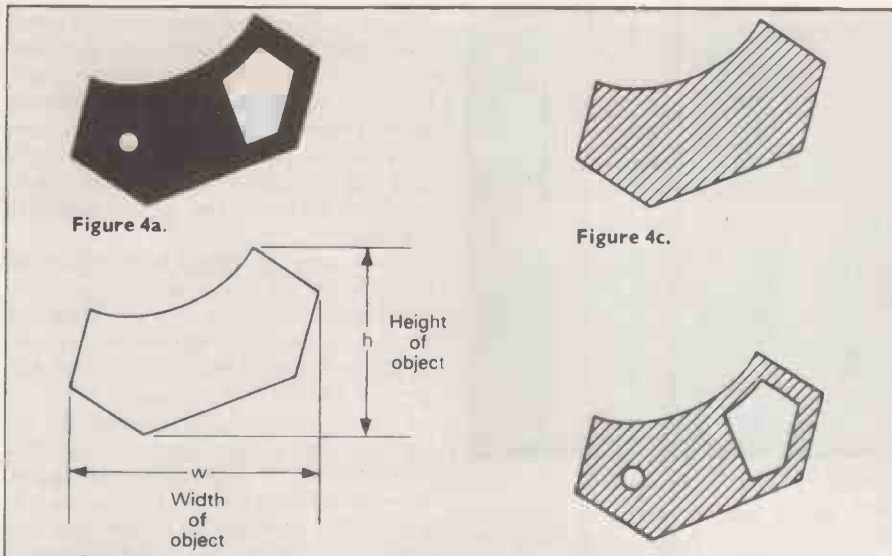


Figure 4a. Figure 4b. Figure 4c. Figure 4d.

(continued from previous page)
arm and deposited correctly in a sorted hopper.

As the arm is designed only to pick objects at one particular point, the table can be rotated and translated in X and Y to position objects correctly. There are two cameras, one directly overhead and one to give a horizontal side-view of the object.

To give a clear binary image, the object can be lit from underneath, eliminating shadowing problems and spurious effects caused by highly-reflective objects.

SRI has developed a system for partially assembling car air-conditioning compressors using visual feedback to control a Unimate 2000B manipulator, McGhie and Hill, 1978. The task chosen was to view a compressor body from above against a black background, illuminated so that the flat top surface appeared bright, but that holes in it formed shadows and appeared dark.

The position and orientation of the compressor body was computed from two large, circular blobs — the holes forming the piston bores. A matching compressor cover was then located on the body and vision was again used to find the bolt holes.

A third system to use binary images was Freddy, part of whose algorithm was described in part five. Freddy had to isolate a part from a heap, recognise it and place it in a standard position so that it could later be used by an assembly program.

The output of the linear scanning device

Figure 4i. Figure 4j.

on CONSIGHT-1 was also limited to a binary signal. The designers of the system were very concious of the problem of visual noise introduced by the grease, dirt and other debris to be found in a typical industrial environment.

Figure 1b shows the lighting arrangement they adopted for use with objects of a reasonable thickness on a conveyor belt. Their research dealt with such components as car engine connecting rods and universal joint yokes.

When the conveyor was empty, the array saw the bright line of light. Whenever an object was illuminated, it would appear, from above, that the light beam was deflected to one side, out of the camera's field of view.

In fact, two projectors had to be used to prevent shadows, since the object first intercepts the beam but is not yet directly under the camera. A full binary image of the object was obtained by continually scanning as it was drawn through the field of view. Needless to say, that requires a good deal of housekeeping on the image.

There are a relatively small number of data extraction processes applicable to silhouette images and which are used to provide sufficient information to allow the program to identify the object from a set of possible objects and stable positions. To locate it accurately in terms of X and Y co-ordinates, or to identify sub-parts of it for detailed assembly see figure 4.

Assuming that the position and zoom settings of the camera remain unaltered and are calibrated, the area of the silhouette is a useful measure in identifying the part, figures 4c and 4d. That is extracted easily as the number of Pixels within the boundary of the image.

A second measure of the image is the length of the perimeter of the shape, obtained by counting the Pixels round the edge — figure 4c. The ratio area to perimeter length is a measure of the complexity of the shape of the object. For a given area, the greater the perimeter, the more convoluted it must be. The compressor assembly program used a measure called 'PEROUND', defined as:

(4*π*TOTALAREA)/
(PERIMETER*PERIMETER)

which returns one for a circular blob, less for more complex outlines — figure 4f.

Within the overall outline of the compressor body there were several dark blobs. All the interesting ones, bolt holes, cover aligning stud holes and the piston bores, were circular. They were isolated from other shapes of holes in the casting using peround, and then identified by their total area; the bores were the largest and the boltholes the smallest.

Once a circle is identified, its centre is found and the information is used to guide the manipulator. While bolts were screwed into the boltholes, force feedback sensors monitored the progress and a final visual check confirmed that the hole had been filled with a bolt and was now invisible.

In general, those measures work and in a reasonable time. It is generally assumed that if a computer-vision system for an industrial robot can reliably perform its

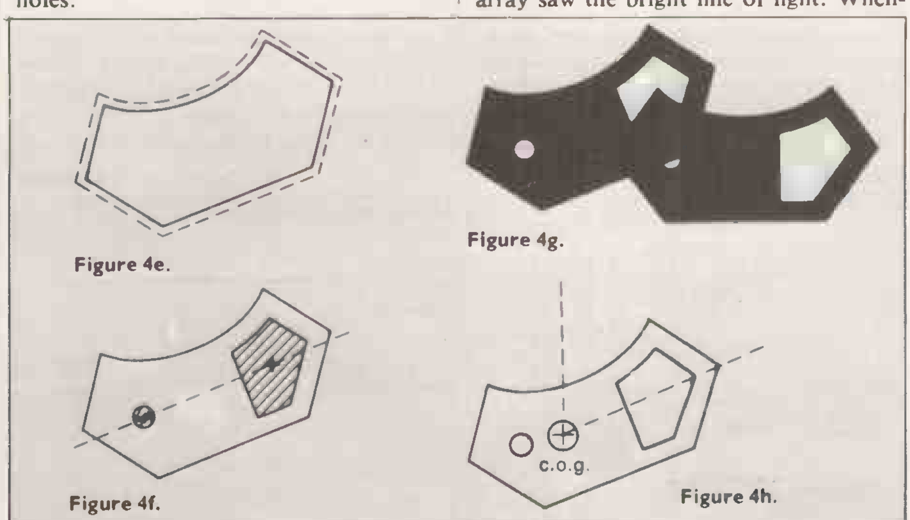


Figure 4e. Figure 4f. Figure 4g. Figure 4h.

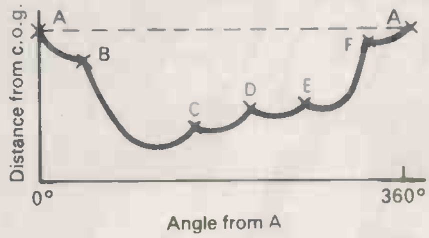


Figure 4k.

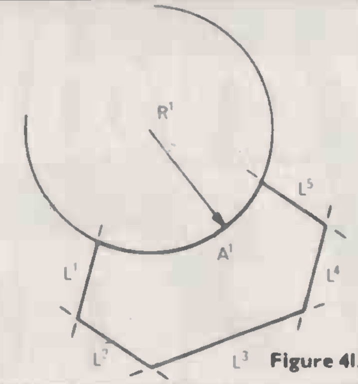


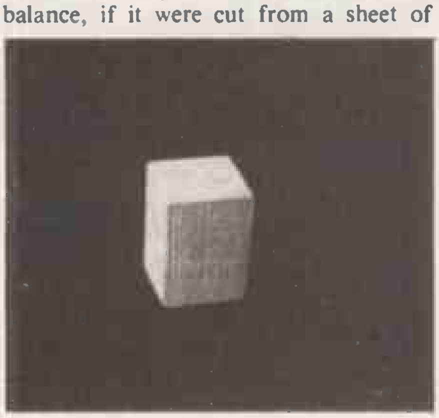
Figure 4l.

computation in a matter of seconds, it will be effective without making the manipulator wait for its instructions.

Those times are possible with current low-cost computers, and the algorithms are available as hardware/software packages — C1064, C1285, manufacturer's literature, Hamamatsu Ltd.

As more objects are added to the working set and the number and size of the differences between them becomes correspondingly smaller, so ever-more detailed features and differences have to be used to distinguish them. Figure 4l shows how the circumference of the shape can be represented as straight lines and arcs of circles.

Object orientation is a similar problem. If there are obvious features, such as the bore holes in the compressor body, their centres can be used to compute the information, i.e., figure 4f. Failing that, the centre of gravity of the image is evaluated — the point at which it would balance, if it were cut from a sheet of

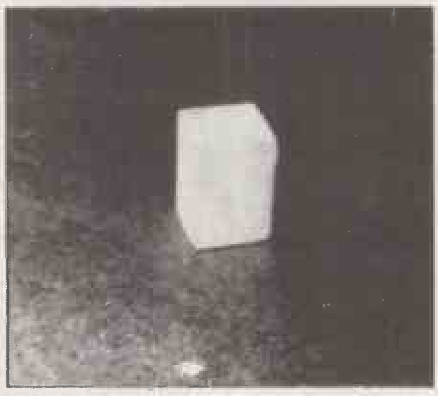


Picture 5.

metal. Figure 4h shows that by calculating the longest line to the edge, the orientation may be found.

Figure 4h is an alternative computation if this result were ambiguous — the ratios of A1 to A4 may also be used as a recognition measure. Saraga and Skoyles, 1976, discuss some criteria for choosing the size of the circle. Figure 4j extends these principles by computing many values from centre to edge and plotting them as an angular displacement graph — figure 4k. Martini and Nehr, 1979, cover the technique in more detail.

Dreyfus, 1974, describes hardware capable of scanning the outline of an object thousands of times a second. The device was used for feature tracking in both reconnaisance satellites and homing missiles. Kulpa, 1978, discusses possible problems to be encountered with calcul-



Picture 6.

ations for the centre-of-gravity method.

Perkins at General Motors, Perkins 1977 and 1978, used grey-level images, 256 × 256 to five bits from which the edges of the objects were extracted, resulting in a picture similar to a line drawing of the parts.

He then fitted a set of concurves to the line images, so that they were made from short line segments and arcs of circles. These relatively-organised descriptions could be compared to ideal descriptions of all the parts it might be.

As more of the features match between the current image and the stored model, the greater chance that the part will be identified correctly. As long as the match is above a certain confidence level, the process can stop.

So for most components only a portion of the object need be visible. In this way, where parts overlap or are only partially within the field of view, data from the model can supply the missing information.

Typically, it would be folly to try to attempt to isolate suitable features for recognition and use with an industrial robot 'by-hand'. After an initial calibration phase, during which the cameras are aligned and grey levels set, etc., the system is shown workpieces in typical orientations and stable states.

As each part is presented, the system runs through each of the parameter-extracting routines and builds-up its model of the parts. That process may be guided by the user if he feels some feature or property of the object to be particularly significant. When that is done, the manipulator can be programmed to use the information from the vision system to complete the task.

Three-dimensional vision, as is required by mobile robots, is an altogether stickier problem. Even after more than 12 years of intensive research by hundreds of people, an elegant, and computationally-fast solution to the problem remains elusive.

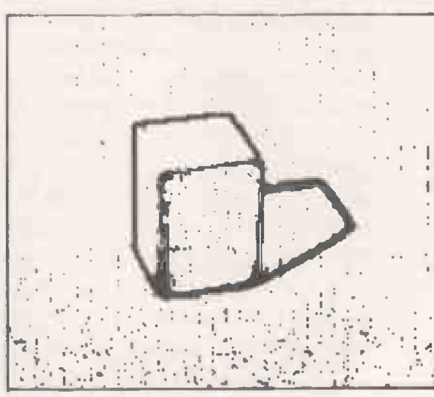
The techniques described for processing silhouette images are inadequate. Once an image is made binary, about half of the objects merge into the background, or with each other and become totally invisible. As the vehicle moves round, the apparent shape of all the objects changes, so simple model-matching will not work either.

One possible starting point is to extract all the lines that bound various objects in the scene. As an illustration, picture 5 and 6 show a small wooden block and the result of digitisation to eight bits.

One algorithm which might be applied is the first difference between each Pixel and its neighbours — picture 7. At each boundary, the accumulated difference will be high and if it above a specified threshold, the Pixel is printed black.

Such an operator is far from ideal — low-contrast lines, or ones which change over a relatively broad front, shadows, for example, are lost easily. Small random discontinuities and grey-level perturbations in the image are favoured strongly and noise can be a significant problem.

Unfortunately, as the threshold is lowered to capture more of the lines, still more noise is introduced. To combat those problems, operators which detect lines locally have been introduced. Picture 8 shows the effect of the Walsh operator, proposed by O'Gorman, 1976. In general,



Picture 7.

the results are more manageable and freer from noise.

Hueckel, Hueckel, 1977, proposed a different operator, used by Perkins, but which is more expensive computationally. As none of the methods can be relied on to give perfect line drawings of the scene, various methods are employed to compute where the lines should be.

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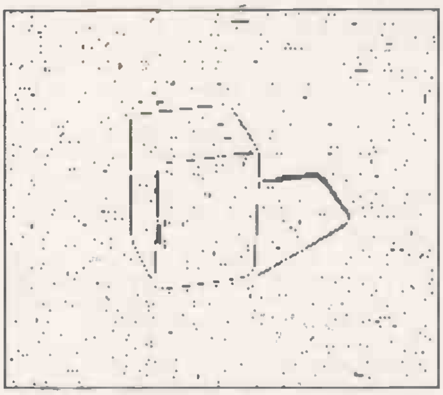


Picture 8.

(continued from page 93)

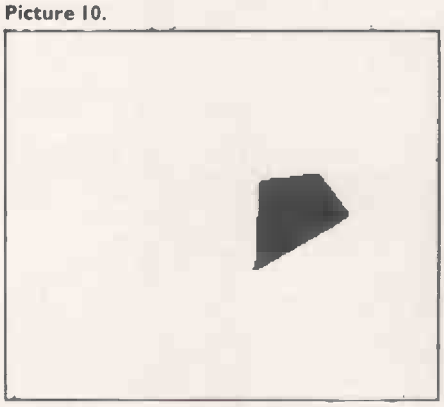
It is interesting to note that those programs seldom reconstruct the lines where a person would. A great many algorithms for analysing and post-processing images digitally are covered by Rosenfeld and Kak, 1976.

Once a scene has been reduced to a line drawing, a number of classic systems have been devised, such as those by Roberts, Waltz and Guzman — reviewed by Winston, 1972, or most books on artificial intelligence, e.g., Boden, 1977. Those systems variously separate, fit models to and identify parallel-piped, blocks-world, objects within the image.

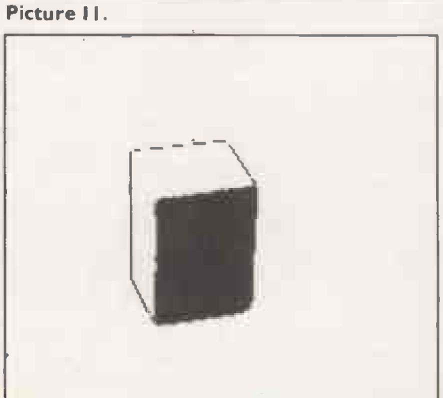
Such programs are based on the observations that lines constituting such objects form readily identifiable patterns where they join and cross. They infer the three-dimensional structure from a two-dimensional picture because the surfaces of the objects are constrained to meet in well-defined ways.

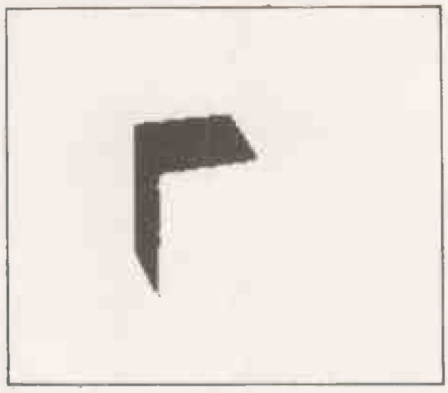
Those algorithms do not extend easily

Picture 10.



Picture 11.

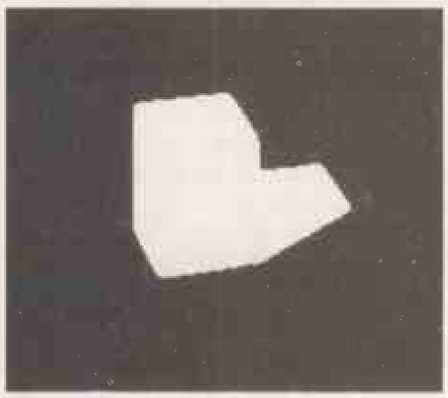




Picture 9.

to scenes containing objects with curved or irregular surfaces which are those of most interest to the robot user.

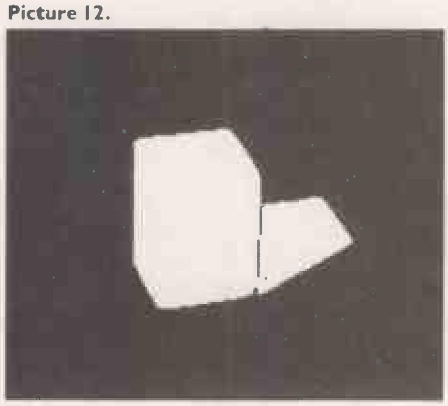
Perhaps a more fruitful approach is to



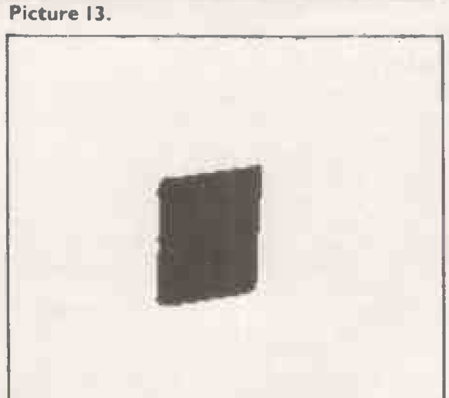
Picture 14.

attempt to isolate the regions in the image which correspond to the surfaces in the original scene, rather than to try directly to isolate the boundaries between them as

Picture 12.



Picture 13.

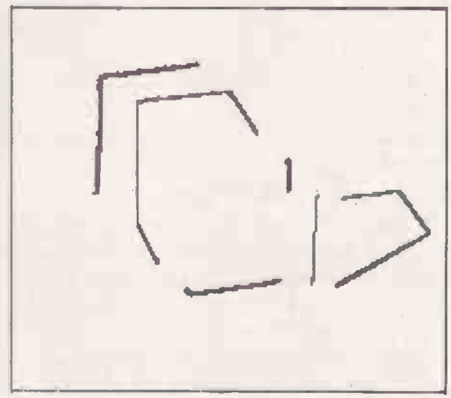


lines. Pictures 9, 10, 11 and 12 show a region segmentation of the image in picture 6.

In this case, a histogram of the grey value of every Pixel is formed on the assumption that each region will have a similar brightness — figure 5. The regions are then extracted as the major peaks in the histogram. Pictures 13 and 14 show the result of a simple but effective noise-removal program to tidy spurious parts of the image.

The histogram obviously works well when there are only a few peaks in separate places. As the scene contains more surfaces, so the grey-level histogram peaks will start to overlap and the segmentation becomes less reliable.

Surfaces with heavy-texture markings may also be segmented in a less-than-



Picture 15.

desirable manner. However, once the regions have been isolated, a good line extraction is made easily.

Picture 15 is an exploded composite obtained by expanding each of the regions by one Pixel round its perimeter and then ANDing it with each of its similarly-expanded neighbours; the boundaries clearly show where they overlap.

Brice and Fennema, 1970, isolated objects in Shakey's world using a region-extraction algorithm but as their model matching was limited to cubic- and prismic-shaped objects, the data produced may have been less than ideal.

In response to an earlier problem, image segmentation can be made on texture measures; Pixels are part of a uniform texture belonging to the same surface, Skalansky, 1978.

Tenenbaum, 1973, proposed a system to analyse pictures of an SRI office using colour and range information. From the range data it is possible to compute the orientation of surfaces, although small errors in range lead to gross shifts in apparent orientation.

The scene could be analysed using that data and knowledge about SRI offices. For instance, the floor is to be found at the bottom of the picture, horizontal and with a specifically-coloured carpet. Desks rest on the floor, have a different height and colour; telephones sit on desks, are black and so on.

(continued on next page)

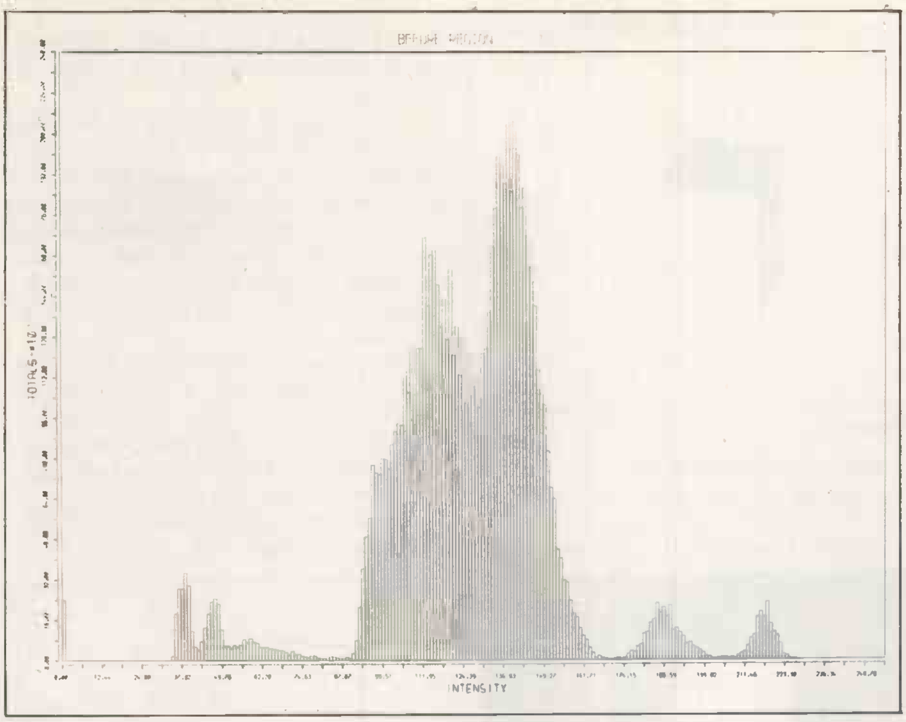


Figure 5.

(continued from previous page)

Shirai, 1978, used edge cues and models which could be transformed to fit images within real-world scenes, such as a desktop. All those vision systems detect and catalogue features of the objects within the scenes they analyse; the area, shape, colour, texture and corners are all identifiable. Features can be complex structures, with lesser features of their own, a telephone may be identified by its dial, a ring of 10 elipses, within a larger elipse.

Some or all of those different modalities can and should be used by a vision program, the danger being that the program will grow to exceed the machine and that the time it takes will increase from seconds to minutes, to hours.

All those systems use static information, The mobile robot is, however, able to move and capture another view of the same objects to resolve any difficulties. By projecting light beams into the scene,

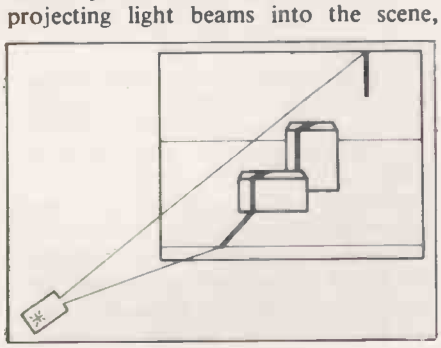


Figure 6a.

information may be obtained that is difficult to infer from conventional two-dimensional images.

Figure 6a shows the effect of projecting a thin sheet of light vertically into a scene, from the camera's point of view. As the light penetrates more deeply into the scene, it appears further and further to the right of the image. Figure 6b shows a plan view of the arrangement.

Knowing the relative positions and angles of the light strip projector and camera and the lenses focal length, it is

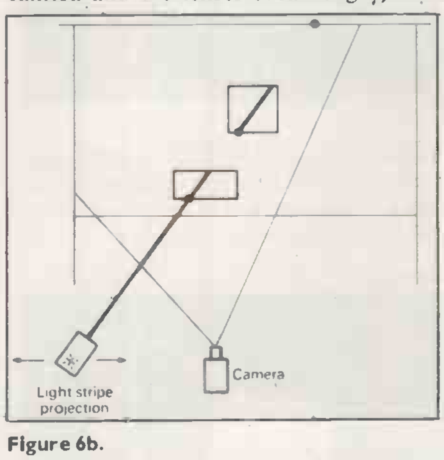


Figure 6b.

easy to compute the depth of any point illuminated by the strip. If the projector is then moved to the left and right it is possible to build-up a complete depth-map of the scene — Popplestone *et al.*, 1975, and Agin, 1979.

Philip Marks, has demonstrated the real-time advantages of processing images using currently-available parallel processors — Marks, 1980.

References

Agin G J (1979). Real-time robot control with a mobile camera. Robotics Today, Autumn, 1979, pp. 35-39.

Boden M A (1977). Artificial intelligence and natural man. An Open University set book. Hassocks. The Harvester Press. ISBN 0-85527-435-2.

Brice C R and Fennema C L (1970). Scene analysis using regions. Artificial Intelligence 1-3 Autumn, 1970, pp. 205-226.

Dreyfus M G (1974). Visual robots. The Industrial Robot 1-6. December 1974, pp. 260-264.

Green D K (1980). Improving photodiode camera signals. Wireless World 86-1532, April, 1980, pp. 85-88.

Hale J A G and Saraga P (1975). Control of a PCB drilling machine by visual feedback. Advance papers of 4th International Joint Conference on Artificial Intelligence. (IJCAI) held at: Tbilisi, Georgia, USSR, September 3-8, 1975. pp. 775-781.

Holland S W, Rossol L and Ward M R (1979). Consight-1: A vision-controlled robot system for transferring parts from belt-conveyors. Computer vision- and sensor-based robots. New York: Plenum Press. ISBN 0-306-40305-6. pp. 81-100.

Hueckel M H (1977). An operator which locates edges in digitised pictures. Journal of the Association of Computing Machines, Vol. 18, pp. 113-125, January 1971.

Kirsch J (1979). Progression of intelligence in limited sequence robots. Industrial robots vol. 2. Tanner W R ed., Michigan: Society of Manufacturing Engineers. ISBN 0-87263-046-3. pp. 277-284.

Kulpa Z (1978). Errors in objects positioning with centre-of-gravity method. The Industrial Robot 5-2, June 1978, pp. 94-99.

Marks P C (1980). Low-level vision using an array processor. Computer Graphics and Image Processing.

Martini P and Nehr G (1979). Recognition of angular orientation of objects with the help of optical sensors. The Industrial Robot 6-2. June 1979, pp. 62-69.

McGhie D and Hill J W (1978). Vision-controlled sub-assembly station. Robots III conference at Chicago, Illinos, November 7-9, 1978. (SRI report).

O'Gorman F (1976). Edge detection using Walsh functions. Conference proceedings of AISB Summer Conference, July 12-14, 1976. University of Edinburgh: Dept of A I, pp. 195-206.

Onda H and Ohashi Y (1979). Introduction of visual equipment to inspection. The Industrial Robot 6-3, September 1979, pp. 131-135.

Perkins W A (1977). Model-based vision system for scenes containing multiple parts. General Motors Research Laboratories Research Publication GMR-2386.

Perkins W A (1978). A model-based vision system for industrial parts. IEEE Transactions on Computers, vol. C-27-2, February 1978, pp. 126-143.

Popplestone R J, Brown C M, Ambler A P and Crawford G F (1975). Forming models of plane-and-cylinder faceted bodies from light strips. Advance papers of 4th. IJCAI. pp. 664-668.

Rosenfeld A and Kak A C (1976). Digital picture processing. London and New York: Academic Press. ISBN 0-12-597360-8.

Saraga P and Skoyles D R (1976). An experimental visually-controlled pick-and-place machine for industry. 3rd. Int. Joint Conf. on Pattern Recognition. Held: Coronado U.S.A. November 8-11 1976. pp. 17-21.

Shirai Y (1978). Recognition of real-world objects using edge cue. Computer vision systems, Hanson A R and Riseman E M eds. ISBN 0-12-323550-2. pp. 353-362. London and New York: Academic Press.

Skalansky J (1978). Image segmentation and feature extraction. IEEE Transactions on systems, man, and cybernetics. Vol. SMC-8, 4, April 1978. pp. 237-247.

Taylor R (1977). New approach to image processing. Systems International, February 1977, pp. 33-35.

Tenenbaum J M (1973). On locating objects by their distinguishing features in multi-sensory images. Stanford Research Institute Artificial Intelligence Centre, Technical note 84, September 1973.

Uno T, Ikeda S, Ueda H, Ejiri M and Tokunaga T (1979). An industrial eye that recognises hole positions in a water pump testing process. Computer vision- and sensor-based robots. New York: Plenum Press.

Winston P H (1972). The MIT robot. Machine Intelligence 7, Meltzer B and Michie D. eds. pp. 431-463. Edinburgh University Press, ISBN 0-85224-234-4.

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1980 MICRO-COMPUTER SHOW

Wembley Conference Centre

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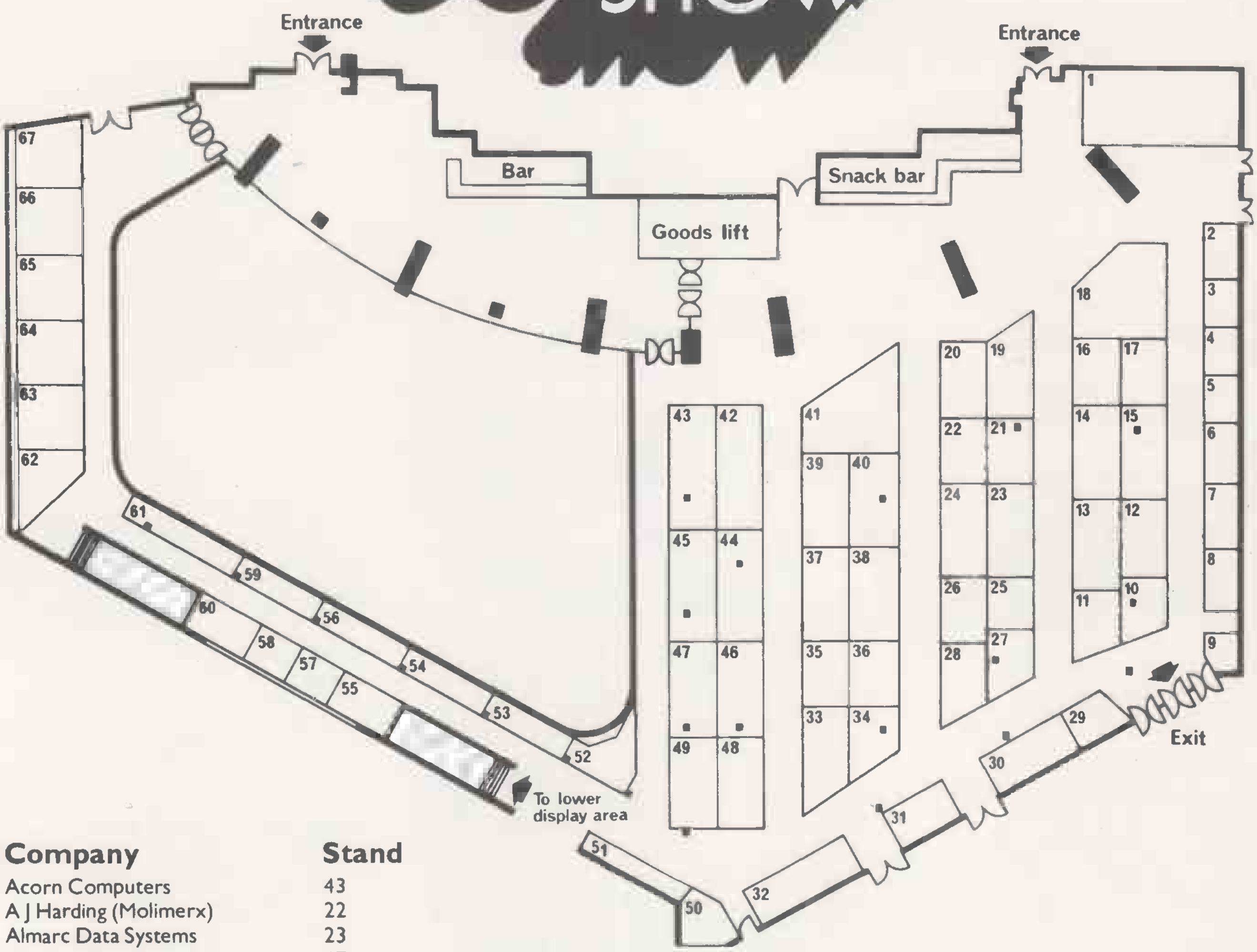
1980 MICRO-COMPUTER SHOW



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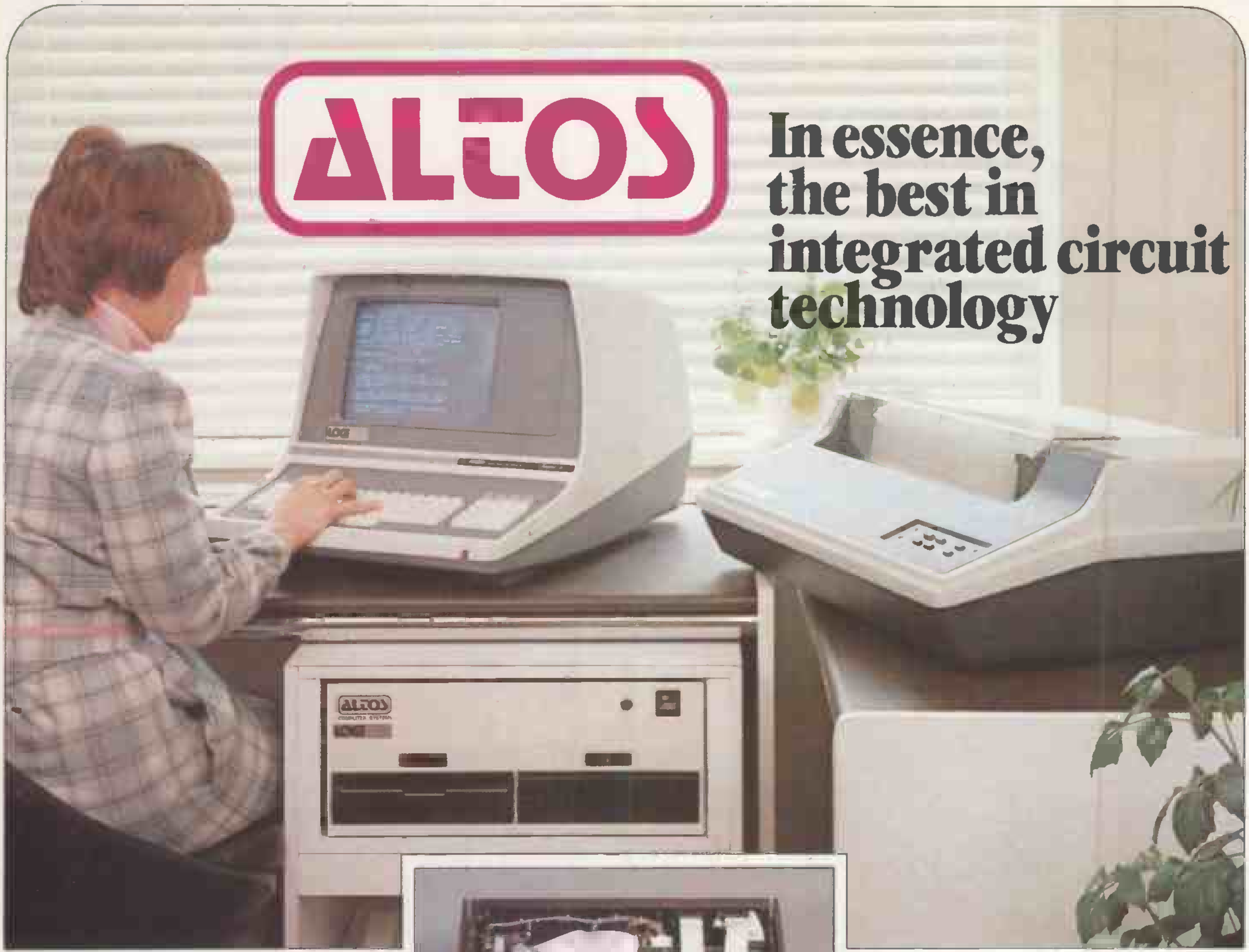

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Microelectronic Applications **July 22-23**
This twin-stream international conference will examine the present development of microelectronics, both in manufacturing and in the rather controversial area of data processing.

Microprocessors in Industry **Tuesday, July 22**
This seminar sets out to discuss in straightforward terms the various ways that large and small companies can take advantage of this new technology.

Microsystems in Business **Wednesday, July 23**
The main theme of this seminar is to acquaint the first-time user with the opportunities and pitfalls of installing a microsystem.

Microcomputers in Education **Thursday, July 24**
Participants will have the opportunity to hear experienced teachers and advisors express and demonstrate what they feel to be the importance of computers in schools.

Future Computing **Thursday, July 24**
A full-day seminar presented by Dr Portia Isaacson and Dr Egil Juliussen of the U.S.A., with the emphasis on technology forecasts, small computing, microprocessors and distributed processing.

List of exhibitors

Acorn Computers
4a Market Hill, Cambridge, Cambs.
Tel: 0223 50262
Sales contact: Chris Curry
Stand 43

ON THE stand is the new Acorn Atom ready-cased with a complete full-size QWERTY keyboard. It can be plugged into a black and white television to give a VDU 16 lines by 32 characters. It can be altered for graphics modes ranging in resolution to a high resolution which is 256 × 192. This VDU uses 6K of RAM a normal VDU uses ½K.

Space for 12K RAM on board of which 6K is used for the screen leaving 8K for the program case. The Acorn Atom also comes with 32K of ROM which contains a full integer Basic using 32-bit integers. There is also a 2K assembler using standard 6502 mnemonics.

A J Harding (Molimerx)
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Tel: 0424 220391 Telex: 86736
Sales contact: John Harding
Stand 22

THE company specialises in the supply of software for TRS-80, Models I and II. Staff of Harding Molimerx on stand 22 will demonstrate any of its software. Of particular interest this year are Microsoft utilities including new editor/assembler, together with a new structured Basic assembler.

Customers may purchase software at stand 22 together with accessories such as diskettes, tapes and the well-known Green Screen. Also on display is a new book by Hubert S Howe on machine language programming and contents of ROM and RAM.

Almarc Data Systems
906 Woodborough Road, Nottingham.
Sales contact: David Swain
Stand 23

ALMARC Data Systems, now main U.K. agents for the full-range of Vector Graphic Systems, will be exhibiting: Full business packages including word-processing systems — prices from £5,490. The Vector System "B" at £3,195. The Vector System 2800, a twin eight in. floppy drive system, IBM-format drives with a total formatted capacity of 2.4Mbytes. Price from £4,195. The Vector System 3030, a 32Mbytes hard disc system. Price from £7,500. An industrial-control system utilising the powerful Vector System B.

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Stand 67

ON display a full range of Ohio Scientific microcomputers from the single-board Superboard II to hard disc systems.

Audiogenic
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Stand 58

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BMG Microsystems Ltd

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Tel: Swindon (0793) 37813
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Stand 13

BMG Microsystems is exhibiting its expandable, attractively-designed MS5000 range of business computers. Elegant desk unit incorporates Intel 8085A microprocessor with 64K RAM, Intel Multibus, a high-quality tilt/swivel display, detachable keyboard, 1MB floppy disc, 10MB fixed disc, 10MB demountable hard discs and 160cps printer — other printers are available. Multiple displays may be attached. System provides for easy upgrade. Intel 8086 16-bit microprocessor and larger disc capacities will be available later this year.

BMG is a distributor of standard software including CP/M and MP/M and Microfocus CIS Cobol, plus a wide range of other compilers. Application software includes production-control/shop-scheduling package.

Clenlo Computing Systems

15 Southview Court, The Woodlands,
Beulah Hill, London SE19 3EJ.
Tel: 01-653 6028
Sales contact: J L Harris
Stand 66

CLENLO Computing Systems is a south-London-based firm specialising in all aspects of hardware and software for microcomputer business and organisational applications. Its hardware product range is centred round an S-100-based microcomputer which allows the adoption of a wide variety of options by the end-user, ranging from no disc facilities at all, through mini and full-size floppy disc drives up to four 26Mbyte hard discs.

On the software side, it is U.K. distributor for the first application generator package to be made available on Z-80 and similar-based microcomputers. The package is called PEARL and runs under the widely-used CP/M operating system.

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Stand 18

COMART is announcing and launching major new products at the 1980 Microcomputer Show. A multi-user operating system supporting up to seven users extends the facilities of the powerful Cromemco Z-2H hard disc system and maximises the storage of the diskette-based Systems 2 and 3. The Cromemco product range is further enhanced by an extremely high-resolution colour graphics hardware and software package demonstrated publically for the first time in Europe.

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Stand 41

COMPSHOP, Europe's largest discount personal computer shop, will be displaying probably the most comprehensive range of equipment at this year's show — everything from games to complete computer systems. The stand will feature the Radio Shack TRS-80 Model 2, running CP/M along with a number of other languages.

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Stand 52

COMPUTER Bookshop is U.K. distributor for the Sybex Inc. The complete range of Sybex books including Programming Z-80 and Z-8000 is on display and for sale. Exhibited are approximately 200 other titles including a range of new books from Howard Sams who published 6502 Software Design Book, Osborne's Pet and IEEE 488 and Bus and the Pet Guide. Comprehensive catalogues are available on the stand and advice about your nearest microcomputer store.

Department of Industry (MAP)

Gaywood House,
29 Great Peter Street,
London, SW1 3LW.
Tel: 01-212 0690
Sales contact: G M Bowen-Jones
Stand 44

GOVERNMENT assistance is available under the Microprocessor Application Project (MAP) to encourage U.K. industry to apply microelectronic technology. Assistance of up to £2,000 is available under the MAPCOM scheme; this is towards the cost of employing consultants to carry out a feasibility study to identify microprocessor applications in a company's product or production processes and systems.

Other support is for actual projects involving microprocessors. This takes the form of either a grant up to 25 percent or qualifying costs, or a shared-cost contract under which the Government will contribute up to 50 percent of cost in return for a levy on resulting commercial sales.

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The Sinclair ZX80 is not just another personal computer. Quite apart from its exceptionally low price, the ZX80 has two uniquely advanced components: the Sinclair BASIC interpreter; and the Sinclair teach-yourself BASIC manual.

The unique Sinclair BASIC interpreter offers remarkable programming advantages:
- **Unique 'one-touch' key word entry: the ZX80 eliminates a great deal of tiresome typing. Key words (RUN, PRINT, LIST, etc.) have their own single-key entry.**
- Unique syntax check. Only lines with correct syntax are accepted into programs. A cursor identifies errors immediately. This prevents entry of long and complicated programs with faults only discovered when you try to run them.
- Excellent string-handling capability – takes up to 26 string variables of any length. All strings can undergo all relational tests (e.g. comparison). The ZX80 also has string input – to request a line of text when necessary. Strings do *not* need to be dimensioned.
- Up to 26 single dimension arrays.
- FOR/NEXT loops nested up 26.
- Variable names of any length.
- BASIC language also handles full Boolean arithmetic, conditional expressions, etc.
- Exceptionally powerful edit facilities, allows modification of existing program lines.
- Randomise function, useful for games and secret codes, as well as more serious applications.
- Timer under program control.
- PEEK and POKE enable entry of machine code instructions, USR causes jump to a user's machine language sub-routine.
- High-resolution graphics with 22 standard graphic symbols.
- All characters printable in reverse under program control.
- Lines of unlimited length.

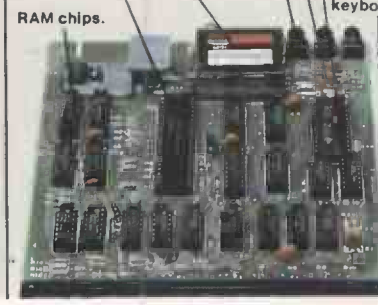
Fewer chips, compact design, volume production – more power per pound!

The ZX80 owes its remarkable low price t its remarkable design: the whole system is packed on to fewer, newer, more powerful and advanced LSI chips. A single SUPER RO for instance, contains the BASIC interpreter, the character set, operating system, and monitor. And the ZX80's 1K byte RAM is roughly equivalent to 4K bytes in a conventional computer – typically storing 100 lines c BASIC. (Key words occupy only a single byte

The display shows 32 characters by 24 lin

And Benchmark tests show that the ZX8 is faster than all other personal computers.

No other personal computer offers this unique combination of high capability and low price.



plete

The Sinclair teach-yourself BASIC manual.

If the specifications of the Sinclair ZX80 mean little to you – don't worry. They're all explained in the specially-written 128-page book *free* with every kit! The book makes learning easy, exciting and enjoyable, and represents a complete course in BASIC programming – from first principles to complex programs. (Available separately – purchase price refunded if you buy a ZX80 later.) A hardware manual is also included with every kit.

The Sinclair ZX80. Kit: £79.95. Assembled: £99.95. Complete!

The ZX80 kit costs a mere £79.95. Can't wait to have a ZX80 up and running? No problem! It's also available, ready assembled, for only £99.95.

Demand for the ZX80 is very high: use the coupon to order today for the earliest possible delivery. All orders will be despatched in strict rotation. We'll acknowledge each order by return, and tell you exactly when your ZX80 will be delivered. If you choose not to wait, you can cancel your order immediately, and your money will be refunded at once. Again, of course, you may return your ZX80 as received within 14 days for a full refund. We want you to be satisfied beyond all doubt – and we have no doubt that you will be.

sinclair ZX80

Science of Cambridge Ltd

6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: 0223 311488.

ORDER FORM

To: Science of Cambridge Ltd, 6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Remember: all prices shown *include* VAT, postage and packing. No hidden extras.
Please send me:

Quantity	Item	Item price £	Total £
	Sinclair ZX80 Personal Computer kit(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	£79.95	
	Ready-assembled Sinclair ZX80 Personal Computer(s). Price includes ZX80 BASIC manual, excludes mains adaptor.	£99.95	
	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	8.95	
	Memory Expansion Board(s) (each one takes up to 3K bytes).	12.00	
	RAM Memory chips – standard 1K bytes capacity.	16.00	
	Sinclair ZX80 Manual(s) (manual free with every ZX80 kit or ready-made computer).	5.00	
NB. Your Sinclair ZX80 may qualify as a business expense.		TOTAL	£

I enclose a cheque/postal order payable to Science of Cambridge Ltd for £________
Please print
Name: Mr/Mrs/Miss________
Address________

PC7

E9

ECC Publications

30-31 Islington Green, London, N1 8BJ.
Tel: 01-359 7481
Sales contact: Cathy Lane
Stand 12

THE MAGAZINE for all business computer buyers and users, WHICH COMPUTER?, offers unprejudiced opinions on many categories of computer equipment and thoroughly-researched assessment of individual systems. WHICH WORD PROCESSOR? — published as an occasional supplement to WHICH COMPUTER? — serves as an update on the latest developments in the word processing market.

Educational Computing — everything about using computers in schools, colleges and universities to keep them in touch with each other and with the industry. *Computer Guides*, three volumes giving a complete overview of small business systems, word processors, and production-control systems.

Equinox Computer Systems

Kleeman House, 16 Anning Street,
New Inn Yard, London EC2.
Tel: 01-739 2387
Sales contact: Mike Kusmirak
Stand 38

EQUINOX Computer Systems, one of the leading U.K. and most-established micro-system suppliers is exhibiting its multi-user, multi-tasking systems offering a choice between MVT/FAMOS, OMNIX + CAP MicroCobol. The system is based on the Equinox cartridge disc drive and Series 8000 desktop or desk microcomputer which is supplied with two or three 8-in. floppy disc drives, a high-speed printer and VDU/keyboard.

The cartridge drive has 5MB of removable cartridge and 5MB of fixed platter which eliminates the need to provide separate data back-up. The removable disc allows for fast back-up and, therefore, unlimited off-line storage.

Ferranti Computer Systems Ltd

20 Denmark Street,
Wokingham, Berkshire.
Tel: 0734 790079 Telex: 8438367
Sales contact: D E Stone
Stand 24

FERRANTI is showing the latest version of the F100-L 16-bit microcomputer. A single desk-mounted module contains a complete microcomputer system including two double-density floppy disc drives. Only four cards are necessary to provide a Coral 66 high-level language compilation facility. The remaining eight slots are available for additional printed circuit cards from standard F100 range, which has now been expanded to include D/A and A/D converters, enabling a complete process-control system to be configured using the F100-K microcomputer. In addition to its general-purpose role, F100-L microcomputer is also used to provide resident program generation facilities to support the F100-L microprocessor.

Harvey Fabrication Ltd — Special Products

Woolwich Road, London, SE7 7RJ.
Tel: 01-858 3232 Telex: 896648 APW.
Sales contact: D A Bevan
Stand 60

ENCLOSURES for electronics, computer and instrument industries, produced in rigid polyurethane without the necessity for expensive hard tooling. Enclosures finished to customers' choice, with the ability to supply in any colour. Surface finish and colour are produced direct from the mould giving a very hard and durable coloured enclosure moulding. The process requires a Master Model from which a prototype or small-to-medium production run of up to 2,500 units can be produced.

Hayden Book Company

50 Essex Street, Rochell Park,
New Jersey, 07662 U.S.A.
Tel: 010 1 201 843 0550
Sales contact: Alan Bonds
Stand 65

THE 1980s will be the microcomputer decade, and no one publisher will be able to meet the needs of this decade better than the Hayden Book Company Inc. Why? Because, on the one hand, we are the number one publisher of microcomputing books. Practical and informative books, written by experts, covering the gamut from introductory material through specific advanced material. On the other hand, we have already gained the reputation of being a quality software publisher. Software compatible with the TRS-80, Apple II, Pet, Sorcerer, and Heathkit, and Hayden will offer software for other micros in the future.

H B Computers Ltd

22 Newland Street,
Kettering, Northamptonshire.
Tel: 0536 83922/520910
Telex: 341297
Sales contact: Colin Stanley
Stands 2 - 8

H B COMPUTERS is showing a range of computer hardware starting in price at around £500 for Sharp MZ80K computer to CBM professional systems and upward to ACT 800/824 systems. It aims to show microcomputers and software to suit all applications and pockets.

Apart from the highly-successful H B sales, purchase and nominal packages, there is also fully-integrated Nebula business software package from ACT, and other business application packages. Media and consumables are featured, prominent among this section being the BASF range of supplies for which H B is a distributor, confirming the position of H B as leading suppliers of hardware, software, media and consumables suppliers.

James Scott Electronic Developments

William Press Group,
28 Essex Street, WC2R 3AY.
Tel: 01-353 6544 Telex: 887832
Sales contact: Martin Underwood
Stand 28

JAMES SCOTT Electronic Developments manufactures and markets the Lyme Peripherals range — including 4000 series, which features instant local recall of up to 26 lines, 72 characters per line and a 12 × 7 character dot matrix. An additional feature, within range, is capability to emulate DECVT2 and Data General Dasher 6053. James Scott Electronic Developments is backed by extensive production facilities of James Scott Manufacturing Division and is part of engineering group, William Press.

Katanna Management Services

22 Roughtons, Galleywood,
Chelmsford, Essex.
Tel: 0245 76127
Sales contact: Antoinette Dean
Stand 10

KATANNA specialises in complete systems either in ready-prepared packages or individually-written programs for most sizes of microcomputer. On show is the Tandy TRS-80 microcomputer, with packages for the following: stock control, payroll, sales ledger, purchase ledger, nominal ledger and word processing.

Keen Computers Ltd

5 The Poultry,
Market Square, Nottingham.
Tel: 0602 583254
Sales contact: Tim Keen
Stand 14/16

ON SHOW at the Keen stand will be the very latest technology to help you to solve your problems plus the very best personnel to advise you. The following products are to be displayed for the first time by KCL. The Corvus Constellation. The ultimate in mass storage for your micro. Share up to 40MB of hard disc between up to 64 computers. You can have Apples, Pets, TRS-80s, LSI-11s, Northstars or any S-100 system. Ideal for business or scientific use. The Mirror. The most revolutionary back-up to Winchester hard disc yet devised. An interface to a video tape recorder. Now you can have over 300MB of tape storage. Transfer of 1MB per minute approximately.

CCS Interfaces. California Computer Systems, one of the fastest growing interface manufacturers in the world, is releasing a number of new interfaces for Apple, S-100 and Pet computers.

Logitek

Portmand Street, Chorley, PL7 1SF.
Tel: 02572 55803 Telex: 677354
Sales contact: Jim Pickup
Stand 39

ALTOS ACS 8000 new generation single-board microcomputer demonstrates a comprehensive multi-user business system with 14.5Mbytes of hard disc storage. This system is supported by an off-the-shelf library of software packages, fully compatible for U.K. and European business applications.

Library is updated continually and extended with a capacity for structuring programs for specific requirements. The Altos unit with its advanced software capability has already attracted designers involved in research, production and other control systems. Apart from reliability of its single-board technology, the unit has a built-in expansion capability of up to 58Mbytes storage on hard disc.

Mannesmann Tally

7 Crenyll Road, Reading RG1 8NQ.
Tel: 0734 580141
Sales contact: Bernard Lavell
Stand 62

M80MC: When personal computers are used on small business systems, the printer is often the weakest link. The M80MC is a well-engineered and reliable replacement which is much faster and only slightly more expensive. It is an 80-column microprocessor-controlled version of a well-proven machine, parallel interface compatible with all well-known personal computers and micros.

TI602: New models of this popular printer will be launched at the exhibition. In all its forms, it gives you optimised, bi-directional microprocessor-controlled printing at 160 cps.

T1612: Forty-two keyboard programmable functions makes the T1612 the most versatile 1200baud printer around.

M132MC: The M132MC microprocessor version of another well-tried printer gives exceptional print quality at 200 cps at a low price.

Michael Gurr Associates

140 High Street,
Tenterden, Kent TN30 6HT.
Tel: 05806 4278
Sales contact: Jon Gurr
Stand 29

APPLE Systems displayed include: Cameo disc — 5MB fixed/5MB removable; Sanders media printer and/or 1DS 440W/graphics; CCS Arithmetic processor, CIS Dealer Advertising software; CMA Teacher plus Apple Education software; Databases and software from: Synergistics, High Technology, CCA, Baclan, Rainbow, SMI, Sensible Software, Computer Station, Mighty Byte Computer, Creative Discount Software and CIS; Keen Supercolor; Covercraft dust covers.

Micro '80 Publications Centre

Argyle House, Joel Street,
Northwood Hills, HA6 1TS.
Tel: 09274 28211
Stand 1a

THE Micro '80 Publications Centre will have a wide range of publishers of computer books represented. A central information desk will be manned at all times where publishers price lists, catalogues and order forms may be obtained. In some cases, publishers participating may arrange for one of their representatives to be present at certain times on the stand. Among publishers which will be attending are Online Publications, QED Information Sciences Inc U.S.A., Logica, Palace Publishing and Pitman's Publishing.

MicroAct Ltd

66/68 Hagley Road,
Edgbaston, Birmingham.
Tel: 021-455 8585
Stand 46b

PETSOFT and Appleware will be displaying and offering for sale the largest range of software and ancillary products for the Pet and Apple machines. See us at our stand and collect the latest exciting brochures.

Microbyte

Division of Maclin-Zand Electronics
38 Mount Pleasant,
London WC1X 0AP.
Tel: 01-278 7369/01-837 1165
Telex: 8953084
Sales contact: Neil Zand
Stand 57

MICROCHIPS at micro prices has been the Microbyte promise ever since the company started trading nearly two years ago. The aim was simple — fill a large gap in the market by offering a wide range of memories, CPUs and EPROMs at very competitive prices and mostly ex-stock. The demand for the company's products started in much the same way as the company has grown ever since — phenomenally, and today Microbyte is rapidly gaining a reputation for always being first to offer the new chips as they come off the production line, as well as a good range of books on microcomputers — also at micro prices, naturally.

Microsolve Computer Services Ltd

Middlesex House,
29/45 High Street, Edgware, Middx.
Tel: 01-951 0218/9/0
Sales contact: Stanton Smith
Stand 26

ON display is the Apple II computer system demonstrating business accounting systems and word processing. Lear Siegler 300 printer and Qume daisywheel printer are connected to the systems. Microstar multi-user microcomputer system with two VDUs and high-speed matrix printer is also on display. The system shows different accounting systems fully-integrated to make a complete business system. Alphamicro, probably the most powerful microcomputer available today. The system on display consists of a 10Mbyte hard disc system with two VDUs and printer. A fully-integrated accounting system is also on display.

Midwich Computer Company Ltd

9 Churchgate Street,
Old Harlow, Essex.
Tel: 0279 411226 Telex: 817035
Sales contact: D Watson
Stand 19

FULL range of Nanocomputers is on display including the newest addition, NBZ80HL. It is similar to the NBZ80 but includes a video interace, alpha-numeric keyboard and Microsoft Basic in ROM. A full range of Z-80 books and accessories are available for sale on stand 19 at special exhibition prices.

Newbury Laboratories

40 Bartholomew Street,
Newbury, Berkshire.
Tel: 0635 30505
Stand 32

THE EXISTING new Microcomputer New-Brain is revealed for the first time to the general public. This British-designed product is the first of a new generation of hand-held microcomputers, featuring the following: full QWERTY keyboard, advanced Basic compiler, full set of interfaces including analogue and addressing up to 4MB of store. This fully-expandable device incorporates features found previously only on mainframe computers.

Newbear, a sister company of Newbury Laboratories, is also showing various micro-related products and books.

Online Conferences Ltd

Argyle House, Joel Street,
Northwood Hills, HA6 1TS.
Tel: 09274 28211
Stand 1b

ONLINE is a organisation specialising in the co-ordination of significant high-level conferences and exhibitions in the fields of information processing and communications technology.

The 1980 Microcomputer Show is the

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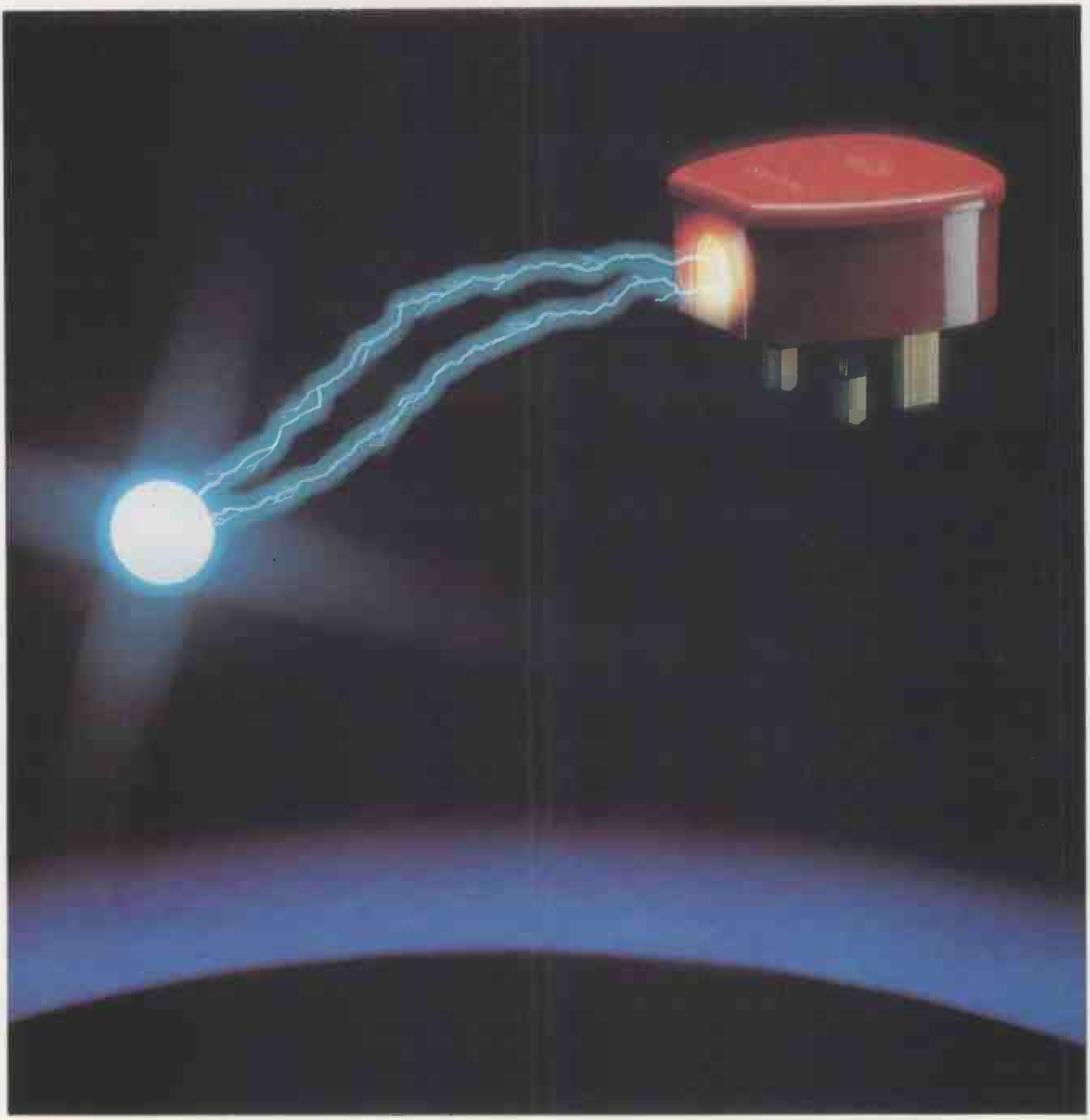

fifth micro show that Online have organised. Last year thousands of visitors packed the Bloomsbury Centre Hotel — hence the decision to change this year's venue to Wembley Conference Centre. Earlier this year, Online also ran its first ever micro show in the North West — the successful Mersey Micro Show and it is now certain that this event will be repeated next year.

Padmede Computer Services Ltd

The Tuns, 112-116 High Street,
Odiham, Hants RG25 1LS.
Tel: 025 671 2434 Telex: 858575
Sales contact: John Packwood

Stand 46a

DISPLAY and demonstrations will be given of the Padmede-developed and written Apple/ITT 2020 business software. Applications include incomplete records accounting, nominal ledger, sales ledger, purchase ledger, invoicing, stock control, time and cost recording, insurance broker system, job costing. Also on display is VisiCalc, Desktop Plan and Apple writer.

Padmede's successful incomplete record accounting system with considerably more than 100 users has formed the basis for standard, reliable, software modules, used in its other systems. Operating techniques are the same throughout, so operation is easy and all systems are superbly documented.

Personal Computers Ltd

194/200 Bishopsgate,
London, EC2M 4NR.
Tel: 01-626 8121 Telex: 888264
Sales contact: Mike Sterland

Stand 33

PERSONAL Computers is showing Apple III for the first time. It is also exhibiting financial planning and word processing software for Apple II, together with a new 80-character card and alpha-numeric keypad. In addition, a powerful range of printers are on display. These include Qume 5/45 RO, Paper Tiger, TCM 100/200, as well as new Centronics 730. Each printer has certain characteristics for particular applications.

A number of new interfaces are on show, including parallel/serial card and a specialised music synthesizer interface, the Super Sound Generator. A specialist is also on hand to demonstrate the very latest, low-cost computer graphics with Apple graphics table.

Personal Computer World

14 Rathbone Place, London, W1.
Tel: 01-637 7991 Telex: 8954139
Sales contact: Stephen England

Stand 34

Personal Computer World is Europe's biggest-selling microcomputer magazine. Every issue carries more news than any other monthly, benchtests on latest equipment and a complete buyers' guide to microcomputers. Readers in the business, hobby and education sectors find articles on software, hardware, books, games and languages. On sale is the current issue of *Personal Computer World,* back issues and binders. Editorial and advertising staff are on hand to discuss any problems in detail.

Practical Computing

Dorset House,
Stamford Street, London SE1 9LU.
Tel: 01-261 8000 Telex: 25137
Sales contact: Tom Moloney

Stand 25

THE U.K.'s leading microcomputer journal, *Practical Computing,* is for those who are interested in putting low-cost computers to work in small businesses, schools and colleges and the home.

Each month, *Practical Computing* carries at least one hands-on test of a popular microcomputer, providing just the information you need — technical data and unbiased critical comment on the strengths and weaknesses of each system. Each issue is packed with essential reading on microcomputers and back issues are a valuable source of reference for those who are considering the purchase of microcomputers, peripherals. Visit us on Stand 25 to check whether we have reviewed the equipment you are interested in.

Product Launch Ltd

West End House, Hills Place,
London W1.
Tel: 01-445 8452

Stand 30

PRODUCT Launch and associates will be exhibiting examples of the various services it has to offer. Product Launch is actively promoting a number of new products that are being created in the U.K. This company takes on the initial promotion and co-ordinates the marketing, advertising, PR, sales training, sales promotion, exhibitions, seminars, etc., which may be necessary to launch the product.

Specialist Micro Design is another part of the group. This company consists of the entire team that created Nascom Microcomputers and has extensive experience of microcomputer design. The team works for some of the largest companies in the country and is at the exhibition to discuss future projects with people who may well have an interest in designing a new product or in enhancing existing products.

Quality Systems International Ltd

Imperial House, 108-110 New Walk,
Leicester LE1 7EA.
Tel: 0533 543553

Stand 60

QUALITY Systems International will exhibit a new intelligent point-of-sale terminal designed in Britain. The use of microprocessors and low-cost peripheral hardware enables QSI to offer a complete system which includes an alpha-numeric single-line display, two hard copy alpha-numeric printers for customer receipts and audit trails etc., and a data cartridge for the logging of daily or weekly transactions for subsequent processing. A fully-equipped alpha-numeric keyboard which may be customised specially is also supplied as standard.

Various options are available including bar coding, bubble memory for priced look-up tables, magnetic card readers and communications. The QS5000, the first point-of-service system to be released by QSI and all its other models are capable of supporting applications which may be designed to meet customers specific requirements.

Research Machines Ltd

P.O. Box 75, Oxford, OX2 0BW.
Tel: 0865 49792

Stand 17

RESEARCH Machines is showing its Z-80A-based microcomputer in various configurations. 380-Z is available as a floppy-disc or cassette-based system. Disc-based systems include the industry standard CP/M operating system and use either mini-floppy discs or double-sided standard eight in. discs, which provide one megabyte on-line storage.

One system on show demonstrates the RML high-resolution colour graphics option. Resolution of graphics is 319 × 191. Alpha-numerics can be mixed with graphics and graphics picture can either be combined with normal VDU display or displayed on a separate screen. Board incorporates its own 16Kbytes of RAM.

Sigma U.K.

6 The Jays, Burgess Hill, Sussex.
Tel: 04446 44159
Sales contact: John Dobson

Stand 15

SIGMA U.K., an associated company of Sigma International, Scotsdale, Arizona, shows products from its comprehensive wholesale range. Included in a number of products new to the U.K., is the Sintelwriter, a letter quality printer based on the NEC Spinwriter mechanism and the Datasouth 180, a 180 cps matrix printer.

VDUs are represented by the Visual Technology 100 and 200, the former a DEC VT-100 plug-compatible unit, and the latter an intelligent terminal which is switch-selectable to emulate several popular terminals. The Z-800A-based ONYX 8001 system will be featured for the first time in the U.K. This has a built-in eight in. Winchester disc, 10MB 3M tape drive, plus upgrade capability to the Z-800-based 8002 system.

Sirton Computers

76 Godstone Road,
Kenley, Surrey CR2 5AA.
Tel: 01-688 0761
Sales contact: Mrs M E Alan
Stand 11

SIRTON Computers is displaying its Midas range of microcomputers which cover the spectrum from non-disc-based units with single-board computers through to units with eight in. double-sided disc drives giving 2Mbytes of on-line data storage. A Winchester hard disc unit is now available providing additional storage capacity between 10 and 20Mbytes.

A large range of S-100 boards, including real-time clocks, high-density graphics, colour graphics, A/D/D/A, Serial/Parallel I/O boards etc., are kept in stock and can be used to configure special customised systems. Dealer and OEM enquiries are welcome for our Midas systems. DPS-1 computer with the MPU-80 from Ithaca Intersystems is also featured on the stand together with a disc enclosure for dual eight in. drives.

The Software House

146 Oxford Street, London W1.
Tel: 01-637 2108
Sales contact: Ann Jones
Stand 49

THE Software House sells one of the largest ranges of software in Europe for most popular makes of micro, the Apple II microcomputers and all associated products. It imports manufactures, writes and distributes software both wholesale and retail, and is the sole distributors of the 80 U.S. Magazine. Mad Hatter Software is an associated company, wholesaling American software.

The Software House full range of software programs is available, with sample programs on display and for purchase.

Systematics International

Essex House, Cherrydown,
Basildon, Essex.
Tel: 0268 284601
Sales contact: Ron Young
Stand 40

SYSTEMATICS International is a software developer and distributor for the Apple II and ITT 2020 microcomputer systems. At the show, it is launching several new software products which include an accounting system written in Pascal, The Easy Writer family of products consisting of a word-processor system containing 80 column upper- and lower-case display, The Easy Mover, a program which can transfer files from one Apple to another by telephone.

Other new products to be exhibited for the first time include the text file library, home finder and typing tutor. Our new software catalogue, Edition II, which has a wider range of programs for businesses will be available on the stand along with staff who will be available to answer any questions.

Tandy Corporation

Bilston Road, Wednesbury,
Staffordshire WS10 7JN.
Tel: 021 556 6101 Telex: 339423
Sales contact: J D Hardman
Stand 47

THE TRS-80 has taken 10 percent of the non-mainframe U.K. market in just 10 months and it is not hard to see why. TRS-80 is an attractively-packaged, user-orientated unit with detachable keyboard and the kind of features you would expect with a £2,000 plus price tag. The TRS-80 range has found users in a wide range of settings, including homes, small businesses, schools and colleges.

The system, being modular, can be expanded to deal with changing or developing user needs. Examples of the accessories available comprise printers, computer games, voice input and synthesiser and additional disc drives, upgrading the TRS-80 to a full 64K memory.

Tangerine Computer Systems Ltd

Forehill Works, Forehill, Cambs.
Tel: 0353 3633
Sales contact: B Muncaster
Stand 27

EXHIBITED is Microtan 65 System, based on the 6502 microprocessor, a fully-expandable and powerful microcomputer which uses 8K extended Microsoft Basic. Peripheral modules include Bulk 1/O, Ceefax-compatible, high-definition colour graphics, 40K RAM on a single-board Tanex Expansion Module, IEEE Bus Interface, Tandos controller and drives, mini-racks and system racks, full ASC11 keyboards, Rockwell Aim-65 expansion modules, TV interface, interface module allows expansion via Microtan System rack and Microtan standard modules. The Microtan System is an ideal educational and personal microcomputer, British-designed and manufactured.

Telefusion Ltd

Telefusion House,
Preston New Road, Blackpool.
Tel: 0253 66111 Telex 67446
Sales contact: A Webb
Stand 37

TELEFUSION offers a comprehensive service for supply and maintenance of microcomputers to all relevant applications. Particularly featured is the latest ITT 2020 computer with a full range of supporting hardware and a comprehensive selection of software. Also on display is a microcomputer with full Prestel facilities.

Total Concept Systems Ltd

379/381 High Road, Leyton,
London, E10.
Tel: 01-539 7194
Sales contact: S J Whine
Stand 9

ON DISPLAY is Apple II with electronic cash register and bar code reader demonstrating use of equipment in retail environment. Also various Apple II peripherals such as Graphics Tablet and Apple II application packages. Also Cromemco microcomputer with peripherals demonstrating solicitors', estate agents' and wholesalers' packages.

Transam Computers

12 Chapel Street, London NW1 5DH.
Tel: 01-262 0814
Sales contact: Mr Stride
Stand 31

TRANSAM a manufacturer of computer systems is showing for the first time, the Tuscan S-100 microcomputer, the cheapest S-100 system available. Transam is an exclusive European distributor of the Constructor Floppy Disc Controller from the U.S. manufacturer Dataspeed. Microcomputer products including interfacing, media, disc systems, terminals and memory components.

Premiere at the show are TCL Pascal for Pet, written and developed by operating systems — Research Machines 380Z, TRS-80. With a showroom in West End of London, Transam is the manufacturer of the highly-successful Triton range of computers, a computer kit system sold internationally.

Walters Microsystems Ltd

1 Blenheim Road, Cressex Industrial Estate, High Wycombe, Bucks.
Tel: 0494 445172 Telex: 837600
Sales contact: S Walker
Stand 35

ON DISPLAY the Dolphin BD80P, marketed in U.K., Europe, Africa and Australasia with new markets opening daily. British-made, 80- (132 optional) column line printer, it combines simple mechanical design with sophisticated microprocessor control providing a unit with excellent reliability and performance. Its versatility, utilising any one of three interface boards, makes it suited ideally to many systems, computer terminals or data acquisition equipment.

Also exhibited is Cobra BD136, latest in a line of low-cost, high-performance computer output terminals. It uses microprocessor control to maximise overall printing rate by removing print head the shortest possible distance to start or end of next line.

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
- Cassette load and save
- 16 letter file names
- Graphics Plot, Draw and Move
- Screen editor
- Timer function
- Many extended BASIC features

- 192 Graphics characters
- 5 Graphics modes
- High resolution (256 x 192)
- Internal speaker
- Printer output
- UHF output
- Monitor output
- Colour output
- Communication loop
- Cassette I/O
- 24 User I/O lines
- Internal socket for any Acorn card
- Acorn bus output

ACORN COMPUTER

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

E16

HARD. AND FAST.

Corvus/Constellation.
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Back-room micro brings latest techniques for service agent

by Martin Hayman

IT CAME as a surprise to me to see the familiar flicker of a VDU in the back room of the Kevlin Service Company. My mind was on cleaners not computers at the time and somehow the little vacuum cleaner shop tucked in a back street of Hammersmith in London hardly seemed as though it would be in the forefront of modern service techniques.

Yet there it was, occupying pride of place in the cramped office; a Bytronix Lyte keyboard and VDU with a purposeful-looking processor and twin drives racked underneath the desk and printer.

Several scares

On the other side of the room, the fizz of white noise was shot through with the squawky voices of the road service engineers out in their vans, reporting to base on a two-way link. Clearly this was no ordinary repair shop.

Tom Kevlin, the proprietor of the company, told me he had been interested in the idea of using a computer to improve the efficiency of his operation for several years and had had several scares which indeed made him wonder whether it was all worth it.

Essentially his operation is midway between retailing and wholesaling. As a main Hoover supply and service agent, he sells and services domestic appliances, both new and second-hand. He has six service vans on the road which call on customers; repairs may need any of the 14,000 Hoover listed parts.

Since the main Hoover parts depot is in Bolton, Lancashire, Kevlin also acts as a local "buffer" parts depot, selling direct to the trade, and retains a full-time representative to sell these parts. Since the delay between the time of ordering and the time of receipt is from three to five weeks, it is crucial for the smooth running of the operation that stock be rigorously controlled and orders despatched promptly as soon as stocks of any particular item in Kevlin's warehouse start to fall low.

The Bytronix Lyte keyboard and VDU operated by Christine Edgington.

That means that inputs from the van engineers, the on-the-road sales representative, in-house and guarantee work on new appliances all have to be collated against the running total of spares in hand.

That had been handled previously by a Kalamazoo card-system. It required constant concentration to ensure that it did not fall behind and made the card-handling clerk indispensable. What happened, for instance, if he went away on holiday — even for a week? "Absolute chaos", answers Kevlin.

Theory and practice

The theory ran that a computer would be able to tie all the stock accounting and invoicing together, along with payroll — the service engineers' bonus is calculated according to the number of jobs above a certain minimum per week — and certain specialised items like guaranteed-work credits. In practice, finding a machine for such an application was more difficult and more fraught with perils than Kevlin had imagined.

He took his staff to the National Exhibition Centre at Birmingham for the International Business Show in 1977 and was rather taken aback by the pushiness of the mainframe manufacturers' salesmen, and doubtful about the kind of prices quoted — £16,000 and upwards for the hardware alone.

Rejected proposal

Later he signed for an initial £8,000s' worth — only to find that to have the system running the way he wanted, he would have been committed to another £24,000 over the following three years, along with the supposed big-company benefits. The proposal was rejected and he set to work to study the micro market with the help of *Practical Computing*.

By this time he had learned that hardware was by no means the whole story. He discovered that one of his business acquaintances in the same kind of operation, a washing machine service company called Washvac, was using a micro supplied by a new local firm called Bytronix, and that its system was working well for a total outlay of a quarter the large firm's final quote. Robin Wood of Bytronix arranged for a demonstration: "What impressed me most about Bytronix was that they quoted us a package price, with software", says Kevlin.

Although the big companies had warned Kevlin of the small manufacturers — "Why bother with these unknowns when they may not even be in business this time next year"? was the usual line — he liked the look of what was on offer and decided that the small company offered not only the better deal on price but also seemed flexible enough to cope with any breakdown.

The owner of Bytronix, Tim Avens, is a master mariner and on retirement from the Merchant Navy, formed a central-heating business in Farnham, Surrey. He encountered very similar problems to those of the Kevlin Service Company and indeed of many businesses — too much paperwork taking too much time and for too few results.

Problem solving

So he bought an Altair kit, soldered it and found that it did not do what he wanted it to do. So he set-up Bytronix which Robin Wood joined after a career in and around business machines and mainframe computers. Their approach is essentially one of problem solving — ideally they would require a client to know nothing of computers, but to analyse carefully his own business requirements. They can then supply a system to fulfil those needs. Obvious? Not always in practice.

So the Bytronix system was installed in Kevlin's back room, occupying the remaining space left vacant by the two-way radio control which had been fitted less than two years previously. Wood was on hand to oversee and to allay the co-opted operator's fears at handling a computer. "You have to instil confidence in the system", says Wood. "I arrived at about 2.30 pm and didn't leave until about 7 pm. I told Chris to go ahead and run the payroll the next morning and to telephone immediately if she had any problems. There weren't any".

Disc removal

"Yes there were —", interrupts the personable Christine "when I arrived at the end, I didn't know how to take out the discs". Yet before the event, she had admitted to being terrified of tackling the system. The 13-man payroll now runs in five minutes, where before there was a three-hour panic on Friday afternoon between banking the week's takings and assessing the week's stock depletion for forward orders.

As it stands, the system consists of a Z8080-based 32K Megamicro processor with two serial and two parallel ports, twin DRI 7200 drives, single-density, double-sided floppy discs, a Lyme 4002 display with upper- and lower-case, and a DRI 6320 printer. With the modified sales-ledger and stock-control package — which features four kinds of invoice, a parts description directory and a special routine to convert Hoover part numbers to a form handled more easily by the machine — total cost worked out at slightly more than £8,000 and prompt service if the machine ever breaks down. There have been two minor hitches since last August when the machine was installed.

As for the visible benefits so far, Kevlin says: "Our stock control is much more efficient now. Before it was installed we were in chaos. There used to be a panic hour every Friday afternoon. Like most small businesses, we all do two or three jobs here. We would be doing the payroll, worrying about arriving at the bank on time, trying to talk to the engineers or customers on the telephone and someone has to serve in the shop, but it has done away with all that panic and a good deal of paperwork too".

Further benefits

There are further benefits for operations such as updating prices — a bulk update takes the machine 20 minutes, where before it meant rifling through the catalogues with a ready reckoner and a pen in hand. The monthly stock-taking is now simplicity itself — another three working evenings saved for all staff. With insurers now looking to know exactly what and how much goods they are insuring, that is another indispensable chore which the micro has removed.

Finally, of course, it is the bottom line that every business is looking at. Tom Kevlin illustrates: in the first quarter of 1979, before the micro was installed, turnover was £30,000. The return for the first quarter of this year is £42,000.

Hard-copy capability which is soft on the pocket

John Dawson describes how to obtain hard copy from the Nascom 1, said to be the most popular U.K. single-board computer, using the inexpensive Creed teleprinter.

IN ITS standard form, the Nascom 1 displays information in transient soft form on a TV screen. The program described is designed to print the contents of the TV screen, the VDU RAM, in the format in which it is presented on the TV. Subroutines in the program can be called, however, to print a character or a line in whatever format the programmer chooses.

The printer interface enhances the capability of the Nascom out of all proportion to the cost and effort involved in making the hardware and writing the program. Creed teleprinters are available on the surplus and amateur markets for between £5-£25.

Interface components

Components for the interface should cost less than £15 and the software is designed to output serial CCITT 5 unit code, suitable for standard Creed 75 and 7 series machines. Some Creed teleprinters were modified for use as computer output devices and these printers may have unusual type fonts and coding. The output from the interface, however, is controlled entirely by software and can be adapted easily.

The CCITT code comprises seven elements in all. The first element starts the machine cycle, five elements make-up the character code and a stop element, one and a half times the length of the others, completes the cycle. There are 32 combinations possible from five elements and a mechanical register in the teleprinter is used to allow a second set of 32 characters to be printed.

One code sequence in each set, figures/letters shift, is interpreted by the printer as a command to shift the register before characters in the alternate set are printed. For example, this character sequence requires the appropriate shift character to be inserted in the places marked *.

1 2 3 * THE QUICK * 4 5 * B * 9 * A * 6 7 * BROWN FOX * 0 8 9

A character construction for the letter P and figure 0 is shown in figure 1 and the whole CCITT code is displayed in figure 2.

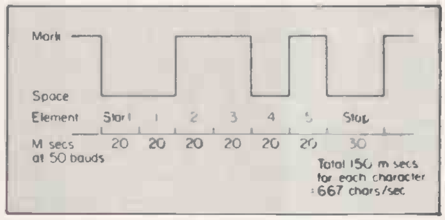
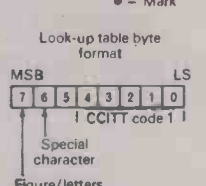


Figure 1.

Figure 2.

CREED MODEL 7 Lower case	Upper case	PERFORATED TAPE Code Elements 1	2	3	4	5	INTERFACE CODE Letters	Figures
A	–	●	●				03	83
B	?	●			●	●	19	99
C	:		●	●	●		0E	8E
D	Who are you	●			●		09	89
E	3	●					01	81
F	%	●		●	●		0D	8D
G	@		●		●	●	1A	9A
H	£			●		●	14	94
I	8		●	●			06	86
J	Bell	●	●		●		0B	8B
K	(	●	●	●	●		0F	8F
L	)		●			●	12	92
M	.			●	●	●	1C	9C
N	,			●	●		0C	8C
O	9				●	●	18	98
P	0		●	●		●	16	96
Q	1	●	●	●		●	17	97
R	4		●		●		0A	8A
S	'	●		●			05	85
T	5					●	10	90
U	7	●	●	●			07	87
V	=		●	●	●	●	1E	9E
W	2	●	●			●	13	93
X	/	●		●	●	●	1D	9D
Y	6	●		●		●	15	95
Z	+	●				●	11	91
Carriage return					●		48	48
Line feed			●				42	42
Letters		●	●	●	●	●	1F	1F
Figures		●	●		●	●	1B	1B
Space				●			44	44

● = Mark



Varying speeds

Teleprinters run at various speeds — 45.5, 50 and 75 bauds. A baud is the reciprocal of the time of one signal element. A teleprinter running at 50 bauds has a signal element length of 20 mSecs — 1 second/50 bauds. The program was written for a 50-baud machine but other speeds can be achieved by changing the timing-loop variables in proportion.

Teleprinters are reliable and well-built pieces of light machinery capable of operating continuously or intermittently for long periods before servicing is required. Nevertheless, maintenance is necessary and, particularly in the case of older machines, adjustment to the manufacturer's specification may not be sufficient.

A form of tuning may be required in which one out-of-tolerance adjustment is offset or balanced by another. The Radio Society of Great Britain (RSGB) publishes *Teleprinter Handbook* which contains a wealth of practical detail and is essential reading for anyone acquiring a Creed or other teleprinter for the first time. The British Amateur Radio Teleprinter Group (BARTG) is also a valuable source of information and sometimes, spare parts.

Interference and voltage surges produced by the teleprinter motor may cause erratic operation of the Nascom. There are three types of motor found in teleprinters; two, 230V and 24V AC/DC-governed motors, will produce interference while running and may require suppression additional to that fitted already inside the printer.

The third type, synchronous motors, produces no interference while running but

```
0C50 01 30 00 21 5D 0C 11 0D
0C58 08 ED B0 18 2E 6F 75 74
0C60 70 75 74 20 73 71 75 61
0C68 72 65 77 61 76 65 20 70
0C70 6F 72 74 20 30 20 62 69
0C78 74 73 20 32 2F 35 20 20
0C80 20 20 20 20 20 20 20 20
0C88 20 20 20 3E 00 D3 00 F5
0C90 06 80 CD 35 00 10 FB F1
0C98 CB D7 CB EF D3 00 F5 06
0CA0 80 CD 35 00 10 FB F1 18
0CA8 E2
```

Figure 4. Program to output a squarewave to port 0, bit 2 and bit 5.

may cause a surge or disturbance in the AC mains when starting or stopping. It may be worthwhile replacing a governed motor with a synchronous alternative, at the same time disabling the cut-out that stops the printer sometime after the end of a message.

Figure 3 is the circuit diagram of the interface which is adapted from the double current magnet driver circuit described in chapter 6 of the RSGB handbook. Port 0 of the Nascom is used predominantly by the keyboard but has two spare bits available to the user.

A signal is taken from bit 2 of port 0 at TTL levels and drives the two Darlington power transistors alternately. A constant current of about 25mA is switched one way through the teleprinter magnet for a mark condition, and in the opposite direction for a space.

The components of the interface can be mounted directly on to Veroboard and neither the lay-out, nor the component values appear to be critical. The three 1.2K resistors in series with the teleprinter

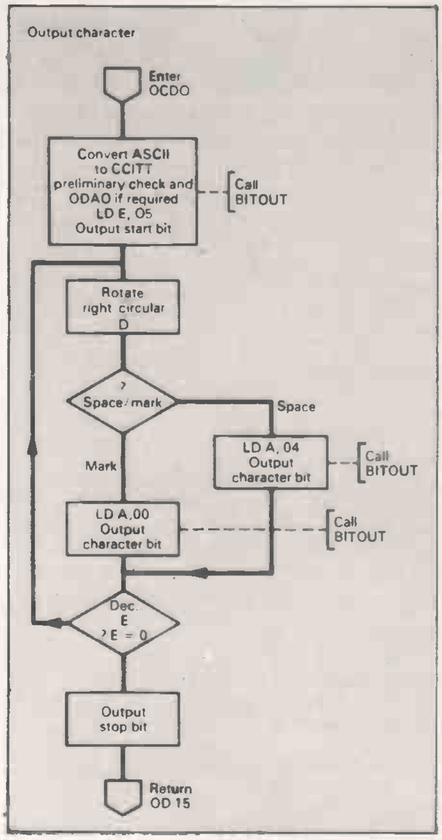


Figure 5.

magnet each dissipate approximately two Watts. The resistors should be wire-wound, rated at five Watts or more and mounted at least 1cm. clear of the Vero-board. Ventilation of the board and resistors is desirable.

No protection against back EMF from the teleprinter magnet is required as the Darlington power transistors are allowed to reversibly break down, within the manufacturer's specification. The transistors are rated to absorb up to 25mJoules of unclamped inductive load energy; well in excess of that produced by this circuit.

The 72-V supply is somewhat lower than the 80V recommended for driving a double-current circuit. If higher voltages are used, it would be sensible to replace the TP110 transistors with others in the same series — TIP111 to TIP112. In practice, the distortion introduced by the lower voltage is insignificant and has caused no trouble in several months' use with a surplus Creed 75 printer.

Software design

The software was designed from the bottom up and was developed using the Nasbug T4 monitor. It should run without alteration on machines equipped with the T2 monitor. The flowcharts followed when it was all working. A test program was written to switch port 0, bit 2 continually on and off.

At slow speeds, the program was useful in tracking bit 2 at the far end of a re-wired and extended keyboard cable using a voltmeter. Figure 4 is a printout of this routine. Shortening the delay loops produces an audio frequency which can be taken easily to an audio amplifier.

The program is based on the subroutine at 0D16 (BITOUT) which sets or re-sets bit 2 port 0 depending on the value in the accumulator when the subroutine is entered. The subroutine waits 20 mSecs after the output instruction, set by variables at 0D1B and 0D1D, and then returns to the calling program.

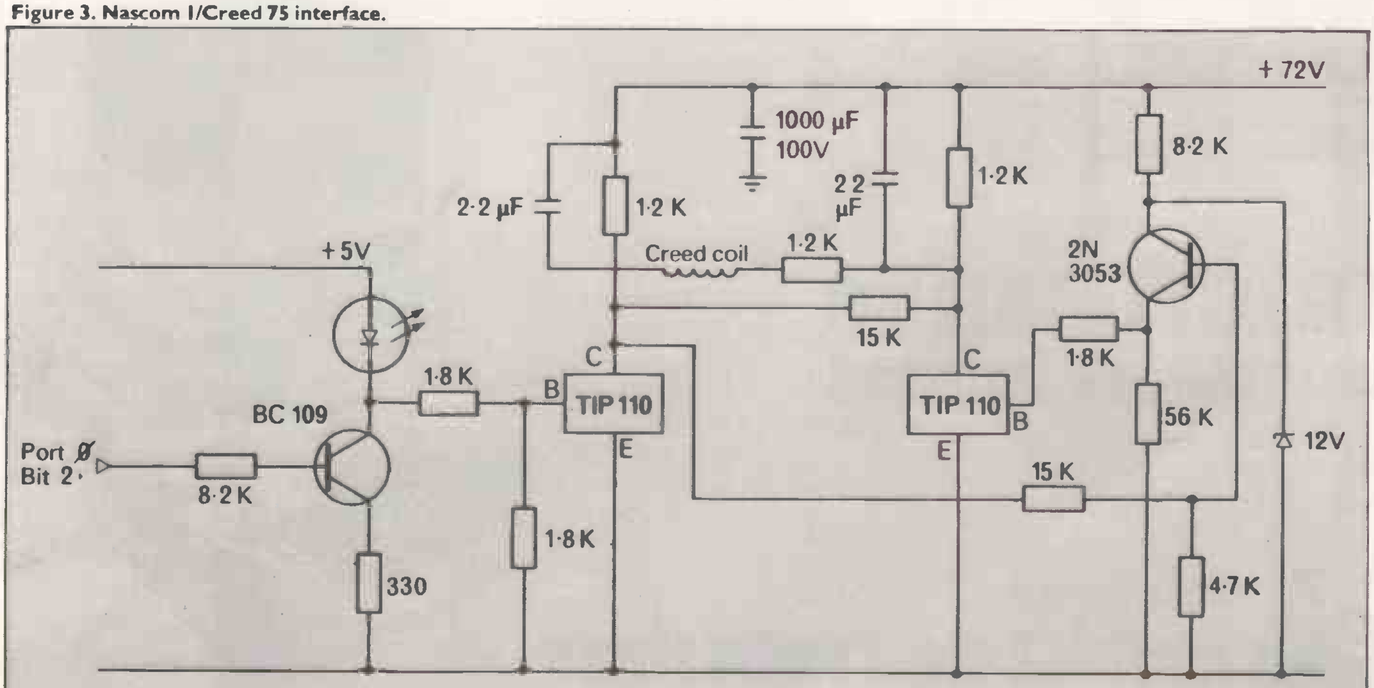
Figure 5 is a flowchart for the character output routine. The routine is entered with the ASCII value in register C. The registers are saved and a reference value (0D10) is loaded into HL. Register B is set

(continued on page 107)

```
0C50 CA 07 0A 08 39 08 00 08
0C58 0D 00 F1 E8 0B 50 0C 00
0C60 00 00 00 00 00 00 00 00
0C68 00 00 CD 6E 0C CF 00 AF
0C70 32 56 0C 06 02 0E 7F CD
0C78 D0 0C 10 F9 CD 90 0D 21
0C80 58 0C 36 0E 2A 50 0C 22·
0C88 52 0C 01 40 00 2A 52 0C
0C90 09 22 52 0C 01 2F 00 09
0C98 22 54 0C 21 58 0C 46 05
0CA0 70 20 01 C9 C5 D5 E5 F5
0CA8 06 30 2A 54 0C 3E 20 56
0CB0 BA 20 05 2B 10 F9 18 0A
0CB8 2A 52 0C 4E CD D0 0C 23
0CC0 10 F9 F1 E1 D1 C1 0E 5E
0CC8 CD D0 0C CD 90 0D 18 BA
0CD0 C5 D5 E5 F5 06 00 21 10
0CD8 0D 09 7E 32 57 0C CB 77
0CE0 CC A0 0D 3A 57 0C 57 1E
0CE8 05 3E 04 CD 16 0D CB 0A
0CF0 38 07 3E 04 CD 16 0D 18
0CF8 05 3E 00 CD 16 0D 1D 7B
0D00 20 EC 3E 00 D3 00 08 D9
0D08 06 04 3E F0 FF 10 FB D9
0D10 08 F1 E1 D1 C1 C9 D3 00
0D18 08 D9 06 03 3E E0 FF 10
0D20 FB D9 08 C9 00 00 00 00
0D28 00 00 00 00 00 48 42 42
0D30 44 84 85 94 94 8D 9A 85
0D38 8F 92 91 91 8C 83 9C 9D
0D40 96 97 93 81 8A 90 95 87
0D48 86 98 8E 8E 48 9E 44 99
0D50 9A 03 19 0E 09 01 0D 1A
0D58 14 06 0B 0F 12 1C 0C 18
0D60 16 17 0A 05 10 07 1E 13
0D68 1D 15 11 8F 9D 92 42 44
0D70 85 03 19 0E 09 01 0D 1A
0D78 14 06 0B 0F 12 1C 0C 18
0D80 16 17 0A 05 10 07 1E 13
0D88 1D 15 11 8F 9D 92 9B 1F
0D90 0E 3C CD D0 0C 06 12 CD
0D98 35 00 10 FB C9 00 00 00
0DA0 C5 D5 E5 F5 21 57 0C 3E
0DA8 80 A6 2B BE 28 14 CB 7E
0DB0 28 09 CB BE 16 1F C3 E7
0DB8 0C 18 07 CB FE 16 1B C3
0DC0 E7 0C F1 E1 D1 C1 C9 00
0DC8 00 00 00 00 00 00 00 00
0DD0 2A 5B 0C 22 5D 0C 06 06
0DD8 2A 5D 0C 11 68 00 19 22
0DE0 5D 0C 22 0C 0C 19 22 0E
0DE8 0C C5 D5 E5 F5 CD FC 01
0DF0 CD 6E 0C F1 E1 D1 C1 10
0DF8 DF CF 00 00 00 00 00 00
```

Figure 8.

Figure 3. Nascom I/Creed 75 interface.



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APPLE COMPUTER SYSTEMS APPLE COMPUTER SYSTEMS

(continued from page 105)

to 00H and BC is added to HL. For characters printed on the Creed or used to control the machine the resulting value will lie between 0D2D and 0D8F, the look-up table is situated in this area of memory. The value from the table is loaded into 0C57 for temporary storage.

The remainder of the character output routine is straightforward and is illustrated by the flowchart. The figures/letters shift subroutine at 0DA0 is bypassed if bit 6 of the CCITT code is set, saving time for space and line feed characters. The construction of a look-up byte and flowchart for this routine is shown in figure 6.

Program variables

A flowchart for the program section that prints a line is displayed in figure 7 and variables for the complete program are set-out in table 1. Note, the number of lines to be printed is decremented before the output of the first line is started; if the whole screen of 16 lines is to be printed 0C83 should be set to 11 Hex — 17 Decimal.

The subroutine at 0D90 causes a carriage return to be executed which is followed by a short delay of approximately 80mSecs so that the type head or carriage can reach its resting position before the next character is sent.

Table 1

0C50	Top-left reference
0C52	Current left margin
0C54	Current right margin
0C56	Last character
0C57	Current character
0C58	Number of lines to print
0C5B	Multiple page tabulate reference
0C5D	Current page start tabulate address
0C83	Number of lines + 1
0DD7	Number of screens to print

The program is normally executed at 0C6A. That calls the routine to output the current information on the VDU and returns to the monitor. A routine at 0DD0 tabulates a section of memory starting from the value set in 0C5B plus 68H on to the screen, prints the screen, and loops to continue the process. 0C5B — 0C5C should be modified to E8 — 0B to start printing at 0C50. The line number reference (0C83) should be set to 0EH to obtain a continuous print, the object code listing — figure 8 — was printed in this way.

Creed teleprinters are not 45 cps, bi-directional, correspondence-quality printers with associated proportional-spacing software. At worst, the machine prints a shift character before each character which appears on paper, object code listings often approach this condition as there are many figure/letter combinations in the machine-code instructions. In such a case, the print speed will be nearly halved and will approximate to four characters per second.

Extremely useful

On the other hand, the program and printer produce results that are legible, reliable, very cheap and extremely useful. Program development becomes possible away from the Nascom; this program was disassembled to draw the flowcharts on a commuter train. The printer can be used to draw surprisingly-useful histograms and segments of the program can be incorporated into others to print the results of calculations or, for example, to plot changing analogue values. The program has been used as part of a crude word-processing package.

The ability to obtain an accurate hard copy of an experimental program at the end of a session cannot be overestimated.

Figure 6. Figures/letters shift routine.

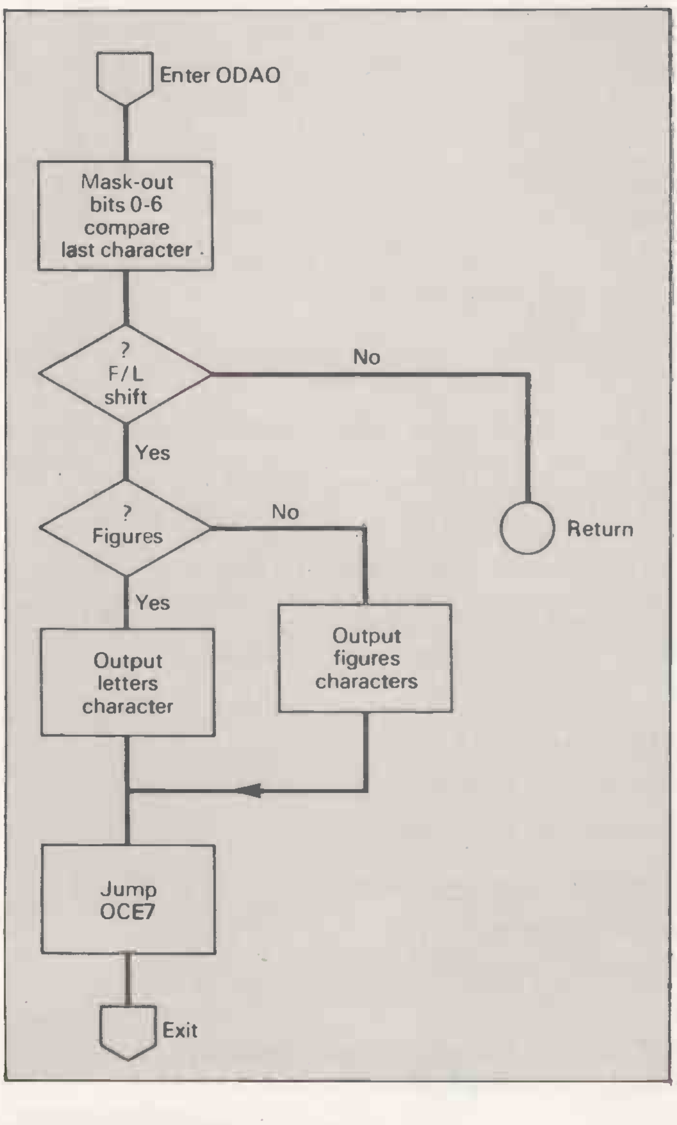
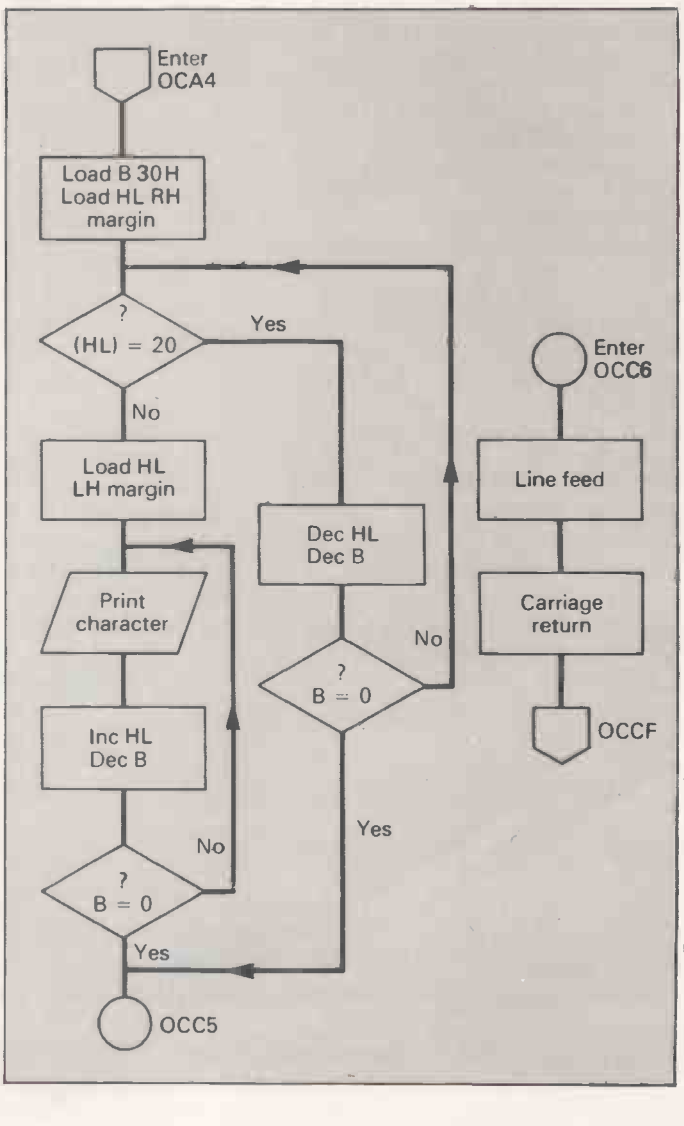


Figure 7.



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• Circle No. 180

This section is open to the Apple user. In every issue we hope to print ideas, hints and comments about the Apple and its suppliers. They must come from you, so write and tell us what you know.

Suicide bombers

A GAME written in Applesoft by Simon Goodwin of Hereford demonstrates some of the exceptional graphics facilities of the Apple. It runs reasonably quickly and produces a picture of a black ship on a blue background, able to fire at a succession of small moving targets which dive towards it from random positions at random times.

The targets explode in a delicate shade of purple when hit and also when they crash into the superstructure of the ship. The program makes special use of the 'CALL 62454', which, after a 'HCOLOR = 2, turns the whole display blue.

From then on, instead of erasing each plot with HGR or HCOLOR=0, it need only be overdrawn in blue to achieve the desired result. The very convenient join-points instruction is used to display the line of fire of the gun, and the similar-triangles formula in 300 is used to decide whether or not the fire passes through the target.

To achieve sufficient speed for a challenging game, multiple statements are used in the crucial lines 220 and 230. In fact, the program could be made still faster by replacing the constants on these lines with variables.

Objectives are to hit the enemy aeroplanes as early as possible, with the minimum expenditure of ammunition. By selecting a higher skill rating, it is made harder to hit each attacker — greater accuracy is required.

If you want to test the program, lines 0-99 and 500-590 are optional and it will run happily without them.

```
LIST

10   TEXT : HOME : PRINT "";: REM
       CTRL G
20   PRINT "SUICIDE BOMBERS : A GU
       UDWIN GAME, 1980."
25   PRINT
30   PRINT "**********************
       ****************"
35   PRINT
40   PRINT : PRINT "YOU CONTROL TH
       E FIRE OF A SHIP AGAINST "
45   PRINT
50   PRINT "FIFTEEN ATTACKING SUIC
       IDE AIRCRAFT."
55   PRINT
60   PRINT "TURN #1 PADDLE AND PRE
       SS THE BUTTON "
65   PRINT
70   PRINT "TO FIRE AT THE PLANES
       BEFORE THEY HIT."
75   PRINT
80   PRINT "YOU MUST SAVE AMMUNITI
       ON AND HIT THE "
85   PRINT
90   PRINT "PLANES EARLY TO GET A
       GOOD SCORE."
95   PRINT : PRINT "PRESS ANY KEY
       TO START THE GAME.... ";: GET
       A$: PRINT
99   REM  ** SET UP **
100  TEXT : HGR : HCOLOR= 2: HPLOT
       0,0: CALL 62454:S = 500
110  HCOLOR= 0: HPLOT 120,148 TO
       132,140 TO 144,148
120  HPLOT 110,159 TO 90,148 TO 2
       79,148 TO 259,159
130  HPLOT 155,148 TO 160,141 TO
       230,141 TO 235,148
140  HPLOT 190,141 TO 190,132 TO
       204,132 TO 204,141
150  PRINT "SUICIDE BOMBERS : A G
       OODWIN GAME, 1980. "
```

```
160  INPUT "TYPE YOUR SKILL RATIN
       G (0-6) ";J:J = 8 - J
190  REM  ** MAIN LOOP **
200  FOR X = 1 TO 15: PRINT "TARG
       ET ";X:T =  INT ( RND (1) *
       100) + 10
210  FOR D = 0 TO  RND (1) * 1000
       : NEXT D
220  FOR V = 0 TO 140 STEP 4:H =
       T + V: HCOLOR= 1: HPLOT H,V TO
       H + 4,V: HCOLOR= 0:P =  PDL
       (1): HPLOT P,0: IF  PEEK ( -
       16286) > 127 THEN S = S - 23
       : GOTO 300
230  HCOLOR= 2: HPLOT P,0 TO 128,
       145: HPLOT H,V TO H + 4,V: IF
       Z = 1 THEN V = 200
235  NEXT V: IF V > 150 THEN  PRINT
       TAB( 18)"HIT!": GOTO 250
240 S = S - 100: HCOLOR= 6: HPLOT
       H,150 TO H + 1,140 TO H + 2,
       148 TO H + 3,142 TO H + 4,15
       0
250  PRINT "+++++++++++ NEW SCORE
       ";S;" +++++++++++":Z = 0: NEXT
       X
260  FOR D = 0 TO 1000: NEXT D
270  TEXT : HOME : PRINT "GAME OV
       ER.": PRINT
280  PRINT "YOU SCORED ";S: INPUT
       "TYPE 0 TO END, ANY NO. TO P
       LAY ";D: IF D <  > 0 THEN  CLEAR
       : GOTO 100
290  GOTO 400
295  REM  ** GUNFIRE **
300 D = (159 - V) / 159 * (P - 12
       8) + 128
310  HPLOT P,0 TO 128,145
320  IF D < H OR D > H + J THEN 2
       30
330  HCOLOR= 6: HPLOT H,V TO H +
       1,V + 8 TO H + 2,V + 2 TO H +
       3,V + 10 TO H + 4,V:S = S +
       200 - V
340  HCOLOR= 2: HPLOT H,V TO H +
       1,V + 8 TO H + 2,V + 2 TO H +
       3,V + 10 TO H + 4,V:Z = 1: GOTO
       230
400  HOME : END
500  REM  ** VARIABLES **
510  REM  A$=REPLY
520  REM  D=GENERAL PURPOSE
530  REM  H='X' COORD.
540  REM  T=START POSITION
550  REM  V='Y' COORD.
560  REM  X=TARGET COUNT
570  REM  Z=HIT NOTE
580  REM  CTRL G IN 235
590  REM     S.N.GOODWIN, 12,3,80

]
```

Graphic illustration

IN MY very early days of programming, writes Frank Atkinson of Gateshead, Tyne and Wear, when anything was possible if you had the knowledge, I had the idea of producing a tabular illustration of some monthly totals. How neat it would be, I thought, if I could persuade my Apple and its printer to provide a simple illustration after the entry of 12 figures.

The problem proved more difficult than I had envisaged. At first, I struggled trying to codify the input figures into horizontal lines to be printed sequentially. Then suddenly all was light — all you do is a regular sift and if the figure you have next is the appropriate one, you print some mark e.g., "xxxx". If not, you print an equivalent space "   ".

The secret really lies in the use of the semicolon which permits sequential printing along the print line. In lines 350 to 380, X(M) is the figure, suitably scaled-down (by line 160), which is relevant for month M. If that figure is less than, or equal to Q and Q is the vertical axis, we print "xxxx".

If X(M) is greater than Q, then an equivalent space "   " is printed. Note especially the semicolon on line 360, which is followed by a colon to permit use of GOTO. Also a semicolon on line 370. The PRINT of line 390 is necessary to stop all that and to force a new printed line to be started for the next value of Q.

```
]
]LIST

0   REM ******************
1   REM *                *
2   REM *   GRAPH PLOT   *
3   REM *    * * * *     *
4   REM *   COPYRIGHT    *
5   REM * FRANK ATKINSON *
6   REM *      1980      *
7   REM *                *
8   REM ******************
60  DIM W$(12),X(12),F$(12)
70 D$ =  CHR$ (4);L$ =  CHR$ (12)
80  DATA "JANUARY","FEBRUARY","MARCH",
"APRIL","MAY","JUNE","JULY","AUGUST",
"SEPTEMBER","OCTOBER","NOVEMBER","DECEMBER"
90  FOR M = 1 TO 12: READ F$(M): NEXT
100  FOR M = 1 TO 12: READ W$(M): NEXT
110  DATA "JAN","FEB","MAR","APR",
"MAY","JUN","JUL","AUG","SEP","OCT","NOV","DEC

120  INPUT "ENTER THE YEAR TO BE RECORDED ";YY
130  PRINT "ENTER TOTAL VISITORS FOR THE MONTH OF"
140  FOR M = 1 TO 12
150  PRINT W$(M): INPUT R
160 X(M) = 30 - ( INT (R / 3333))
200  NEXT
210 Z$ = "****"
220  PRINT D$;"PR£2"
240  PRINT "     MONTHLY ATTENDANCES FOR ";YY;"  ('000)"
250  PRINT "     ****************************************"
260  PRINT : PRINT
280  FOR Q = 1 TO 30
290  IF Q = 1 THEN  PRINT "100 I   ";: GOTO 350
300  IF Q = 7 THEN  PRINT " 80 I   ";: GOTO 350
310  IF Q = 13 THEN  PRINT " 60 I   ";: GOTO 350
320  IF Q = 19 THEN  PRINT " 40 I   ";: GOTO 350
330  IF Q = 25 THEN  PRINT " 20 I   ";: GOTO 350
340  PRINT "    I   ";
350  FOR M = 1 TO 12
360  IF X(M) <  = Q THEN  PRINT Z$;: GOTO 380
370  PRINT "    ";
380  NEXT
390  PRINT
400  NEXT
410  PRINT "     ****************************************"
420  PRINT "        ";
430  FOR M = 1 TO 12: PRINT W$(M);" ";
440  NEXT
450  PRINT L$;D$;"PR£0"
460  END
```

Program naming

HAVING enjoyed the program-naming facilities offered on the Pet, I have often wished for such facilities for the Apple. As a result, I have written the following machine-code (6502) routines.

To use the routines type-in the routines from Hexadecimal values £02FD to £03FA. Due to the limitations of my typewriter, I have had to use the following: £ = dollar, used to represent Hexadecimal numbers. @ = hash, used to represent the immediate mode.

Having typed them into your Apple —

(continued on next page)

(continued from previous page)
if you are not sure how, see page 68 of the Apple II reference manual — save them by using the monitor WRITE command:

* 2FD.3FAW (RETURN)

Once saved to tape, or BSAVEd to file on diskette, they may be loaded by

* 2FD.3FAR (RETURN) or BLOAD (Filename) from diskette

Note, if disc operating system is in use, the routines must be re-located, since they reside in page three of memory.

To save a program under a name, enter integer Basic — the routines do not work for Applesoft — with a CONTROL B RETURN. You may now either write a program or else load a program using the standard LOAD method. When you are ready to save your program, hit re-set or do a CALL-151. The monitor asterisk should appear. Then type in:

* Y_cW????? (RETURN)

Before you hit return, press play and record on your tape deck. The Y_c stands for CONTROL Y — if you do not know what it does, see page 70 of the Apple II reference manual.

Immediately following the control Y is the letter "W" for WRITE. It is followed by five letters or numbers of your choice which will be the program name. There should be a short pause after you hit return, a beep from the speaker, and the screen should clear. The top line should read OUT:?????

where ????? is the name.

There will be another pause and another beep at which time the cursor will return with something similar to

*38F— A = FD X = 00 Y = 00 P = B1 S = EE

Your program is now saved under the name ?????. You may now do a CONTROL C to return to your program, or repeat the procedure.

To load a program, be sure the routines are in memory. Do a control B RETURN to set the pointers, and hit re-set or type CALL-151 from Basic.

Then type

* Y_cR????? (RETURN)

Press play on your tape before hitting return. That is type CONTROL Y followed immediately by R for READ, and the program name. Note as with the W in the save routine, the R must follow immediately the CONTROL Y.

The read routine compares only the first letter of your input name to the first letter of each program name encountered. Hence, if you try to load a program saved under the name TRAIN, and the routines encounter the program TEST1 first, TRAIN will be loaded instead of TEST1.

When you hit return the cursor disappears, there is a beep from the speaker, and the screen clears. The top line should read: I:?????

where I stands for IN.

There will be another pause, then a beep. If the first letter of your input name matches with that of a found program, that program will be loaded or it will be ignored and the routines will continue through the tape until the appropriate program is finally, if ever, encountered.

Once your program is loaded type CONTROL C RETURN to get into Basic, and your program should be waiting for you.

These programs may not work on the ITT 2020. Do not record speech or anything between saved programs as it will interfere with the routines. If a load error occurs, the routines will end and you will have to start again.

Listing 1

```
£02FD-  4C 8D 03    JMP £038D
  300-  AD 01 02    LDA £0201
  303-  C9 D7       CMP @£D7
  305-  F0 05       BEQ £030C
  307-  C9 D2       CMP @£D2
  309-  F0 F2       BEQ £02FD
  30B-  00          BRK
  30C-  A5 CA       LDA £CA
  30E-  85 05       STA £05
  310-  A5 CB       LDA £CB
  312-  85 06       STA £06
  314-  A5 4C       LDA £4C
  316-  85 07       STA £07
  318-  A5 4D       LDA £4D
  31A-  85 08       STA £08
  31C-  A9 09       LDA @£09
  31E-  85 42       STA £42
  320-  A9 00       LDA @£00
  322-  85 43       STA £43
  324-  A9 02       LDA @£02
  326-  85 3C       STA £3C
  328-  85 3D       STA £3D
  32A-  85 3F       STA £3F
  32C-  A9 0C       LDA @£0C
  32E-  85 3E       STA £3E
  330-  20 2C FE    JSR £FE2C
  333-  A9 05       LDA @£05
  335-  85 3C       STA £3C
  337-  A9 00       LDA @£00
  339-  85 3D       STA £3D
  33B-  85 3F       STA £3F
  33D-  A9 13       LDA @£13
  33F-  85 3E       STA £3E
  341-  20 CD FE    JSR £FECD
  344-  A5 CA       LDA £CA
  346-  85 3C       STA £3C
  348-  A5 CB       LDA £CB
  34A-  85 3D       STA £3D
  34C-  A5 4C       LDA £4C
  34E-  85 3E       STA £3E
  350-  A5 4D       LDA £4D
  352-  85 3F       STA £3F
  354-  20 CD FE    JSR £FECD
  357-  20 58 FC    JSR £FC58
  35A-  A9 CF       LDA @£CF
  35C-  8D 00 04    STA £0400
  35F-  A9 D5       LDA @£D5
  361-  8D 01 04    STA £0401
  364-  A9 D4       LDA @£D4
  366-  8D 02 04    STA £0402
  369-  A9 FA       LDA @£FA
  36B-  8D 03 04    STA £0403
  36E-  AD 02 02    LDA £0202
  371-  8D 04 04    STA £0404
  374-  AD 03 02    LDA £0203
  377-  8D 05 04    STA £0405
  37A-  AD 04 02    LDA £0204
£037D-  8D 06 04    STA £0406
  380-  AD 05 02    LDA £0205
  383-  8D 07 04    STA £0407
  386-  AD 06 02    LDA £0206
  389-  8D 08 04    STA £0408
  38C-  00          BRK
  38D-  A9 00       LDA @£00
  38F-  85 3D       STA £3D
  391-  85 3F       STA £3F
  393-  A9 05       LDA @£05
  395-  85 3C       STA £3C
  397-  A9 13       LDA @£13
  399-  85 3E       STA £3E
  39B-  20 FD FE    JSR £FEFD
  39E-  AD 02 02    LDA £0202
  3A1-  C5 09       CMP £09
  3A3-  D0 04       BNE £03A9
  3A5-  A9 40       LDA @£40
  3A7-  85 04       STA £04
  3A9-  20 58 FC    JSR £FC58
  3AC-  A9 C9       LDA @£C9
  3AE-  8D 00 04    STA £0400
  3B1-  A9 FA       LDA @£FA
  3B3-  8D 01 04    STA £0401
  3B6-  A5 09       LDA £09
  3B8-  8D 02 04    STA £0402
  3BB-  A5 0A       LDA £0A
  3BD-  8D 03 04    STA £0403
  3C0-  A5 0B       LDA £0B
  3C2-  8D 04 04    STA £0404
  3C5-  A5 0C       LDA £0C
  3C7-  8D 05 04    STA £0405
  3CA-  A5 0D       LDA £0D
  3CC-  8D 06 04    STA £0406
  3CF-  A5 05       LDA £05
  3D1-  85 3C       STA £3C
  3D3-  85 CA       STA £CA
  3D5-  A5 06       LDA £06
  3D7-  85 3D       STA £3D
  3D9-  85 CB       STA £CB
  3DB-  A5 07       LDA £07
  3DD-  85 3E       STA £3E
  3DF-  85 4C       STA £4C
  3E1-  A5 08       LDA £08
  3E3-  85 3F       STA £3F
  3E5-  85 4D       STA £4D
  3E7-  20 FD FE    JSR £FEFD
  3EA-  A5 04       LDA £04
  3EC-  C9 40       CMP @£40
  3EE-  F0 03       BEQ £03F3
  3F0-  4C 8D 03    JMP £038D
  3F3-  A9 00       LDA @£00
  3F5-  A5 04       STA £04
  3F8-  00          BRK
  3F8-  4C 00 03    JMP £0300
```

• **Circle No. 181**

Almost definitive

I WRITE concerning Mike Todd's final and definitive words on the RND function in Pet Corner, May. Unfortunately, they are not, writes Peter Drew of Nottingham.

The correspondence on RND seems to have concentrated on generating a different series of number each time. However, little thought seems to have been given to how those numbers are distributed.

For example, if continuous calls to RND(1) are made and the numbers are accumulated in 10 equal ranges, 0-0.1, 0.1 to 0.2 etc., it can be shown, using the statistical Chi-squared test, that the distribution is not truly random. Almost, but not quite. Here is one way of generating a random digit (F%). I am sure there are many others.

```
2000 F$ = STR$(RND(1)*LOG(TI))
2010 F% = VAL(MID$(F$,8,1))
2020 RETURN
```

It is slow but passes the Chi-squared test. Obviously, numbers of any size can be obtained by concatenation. The controversy continues unabated.

Delete routine

A DELETE routine for 8K Pet has been sent to us by Bill Short of Newcastle upon Tyne. The routine is entered by a statement such as:

```
100 SA = 10: SP = 5: EN = Z1:RS = 110:
GOTO 9000
```

where SA is the initial line number to be deleted, SP the step, EN the number of lines and RS the line number to re-start the program.

The PRINT statement in 9000 bypasses the break-message return; 9001 prints-out eight line numbers to be deleted; 9002 saves the variables in line 8999 — which are otherwise set to 0 when RUN command is implemented.

Lines 9003 and 9004 continue the program and 9005 produces 10 RETURNs to delete or input statements producing instructions. REM statements may be deleted usefully while the program is running. The routine will also delete itself if 9003 is first deleted.

I have produced a similar program to that of C B Lake, Pet Corner, December, 1979 — instead of PEEK(515) and subsequent conversion problems, I found PEEK(525) gave me the correct location in the keyboard buffer (527-536) in which to find the value which could be POKEd on screen directly. Also POKE 224 and 225 will move the cursor more easily than using strings of cursor-control characters.

After producing the diagram or drawing, the program converts it to DATA statements which are entered with a routine similar to DELETE. The program then deletes itself leaving only the DATA statements which can be used to produce a diagram in another program — particularly useful to those in the teaching profession.

My compliments to all at *Practical Computing* — an excellent magazine. The

specialist columns are really useful and must greatly influence the development of microcomputing in the U.K.

```
8998 STOP:REM DELETE
     ROUTINE 2-JW SHORT
9000 POKE 59409,228:
     PRINT"[CLR]QQQ":IF EN=0
     THEN9004
9001 FOR X=0 TO 7:
     IF EN 0 THEN PRINT
     SA:EN=EN-1:
     SA=SA+SP:NEXT X
9002 PRINT"8999SA=";SA;"[]:
     SP=";SP;"[]:EN=";EN;
     "[]:RS=";RS
9003 PRINT"RUN8999":
     GOTO 9005
9004 PRINT"POKE 59409,
     60:RUN";RS
9005 PRINT"S":POKE 525,0:
     FOR X=1 TO 10:
     POKE (526+X),13:
     NEXT:POKE525,10:STOP

[♡]=CLR
[Q]=cursor down
[ ]=cursor left
[S]=home
```

Clock functions

THE PET has several built-in clock functions but, surprisingly, there are major problems in timing in the millisecond time region, writes Chris Smith from north London.

The processor-based clocks, fast clock at 59464/5, run asynchronously from the jiffy-based clocks, TI and TI$. The fast clock counts up to 64 milliseconds only.

Keyboard presses, an obvious way to stop and start the timer, are checked only once a jiffy, thus giving a ± 8 millisecond error on both start and stop.

The timer described in my article on microphysiology, *Practical Computing*, January, 1980, solved the first problem by using a two-byte, machine-code counter in 1/20 millisecond steps, but fell foul of the second problem.

A revised routine makes use of the chance that one of the keyboard sense lines is accessed directly by location 59410, old and new ROMs. I suppose that this sense line is direct because it includes the stop key. Store 59410 contains:

```
255 no key active
254 RVS
253
251 Space
247
239 Stop
223 ???
191 .
127 =
```

The program checks the store by incrementing by one, passing if zero, and otherwise storing the incremented value in location 1002 where it may be inspected by a BASIC PEEK(1002).

Line 125 contains the value to trim the delay loop. 197 gives a unit time on my Pet of 1 milliseconds ± .005.

Using a value of five gives a unit very close to 1/20 millisecond. The maximum time is 256×256 units, i.e., 65.536 seconds, or about 3.3 seconds when running at 1/20 milliseconds.

```
60  REM PEEK (1002) GIVES:
65  REM   128 FOR =        192 FOR
70  REM   252 FOR SPACE  255 FOR RVS
75  REM
100 DATA169,1          :REM LDA#1
105 DATA141,232,3      :REM STA 1000
110 DATA169,0          :REM LDA#0
115 DATA141,233,3      :REM STA 1001
120 DATA120            :REM SEI 197
125 DATA169,197        :REM LDA#
                        **TRIM
130 DATA170            :REM TAX
135 DATA202            :REM DEX
140 DATA208,253        :REM BNE —3
145 DATA24             :REM CLC
150 DATA173,18,232     :REM LDA 59410**
                        KEY
155 DATA105,1          :REM ADC#1
160 DATA208,10         :REM BNE +10
165 DATA238,232,3      :REM INC 1000
170 DATA208,3          :REM BNE +3
175 DATA238,233,3      :REM INC 1001
180 DATA208,232        :REM BNE -24
185 DATA88             :REM CLI
190 DATA141,234,3      :REM STA 1002
195 DATA96,999         :REM RTS END
200 L=826
210 READX:IFX<256THENPOKEL,X:L
     =L+1:GOTO210
300 PRINT"Q PUSH KEY WHEN SCREEN
     CLEARS"
305 PRINT"Q = FOR CORRECT":
     PRINT" . FOR WRONG"
310 FORJ=1TO2000+3000*RND(1):NEXT:
     PRINT"♡":GETA$:SYS(826)
315 A$="WRONG":IFPEEK(1002)=
     128THENA$="RIGHT"
320 PRINT"YOU TOOK"(PEEK(1000)+
     256*PEEK(1001))/1000" SEC TO
     PUSH "A$
330 GOTO300
```

Anagram program

CROSSWORD enthusiasts and word-puzzle solvers should find the following short program useful, writes Malcolm Pritchard of Southport in Merseyside. Any group of letters may be entered and the various permutations will then be calculated and presented to the user. If an anagram is being solved and the positions of certain letters are already known, they may also be entered and the remaining letters will be re-arranged to fit the blanks. Depending on the number of unknown letters, it is a simple task to scan the output for the correct solution.

The type of word-puzzle in which some or all of the letters of a given word have to be re-arranged into as many different words as possible is also catered for. The

(continued on next page)

(continued from previous page)
length of the shortest new word can be entered as the starting point for output.

Although the program was written for the Commodore Pet, it should be suitable for other machines with Microsoft Basic available. CHR$(147) in line 110 is the clear-screen, cursor-home character.

From a programming point of view, the most interesting feature is the method of producing the various permutations in lines 300-480. The obvious way to do that would be with a series of nested FOR . . . NEXT loops. Unfortunately, the number of loops required is not known until the letters to be re-arranged have all been entered.

To complicate matters further, the global nature of variables in Basic prevents the use of a subroutine to generate the desired series of FOR . . . NEXT loops directly. The solution is to simulate the loops and hold the loop variables in an array, Q(K). K indicates which loop is being executed at any one time.

The only limitation of the program appears when letters in the original word are repeated. The output will then contain certain permutations more than once.

```
100 REM ANAGRAM PROGRAM,
    MG PRITCHARD APRIL 1980
110 PRINT CHR$(147);TAB(15);
    "ANAGRAM"
120 PRINT TAB(15);"-------"
130 PRINT:PRINT
140 PRINT"TYPE ONLY THE
    LETTERS TO BE REARRANGED":
    INPUT A$
150 PRINT
160 L=LEN(A$)
170 INPUT"ARE ANY LETTERS
    KNOWN (Y/N)";Q$
180 IF LEFT$(Q$,1)="N" THEN 240
190 IF LEFT$(Q$,1)<>"Y"
    THEN170
200 PRINT:PRINT"TYPE THE
    KNOWN LETTERS EG'-B--D-'":
    INPUTK$:W=L
210 T=0:FOR J=1 TO LEN(K$):
    IF MID$(K$,J,1)="-" THEN
    T=T+1
220 NEXTJ:IF T<>L THEN PRINT
    "ERROR":GOTO 200
230 GOTO 270
240 K$="":FORJ=1 TO L:K$=K$+"-":
    NEXT J
250 PRINT:INPUT"NUMBER OF LETTERS
    TO BEGIN";W
260 IF W<1 OR W>L OR W<>INT(W)
    THEN PRINT"ERROR":GOTO 250
270 DIM B$(L),C$(L),Q(L)
280 PRINT:PRINT
290 GOSUB 500
300 FOR J=W TO L
310 K=1
320 Q(K)=1
330 IF B$(Q(K))=""
    THEN 440
340 C$(K)=B$(Q(K)):B$(Q(K))=""
350 K=K+1
360 IF K<=J THEN 320
370 A=1
380 FOR S=1 TO LEN(K$)
390 IF MID$(K$,S,1)="-"THEN PRINT
    C$(A);:A=A+1:GOTO 410
400 PRINT MID$(K$,S,1);
410 NEXT S:PRINT,
420 K=J
430 B$(Q(K))=MID$(A$,Q(K),1)
440 Q(K)=Q(K)+1
450 IF Q(K)<=L THEN 330
460 K=K-1
470 IF K>=1 THEN 430
480 NEXT J
490 END
500 FOR N=1 TO L
510 B$(N)=MID$(A$,N,1)
520 NEXT N
530 RETURN
```

An anagram is one of a set of N!, factorial, permutations of a group of letters which gives a clue to solving the problem. Visualise a serial number for each anagram in the range 1 to N!. The trick is how to code this number. Normal decimal is to the base 10,10,10,10 or binary 2,2,2 or yards, feet and inches 3,12. The coding for a factorial for anagram purposes is to the base of 5,4,3,2,1.

APL helps here as there are functions (TI) of encode and decode which allow exactly for problems like the odd base numbers. The problem is not very difficult in Basic.

- Set-up a counter vector P().
- Increment the last element and test it P(N) >0.
- Transmit a carry if true.
- Test the next P(N-1) >1 etc., until the carry exhausts.
- If the carry does not exhaust, exit from the program.
- The vector now contains a set of pointers to the word.
- Extract the bytes one by one, shrinking the source word and adding to a new anagram.
- Print the anagram.
- Go back to incrementing the counter.

The organisation is similar to that used to extract the determinant of a matrix by the method of minors which also uses a factorial structure. The two methods have one thing in common — they are very slow. To print all the anagrams for a 20-byte word would take 1.11×10^{11} years, i.e. longer than the current age of the universe.

Everyone seems to agree that trying to solve a 20-character anagram poses insurmountable problems. The solutions for smaller words do, however, point us in the right direction. The next problem is to try and devise some simple rules to sort some of the nonsense words.

Short answer

S H BINNS of Hull has sent us a short, six-line anagram program, written in Pet Basic. Also enclosed are details of the mode of action, he writes. A few minutes on your office micro could have yielded the solution.

I am a home user of a Pet and have some experience of scientific programming over the last 10 years using Basic and Fortran. Recently, I have been using APL which gives a completely new insight into programming and handles problems like this very easily.

```
60  DIM P(50):
    INPUT"WORD";
    W$:N=LEN(W$)
100 I=N-1:
    WD$="**"+W$
110 IF I<0 THEN END
120 P(I)=P(I)+1:
    IF P(I)>N-I-1
    THEN P(I)=0:
    I=I-1:GOTO 110
140 AG$="":FOR I=0 TO
    N-1:AG$=AG$+MID$
    (WD$,P(I)+3,1)
150 WD$=LEFT$(WD$,P(I)+2
    +MID$(WD$,P(I)+4):
    NEXT:PRINT AG$,:
    GOTO 100
```

Note, the string "**" is a dummy to prevent the LEFT$(argument becoming zero.

Pet talks

IT USED to be that the greatest competitor of the Pet was the Tandy TRS-80, writes Julian Allason. While Tandy still sells a good deal, especially in the States, the contest is beginning to look like Pet v. The Rest and Pet appears to be winning.

There is certainly more home-grown software for the Pet than for all the other systems put together, if one excludes CP/M. Many universities and industrial research departments have adopted Pet as their standard computer. Talking to a director of ICI recently, I mentioned the Pet: "Yes I have got some of those at my plant", he said. "About 150".

Dr Michael Brinson's computer-aided design of electronic circuits packages are an example of the increasing acceptance of the Pet in the big, computer world. So far there are two such packages: AC circuit analysis and DC circuit analysis, both costing £50 from Commodore dealers and Petsoft.

Circuit components, their value and connection, are keyed-in, in response to questions on the screen. The program then simulates the circuit described and can be used to analyse its performance.

The technique is used widely by professional engineers, but until recently such packages were available only for mainframes and minis and were priced accordingly. As with some of the business packages, mass computer ownership has encouraged software publishers to price professional quality software below £100.

Another sign of the general health of a computer system is the number of bolt-on improvements available. There is certainly no shortage of them for the Pet. One of the most useful, if you have a tendency to crash, is Aughton Automation's re-set kit.

If the screen starts printing 100s of pi signs, or the cursor vanishes when it shouldn't, press the re-set switch and you are back in business. Commodore calls it the hairpin method but it works.

One feature I miss on the Pet is auto-repeat on the keyboard. Kingston Computers, telephone 0262 73036, has produced a hardware repeat key costing £17.50 + VAT or £30 + VAT for the deluxe version.

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Program merger

THE FOLLOWING programming tip, writes P C Inglis of Chelmsford in Essex, will enable you to merge a program located on a cassette with a second program located in memory, i.e., adding an already-recorded subroutine to a main program.

Make sure the program to be merged — the one on cassette — has line numbers larger than those of the program in memory.

Note the contents of location 16633 and 16634 using

PRINT PEEK (16633), PEEK (16634)

If the contents of 16633 is 2 or greater, do the following:

POKE 16548, PEEK (16633)-2:
POKE 16549, PEEK (16634)

If the contents of 16633 is Ø or 1, do the following:

POKE 16548, PEEK (16633) + 254:
POKE 16549, PEEK (16634)-1

CLOAD the program from the cassette, do the following:

POKE 16548, 233: POKE 16549, 66

LIST, RUN or CSAVE the merged program.

If you want to merge two cassette programs which have overlapping numbers and you do not have a re-number facility, enter the following line in command mode. It will add 32ØØØ to all of your line numbers. Note, it will NOT update GOTO, gosub, THEN or ELSE statements, so you will have to do that yourself. The line is:

P = 17129: FOR L = 1 to 9ØØØ: IF PEEK (P + 1) > Ø THEN POKE P + 3, PEEK (P + 3) + 125: P = PEEK (P) + 256 * PEEK (P + 1): NEXT

The value 125 at the end of the third statement controls, in steps of 256, the increase in the line numbers, i.e., if it were changed to 5Ø, all the line numbers would be increased by 5Ø * 256 = 128ØØ.

Tape protection

THIS SUBROUTINE is useful, writes Tim Adye from Winchcombe in Gloucestershire, when you have a program which uses cassette data files and you want to ensure that the user turns-off the recorder — the tape can be damaged if you leave the record or play keys down for a long time.

```
1000 print "please turn-off the recorder."
1010 if inp(255) and 64 then out 255,0 else out
     255,8
1020 if inp(255) and 128 then return else 1020
```

Line 1010 re-sets the cassette input flip-flop, checking whether the video is in the 32- or 64-character-per-line mode, since the tape controller and the video-format controller are on the same output port.

Line 1020 keeps checking bit 7 of input port 255 until it goes high when it returns from the subroutine. That occurs when the stop key on the recorder is pressed.

Several programs have been published in Tandy Forum for de-bouncing the keyboard. The problem with all of them is that it is necessary to load them from cassette each time the computer is turned-on. A much better method is to fix the keys.

TANDY FORUM is devoted to the Tandy TRS-80. Sometimes we will use it to pass on news about the TRS-80 but, above all, it is for users, and would-be users, of the well-established model I and now the new model II. With your tips, queries, moans and comments, this page can become a market-place for TRS-80 information.

To do that, first remove the keyboard fascia, by prising it upwards with a screw-driver blade. Then pull-off the plastic key caps, starting with the shift keys and working inward, but do not try to remove the space key.

Some of the keys may need a strong pull but by easing them slowly, you should be able to remove them all. Clean each of the contacts by inserting a piece of stiff paper between the contacts, pressing the key down, and pulling out the paper while the contacts are still pinching it.

If you want to do a really thorough job, buy some contact cleaner — Tandy sells it for about £1 — and spray it into the contact. Replace the keys — in the correct order — and the fascia.

Another problem is that which occurs occasionally when you have several separate lists contained in data statements and you want to go to the beginning of each list quickly without having to run through all the others.

The solution is to store the address of the beginning of each list in an array and when that particular list is needed, to poke the address into locations 16639-40.

The advantage of the method over that of searching through all the previous lists each time is that you need only one search. It is, therefore, much quicker.

The following program is an example, which, although not very useful in its present form, could be adapted.

```
10 dim hi(10),lo(10): on error goto 40:c = 0
20 read a$:if a$ < > "start" then 20
30 lo(c) = peek(16639):hi(c) = peek(16640):
   c = c + 1:goto 20
40 resume 50
50 input"enter the number of the list you
   want";n
60 poke 16639,lo(n):poke 16640,hi(n)
70 read a$:if a$ = "start" then 50 else print a$:
   goto 70
```

The data statements can be placed anywhere in the program and the first item of each list should be the word start. If you type that word with the shift key held down and do the same with the two starts in the program, the program can distinguish between start as a data item and start as a list header.

Password subroutine

THIS SUBROUTINE, submitted by John Taylor, of Orpington, Kent, will stop the accidental breaking of a program operation. It will work only with the Basic resident in the computer; in disc Basic the poke is altered slightly. The poke, unlike POKE 16405,1 , will allow the entry of alpha-numeric data, except for the break key which is disabled.

```
1 REM *******************************************************
2 REM    P A S S   W O R D   P R O G R A M M E
3 REM *******************************************************
4 REM   B Y   J O H N   T A Y L O R   < C E N T E C >.
5 REM *******************************************************
6 REM
7 REM THIS PROGRAMME USES VARIABLES 'W' ,'A$' AND 'I$'
8 REM
9 ' THIS PROGRAMME USES APPROXIMATELY 1K OF MEMORY WITH THE REM'S INCLUDED
10 CLS:CLEAR 100:POKE 16396,23
11 'THE POKE WILL DISABLE THE'BREAK'KEY <BUT THE RESET KEY WILL STILL WORK>
20 A$="": GOSUB 30 :GOTO 20
24 REM SUB 30 IS THE ACCEPTER FOR THE PASS WORD
26 REM PLACE'GOSUB 30'INTO YOUR PROGRAMME
30 CLS:I$=INKEY$:IF I$="#" THEN 40 ELSE RETURN
32 REM THE '#' IS THE FIRST PART OF THE PASS WORD
40 CLS:PRINT@0,"<><>":PRINT:FOR W=0 TO 3:GOSUB 70:NEXT W
41 REM  THIS WILL PLACE THE '<><>' ON THE TOP LINE
50 IF A$="PASS" THEN POKE 16396,23:END
51 REM THE POKE WILL RE-ACTIVATE THE 'BREAK' KEY
60 CLS:PRINT@460,"ACCESS DENIED IN LINE 60":FOR A=1 TO 1500:NEXT A  RETURN
70 I$=INKEY$:IF I$="" THEN 70 ELSE A$=A$+I$:PRINT@W,"*": RETURN
72 REM THIS WILL COVER THE '<><>' WITH '*' ACCORDING TO
76 REM THE VALUE OF 'W' IN LINE 40
```

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Verification and Filler

THIS MONTH, I have two small programs written in assembler code, writes Walter Wallenborn. The first, by Laurie Lambert, is a verification program which compares two areas of memory. It is written for the SYM-1 but is transplanted easily to any other 6502. The main use for this kind of routine is when moving data or checking EPROMs against the data that should be in them.

The following details will help to transfer the routine to another machine. Monitor routines used are:

OUTBYT	82FA	outputs accumulator in Hex.
COMMA	833A	outputs ASCII for comma.
INCHR	8A1B	gets character from keyboard.
WARM	8003	monitor warm-start.
CRLF	834D	outputs CR and LF.

Before running, put high byte of stop address +1 in 0000, i.e., end address of data block 1 +1.

Addresses 0001 to 0004 contain data block 1 start address low, high followed by data block 2 start address low, high. Location 0005 contains SAVIT — temporary storage.

For example, to compare 0400-07FF to 1800-1BFF.

0000 = 08
0001 = 00
0002 = 04
0003 = 00
0004 = 18
0005 = Don't care

To start, use GO — OCOO. Any errors are displayed as data 1, data 2, data 1 address. Hit Q to exit or any key to continue.

The program is not optimised but works and is a good starting point. Two ways to improve it would be by trying to eliminate jumps where possible and by using the compare indirect addressed indexed by the Y register.

```
OC00        A000    LDY  #0          START WITH 0 OFFSET
     LOOP   B101    LDA  (DATA1),Y   LOAD INDIRECT ADDRESSED
            8505    STA  SAVIT       SAVE TO COMPARE
            B103    LDA  (DATA2),Y
            C505    CMP  SAVIT
            F017    BEQ  OK          BRANCH IF EQUAL
            20FA82  JSR  OUTBYT      PRINT DATA2
            203A83  JSR  COMMA       PRINT COMMA
            A505    LDA  SAVIT       LOAD DATA1
            20FA82  JSR  OUTBYT      PRINT DATA1
            20360C  JSR  FIND        PRINT COMMA AND ADDRESS
            201B8A  JSR  INCHR       WAIT FOR KEY
            297F    AND  #$7F        STRIP BIT 7
            C951    CMP  #$51        Q?
            FO10    BEQ  OUT
            OK      C8   INY         STEP TO NEXT PAIR
            D00A    BNE  OVER        Y ≠ 0
            E602    INC  DATA1+1     HIGH BYTE + 1
            E604    INC  DATA2+1
            A500    LDA  STOP
            C502    CMP  DATA1+1     FINISHED?
            F003    BEQ  OUT         YES
OC30 OVER   4C020C  JMP  LOOP        REPEAT
OC33 OUT    4C0380  JMP  WARM        MONITOR WARM ENTRY
OC36 FIND   203A83  JSR  COMMA
            A502    LDA  DATA1+1     CURRENT ADD HIGH
            20FA82  JSR  OUTBYT      PRINT HIGH ADDRESS
            98      TYA              Y=CURRENT ADD LOW
            A8      TAY
            20FA82  JSR  OUTBYT      PRINT LOW
            204D83  JSR  CRLF
OC41        60      RTS
```

The second program is designed to fill memory with a byte called FILLER. This program, unlike the comparison one, is self-modifying and, therefore, must reside in RAM — the other could have been in EPROM.

The uses of the program include filling memory with $FF so that with the previous program a cleaned EPROM may be checked. It would make a subroutine for checking memory with each bit pattern being loaded in turn and then checked. It is ideal for that job because it is so fast. Although it was written on the AIM-65, I located at the address for the Pet cassette buffer number 2.

THE 6502 SPECIAL is dedicated exclusively to the exchange of information between 6502 users. It is up to you, the reader, to help establish this page with your ideas, problems and guidance for other 6502 users. Please mark your letters 6502 Special. We pay £5 for each contribution published.

```
<N>
ASSEMBLER
FROM=1000 TO=17FF
IN=M
LIST?Y
LIST-OUT=

OBJ?N
PASS 1

PASS 2

==0000
;THIS PROGRAM FILLS
;MEMORY WITH A VAR-
;IABLE CALLED FILLER
; IT FILLS IN 256
;BYTE BLOCKS. BLOCKS
;DETERMINES HOW MANY
;TO FILL AND START
;IS STORED IN THE SE
COND (HI) BYTE
;OF DUMMY ADDRESS
$8000
==0000
        *=$033A
;TAPE #2 BUF ON PET.
  COULD BE ANYWHERE!
==033A
AD4F03 LDA FILLER
;GET FILLER CHAR
A200   LDX #0
;START X REG AT ZERO
AC5003 LDY BLOCKS
;Y REG COUNTS BLOCKS
==0342 LOOP
9D0080 STA $8000,X
;STORE FILLER AT STA
RT +X REG
E8     INX
;POINT X REG AT NEXT
 LOCATION
D0FA   BNE LOOP
;REPEAT 256 TIMES
EE4403 INC LOOP+2
;STEP HIGH ORDER BYT
E OF START ADDRESS
88     DEY
;DECREMENT Y REG (BL
OCKS)
D0F4   BNE LOOP
;DO ANOTHER 256 BECA
USE Y NOT= 0
00     BRK
;ON A PET THIS INSTR
UCTION WOULD BE AN R
TS(RET SUB)
;$0344 (836 DEC) IS
;HIGH BYTE OF START
ADDRESS
==034F FILLER
       *=*+1
;847 DEC
==0350 BLOCKS
       *=*+1
;848 DECIMAL
       BLOCKS *=*+1
;848 DECIMAL
 ERRORS= 0000

<M>=2000 AA AA AA AA
<M>=034F AA 02 AA AA
</> 034F 11 02
<M>=0344 80 E8 D0 FA
</> 0344 20
<*>=033A
<G>/
 034F 11 ORA (02),Y
<M>=2000 11 11 11 11
<M>=2100 11 11 11 11
<M>=21FE 11 11 54 41
```

Confusion dispelled

THERE SEEMS to be a certain amount of confusion concerning saving or loading data on the Superboard UK101, especially in Martin Collins' review in *Practical Computing*, May, writes S Graham of Edinburgh.

L Ritchie's approach in May, 6502 Special, is the best way, although placing a D in front of a number is not really necessary unless there is a danger of the user attempting to load a data tape in immediate mode, as if it were a program. Otherwise, the following can be used perfectly safely:

```
110 POKE 517,1 or 110 SAVE
120 PRINT A    or print A$ for a string
130 POKE 517,0 "UNSAVE"
140 RETURN
```

and to load the value.

```
210 LOAD        (or 210 POKE 515,1)
220 INPUT A     (or INPUT A$ for a string)
230 POKE 515,0  ("UNLOAD")
240 RETURN
```

They will work for strings less than one line long. For longer ones, Kevin Ford's routines would be needed.

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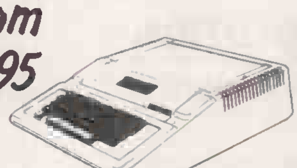

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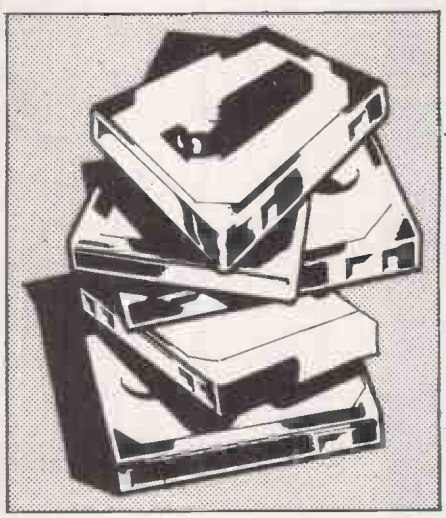
Apple COS: the use of the zero page, language changes and error-proofing

In the third part of his series on the creation of a cassette-operating system for the Apple II, Hugh Dobbs examines zero-page usage, possible language changes and a solution to a common problem.

ALL microprocessors are different. The 6502 found in Apple, Pet, AIM, Kim and Superboard is unusual in its organisation of memory. Firstly, it has no input/output instructions as such, so that all I/O has to be memory-mapped.

There are addresses reserved for cassette I/O, speaker, game controls and keyboard, and these, together with the regions of memory assigned to the extension connectors and switches, make



a 4Kbyte hole in the Apple memory, (CØØØ to CFFF H).

That is why the larger Apple has 48K RAM and 12K ROM rather than the full 64K. It is, of course, possible to ghost most of the I/O. Presumably something like that is done with the Pascal system which has an extra RAM board.

Secondly, the first 256 bytes of RAM, the zero page, can be regarded as either 256 eight-bit registers or 128 16-bit registers which can be addressed by the special 6502 zero-page instructions — two bytes each — as well as by the normal absolute instructions — three bytes each.

For that reason, most page-zero locations are used by one or another of the languages or by the monitor, for instance, pointers for INTeger Basic and for Applesoft (FP), FP re-start vector, FP instruction-reading routine, monitor I/O vectors, top/bottom/left/width of scrolling window.

Thirdly, the 6502 stack is circular — it occupies 1ØØ to 1FF H, and is managed by an eight-bit stack pointer so that 1ØØ is effectively adjacent to 1FF for PHA, PHP, PLA, PLP, JSR, and RTS/RTI instructions. Page-one locations can also be addressed by absolute instructions.

In addition to those restrictions on memory use which are determined by the processor itself, Apple reserves the whole of page 2, 2ØØ to 2FF H, as the keyboard input buffer. FP also uses page 2 for input processing. COS also uses page 2 for command decoding—applied only during printout under program control, when the input buffer is not in use.

Video display

Pages 4 to 7 inclusive, apart from 64 marginal bytes, are used for video display and are subject to scrolling. If the window-width is increased beyond forty-eight, scrolling and, more importantly, the subsequent blanking of the bottom line of the scrolling window extend into page 8, wrecking the cassette version of Applesoft, or INT variable storage, or FP program storage, or the COS HELP page.

COS I/O pointers will not be affected unless the window-width is more than 168, which is more than any of the common printer pages.

Basic programs

The remaining RAM memory, from page 8 onwards, is used for Basic programs, variable storage and certain other purposes. It amounts to 30Kbytes on a 32K machine. You will note that page 3 has not been mentioned. Only a few areas of page 3 are used: the non-maskable interrupt vector points to 3FB H, the interrupt ReQuest vector points to (3FE), the contents of 3FE and 3FF, but NMI and IRQ are not used in the basic Apple.

In monitor, CTRL-Y cases a JSR to 3F8 H; the FP & command calls a machine-code subroutine at 3F5 H; and the DOS re-start vector is stored at location 3DØ.

Because of the extent to which the zero page is used, I have not made any use of it at all for COS pointers, although it would have resulted in a shorter, ROMable program. What we have to do now, however, is to look at the page-zero locations used by INT and by FP to find which ones will have to have their contents altered to protect COS from being overwritten.

The FP handbook gives the locations of all the appropriate pointers. The ones which affect us are those which are set to ØØ Ø8 or Ø1 Ø8 or Ø3 Ø8 when FP is cold-started, CTRL-B following CØ8Ø, LOMEM, start-of-program, end-of-program, start-of-free-space, and so on. Unfortunately, they apply only to FP, and the INT handbook does not give such detailed information.

Like the rest of RAM memory, the zero page is filled with rubbish, usually ØØ ØØ FF FF ØØ ØØ, when Apple is switched-on. To see the effect of cold-starting INT or

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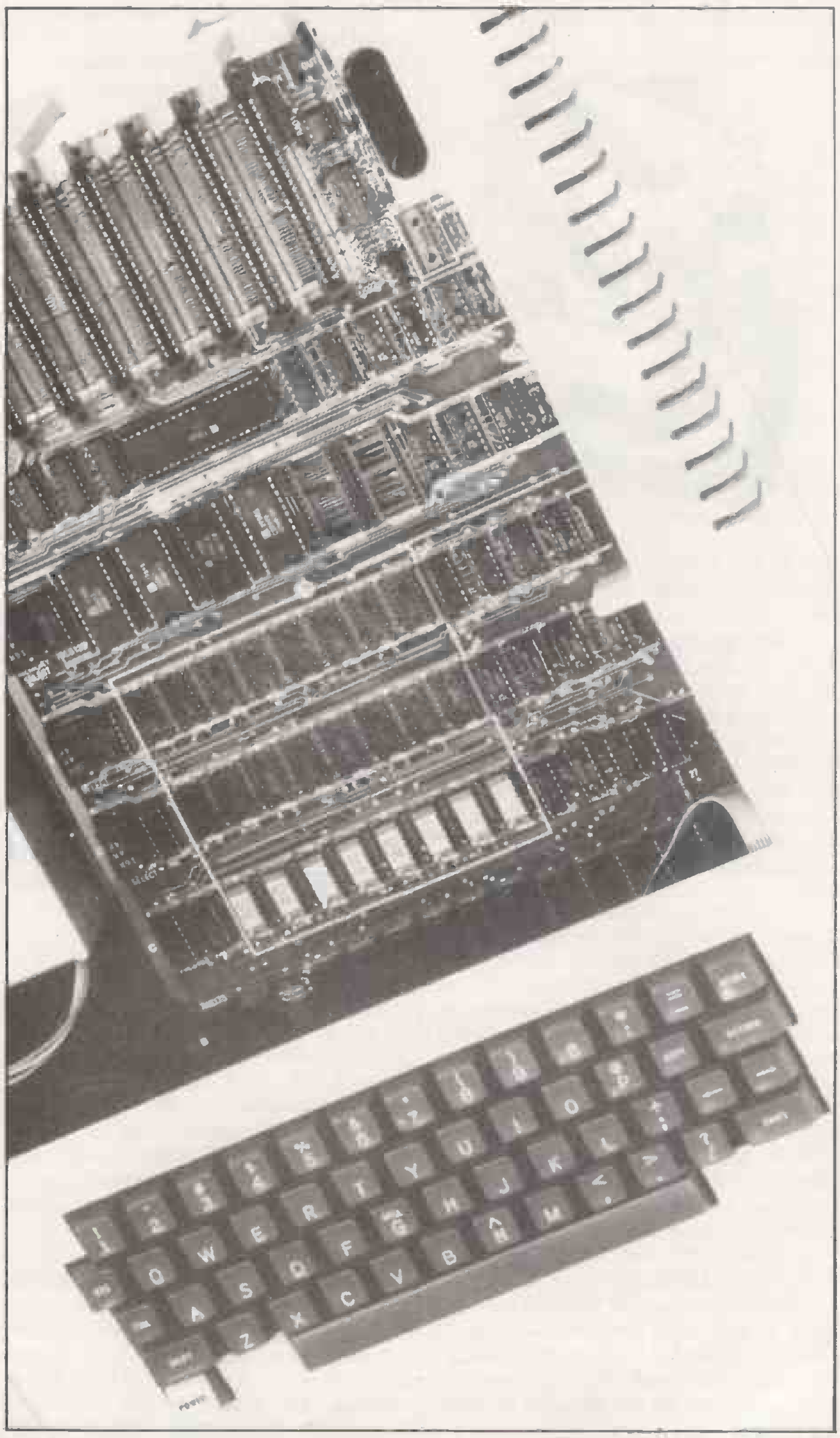

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FP, it is useful to set the whole page to FE H or some such unlikely value first. It is not possible using the monitor alone; whereas typing

```
*300:FE
*301 < 300.3FEM
```

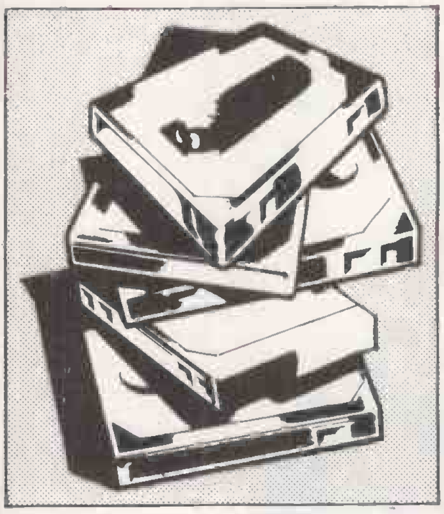
will set the whole of page 3 to FE, the corresponding sequence for the zero page,

```
*0:FE
*1 < 00.FEM
```

does not work; the second instruction crashes the system, and you have to re-set.

```
*0.7F
```

will now display the contents of the first



half of the zero page, showing that FEs have been stored at least as far as location 1F H.

In fact, the process is as far as location 3C H, which holds the low-byte address of the next byte to be moved. Its contents were changed from 3B to FE, which was matched against the low-byte address of the final byte to be moved, in location 3E, and found to be equal. The high-byte addresses were also matched and found to be equal, locations 3D and 3F both contain 00, and so the move then terminated.

By that stage, it had overwritten the storage for the scrolling-window limits, for the cursor horizontal and vertical positions, but most importantly, for the input and output vectors — locations 36 to 39 H. When the monitor tried to issue its next message — either a bell or a retn — control was transferred to FEFE H instead of to the usual output routine at FDF0 H.

What happened after that is not too clear — FEFE is in the read subroutine but is not a valid entry point — but it is possible to obtain some idea by examining page 1, the 6502 stack area, to see the stored return addresses.

Note the advantage of the 6502 arrangement of restricting the stack to page 1. Even an infinite loop with more JSRs and PHs than RTSs and PLs can devastate only page 1 and the rest of RAM memory is protected.

What we want is a machine-code routine to write FEs into page zero and to jump to the re-set entry point to restore those locations which are necessary for system operation: start the ASseMbler (*F666G) and type

```
!300:LDA #FE  let's work in page 3 for a
              change.
!    STA 0
!    INC 303  change 0 to 1 ... to FF and
              back to 0.
!    BNE 302  if 0, we have finished.
!    JMP FF59 'RESET' entry to monitor.
!(re-set)
*300G         test it.
```

Now you have as much of page zero as possible set to FEs, store a copy of it by moving it somewhere else in memory:

```
*1000 < 0.FFM  Move to page 10 H
*1000 < 0.FFV  Verify the copy.
```

Random number

Note that two bytes have changed. 4E H and 4F H store a 16-bit random number — an ordinary number which is incremented as part of the keyboard scan subroutine, so that it changes by an unpredictable amount every time Apple expects a key input. It is most unlikely that either byte is the same as it was when the copy was made, so both are reported on verification.

As explained at the start of the series, I am assuming throughout that you have a 32K Apple II with INTeger Basic on the main board and Applesoft II (FP) in ROM, and no disc system; and that the hardware switch on the back of the FP ROM board is set to select on-board ROM, INT, etc., on re-set. So CTRL-B, retn at this stage will put you in INT.

During the code-start, INT sets a pointer for LOw MEMory: to 800 H and copies it into another location which is the pointer to the storage area for variables. In INT, all variables are stored together irrespective of type — strings, integer variables, integer arrays.

INT does a non-destructive test of the first location in each page of RAM thereafter — read, complement, store, check, complement, store, check — until that no longer works.

Input area

Either you have a dead memory location, or there is nothing at that address, 4000 H on a 16K Apple, or 8000 H on a 32K, or it has reached the keyboard input area — C000 H will be the limit on a 48K Apple. That address is stored as the HIgh MEMory: pointer, and copied into another location which points to the start of any INT program when you write one. Now re-set and

```
*1000 < 0.FFV
```

compare the changed page-zero contents to the previous copy.

As before, 4E and 4F will almost certainly have changed, but so should about 19 other locations. The ones which concern us at present are 4A to 4D and CA to CD. At this stage, *4A.4D should give "00 08 00 80 " if you have a 32K machine. The last byte will be 40 or C0 for 16K or 48K. 4A and 4B are copied to CC and CD; 4C and 4D are copied to CA and CB, so *CA.CD should give " 00 80 00 08 ", etc.

Most of the other changes are bytes which have been set to 00, but there are two further points of interest: locations D9 and F8 which now contain 7F. Repeating the sequence CTRL-B, retn, re-set,

*1000< 0.FFV	will change them both to 3F, and CTRL-C, retn, re-set,
*1000< 0.FFV	will show that only location D9 has changed to 1F.

Clearly, there is an LSR D9 in the warm-start procedure and an LSR F8 in the cold-start procedure for INT which is a subroutine preceding the warm-start, unlike FP where the situation is obscure. F8 is a flag whose high bit is set to show either that AUTO line-numbering is in force, or that INT has not been properly initialised, or that you have been using FP since the initialisation. Any of these states is, of course, cancelled by cold-start.

Pointer verified

To determine which of the various pointers 4A to 4D and CA to CD has which function, re-enter INT — warm-start: CTRL-B — then

>A = 5	do not forget the retn, re-set.
*4A.4D	will display one set of pointers, and
*CA.CD	the other.

Whichever has changed is the end-of-variable-space pointer. Return to INT and

>RUN (*** NO END ERR), re-set.

Then verify that this pointer has returned to its original value — RUN clears all variables. Return to INT and

>10 REM and re-set.

This time, the start-of-program pointer will have changed, since INT programs go to the top of memory. It turns out to be CA-CB (low-high) and that is a very useful fact for those times when you lose a program either by CTRL-B following a re-set, or by using NEW when working in INT.

Search through memory using the monitor until you find the start of your program — it usually starts "XX 0A 00" if you usually start your program with line 10 — and then if the XX is at the HHLL Hexadecimal,

*CA: LL HH

where, of course, you entered the appropriate values for HH and LL and which will re-connect the program. Then warm-start INT, and LIST to check.

DOS lives above HIMEM: and hence changes the HIMEM: and start-of-program pointers. That is probably more practical than what I have chosen to do and means that it can coexist with the RAM version of FP which occupies 800 to 2FFF H.

For the moment, though I keep discovering new disadvantages, COS will continue to live below LOMEM: and will have to change the LOMEM: and end-of-variable-space pointers.

The change we need to make will depend on the length of COS itself and on the amount of space we want to reserve for files. That space might be quite large if we allow for the difference in access times between tape and disc storage — larger blocks will probably be more efficient.

For the moment, we can suppose that COS ends at FFF H, though this will be revised upwards. Assuming that for the moment we do not need any file space apart from the input buffer, we can allow either Basic to use anything from 1000 H upwards.

Minor changes

That can be done for INT simply by cold-starting it and changing the 08 in locations 4B and CD to read 10. FP has far more pointers, but fortunately they are all listed in the FP handbook, Appendix L.

Unfortunately, the FP cold-start routine not merely sets six pointers to 800, 801 or 803, but also sets the contents of locations 800 to 802 to be 00. The contents of location 800 do not seem to matter except that anything other than 00 produces a ? SYNTAX ERROR message following a NEW command but does not prevent the program from being deleted which would have been useful.

Any FP program you may write begins at 801 with the two-byte absolute address of the second line of your program, and a double 00 in these locations — the end-of-program marker — shows that there is no program yet. That means we will also have to write 00s into locations 1000, 1001, and 1002 before FP will run properly with the new pointers.

Unaffected locations

Now, in fact, 4B and CD are not affected during FP cold-start, and 68, 6A, 6C, 6E, 7E and B0 — the FP high-address pointers which need to be changed — are not affected during INT cold-start. We can cold-start the desired Basic and set all those locations to 10 and set 1000 etc., to 00, without causing any difficulties for either system. We can alternatively replace every 08 in page zero with a 10, again without causing any problem.

Now let us put it together. Start the assembler and:

```
!ELA:NOP                        gap to allow
                                INT to start
                                at odd
                                address.
!     LDA # 81;           *INT  C081: latch to
                                select on-
                                board ROM.
!     BNE E21;       TOSETBAS   forced.
!     LDA # 80;            *FP  C080: latch to
                                select FP
                                ROM.
!     CMP A79;         SETBAS   has this
                                Basic been
                                cold-started
                                already?
```

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```
!  BEQ E35;     TOGOBAS if so, skip this
                        part: do not
                        re-initialise.
!  STA A79;      ROMSEL set RAM
                        switch for
                        INT or FP.
!  ORA 878;      INFLAG do not kill
                        EXEC mode,
                        if set.
!  STA 878;      INFLAG set high bit of
                        INFLAG and
                        low bit if INT
!  LDA #0;         COLD E000 is the
                        cold-start
                        address for
                        FP or INT.
!  STA A7C;       CS/WS set RAM
                        switch for
                        cold-start.
!  NOP                  let GOBAS
                        start at odd
                        address (E35).
!  JMP A78;      *GOBAS execute warm-
                        start or cold-
                        start.
!  NOP                  let ASM start
                        at odd
                        address (E39).
!  LDA C081;       *ASM ASM is in on-
                        board ROM
                        with INT.
!  JMP F595;      GOASM like F666, but
                        no bell.
!  CLD;            **BYE probably un-
                        necessary,
                        but harmless.
!  JMP FF69;     GOMONZ start monitor
                        without
                        killing COS.
```

The first free, odd, address is now E43. * in the listing indicates a COS command routine and by inserting two NOPs, we

have acquired an extra command. Return to whatever Basic we were in last, without losing the program.

That covers the first stage, at least, of all the language changes we may want for the moment. INT, FP, ASM, BYE — traditional exit from Basic — and a restart-Basic.

That is about the ninth version of the language-change section, which has been rather tricky. We have some code to enter before it is fully operational, but even at this stage you can test ASM and BYE:

```
!SE3FG        should switch to monitor.
*E39G         should switch back to ASM.
              Re-set and enter FP.
] CALL 3641   should switch to ASM
              directly from FP.
```

That is quite an achievement since the two languages occupy the same address space. Now we need the non-ROMable Basic entry routine, which is to start at A78:

```
!A78:LDA C000;   ROMSEL will be C080
                        or C081
                        before it is
                        used;
                        C000 here
                        shows that
                        neither Basic
                        has been cold-
                        started yet.
!  JMP E000;      CS/WS set for cold-
                        start ; E003
                        for warm-
                        start.
```

You can now test the INT and FP routines:

!SE1BG (into INT); >CALL 3647 (into monitor); *E1FG (into FP);] CALL 3611 (into INT and so on).

The routines are still not complete. CALLing 3611 has the same effect as NEW if you are in INT, while it should have no effect at all. Similarly for CALL 3615 in FP. That is because although we have provided a routine to select cold-start, there is no way as yet of switching it over to warm-start.

Secondly, we have done nothing, as yet, to change the low-memory Basic pointers, so that COS will be overwritten by FP programs and variables, or by INT variables. Thirdly, we have set one bit, perhaps two, in a location called INFLAG.

During or after the initialisation, cold-start, Basic issues a retn — two in the case of FP — a prompt and sets a cursor flashing and waits for input. If COS is connected, control will then pass to the COS input bug at C1B which as yet is only a stub.

INFLAG controls the branching in that part of the program, and I am hereby re-defining the meaning of the various bits in it:

878: INput FLAG : bit 7 is Basic cold-start; bit 6 is EXEC; bit 5 is READ, and bit 0 indicates INT rather than FP for cold-start handling.

We now have to re-write the input bug:

```
!C1B:PHA;            INBUG 14 April 1980.
!    LDA #20                mask bit 5.
!    BIT 878;       INFLAG
!    BMI C2B;     TOXBASIC branch on bit
                            7, top
                            precedence.
!    BNE C27;       TOREAD branch on bit
                            5, higher
                            precedence
                            than EXEC.
!    BVS C27;       TOEXEC branch on bit
                            6.
!    PLA                    normal exit.
!    JMP(8FE);     TOKEYIN to keyboard
                            input routine.
!    PLA;           XBASIC handle cold-
                            start.
!    STA (28), Y            kill cursor.
!    LDA 878;       INFLAG
!    AND #7F                re-set bit 7.
!    LSR                    bit 0 into
                            carry bit (1 =
                            INT, 0 = FP)
```

```
!   PHP                      save processor
                             status, in-
                             cluding carry.
!   ASL                      shift back,
                             with 0 going
                             into bit 0.
!   STA 878;       INFLAG    overall, we
                             have cleared
                             bit 7 and bit
                             0; the value of
                             bit 0 is saved
                             as the carry
                             flag and
                             pushed on the
                             stack, from
                             which we now
                             recover it.
!   PLP
!   LDA # 3;       WARM      E003: warm-
                             start entry
                             to Basic.
!   STA A7C;       CS/WS     set RAM
                             switch to
                             warm-start
                             hereafter.
!   LDY 97E;       COSEND    pick up
                             pointer to
                             first free
                             page after
                             COS; it is
                             stored in
                             RAM to allow
                             it to be
                             changed if we
                             want to leave
                             space for
                             files.
!   BCC C4C;       TOXFP     if carry is
                             clear, this is
                             FP.
!   CLC;           XINT      if not, it is
                             INT.
!   STY 4B                   set INT low-
                             memory
                             pointers.
!   STY CD
!   JMP FD0C;      RDKEY     restore Y, A,
                             cursor and go
                             to normal
                             input.
!   DEC 25;CV;     XFP       move up to
                             overwrite FP
                             prompt.
!   JMP F1A7                 F1A7 is the
                             point in FP
                             initialisation.
```

Re-initialisation

Where HIMEM: and associated pointers have been set and Y contains 08 and X contains 00, forming 0800, ready to set all the low-memory pointers. Our routine leaves X with 00 — input buffer pointer set to zero by normal input routine — and Y with COSEND, so that it re-initialises FP with the desired values. It remains to set COSEND, so re-set and *97E:10 temporarily. Also, if you do not have the earlier parts of COS, you will need to set the exist vector for the input bug: *8FE:1B FD to point to the normal keyboard input routine.

Now connect the COS input bug only — do not use C00G if you have the full system so far: *39:C direct monitor input routine to jump to C1B instead of the usual FD1B. That should be transparent, that is, it should have no obvious effect. We should also change A79 to show that neither Basic should be warm-started at first:

```
*A79:0        or any number other than 80
              or 81
*4A.4D        display first INT pointer area
              (00 08 00 80 maybe).
*CA.CD        display second INT pointer area
              (00 80 00 08 ?).
*E1BG         Go into INT.
 CALL 3647    (or —151) into monitor.
*4A.4D        display first INT pointer area
              (00 10 00 80 ?).
*CA.CD        display second INT pointer area
              (00 80 00 10 ?).
```

The 10 in 4B and in CD shows that we have succeeded in changing the low-memory pointers. Further investigation should show that INT operates normally in all respects, except that variable storage starts at 1000 H instead of 800 H. For instance, if you set A = 3 in INT and then switch to monitor,

```
*CC.CD        will give 06 10, end of variable
              space, and
*1000.1006    will show C1 00 06
```

Similarly, we can check the effect on FP:

```
*67.70        displays most of the FP
              pointers; of these, 68, 6A, 6C,
              and 6E are 08 if FP has been
              initialised normally.
*E1FG         into FP.
 CALL 3647    into monitor.
*67.70        should show all the 08s
              changed to 10s; you can also
              check 7E and B0, 10 again; and
*1000.1002    should show 00 00 00, FP
              start and end of program
              markers. That has not pre-
              vented 800 to 802 from being
              set to 00.
```

The language-changing section can operate on its own, but if the output bug is connected, the low memory pointers remain at 08 after initialisation instead of being changed to 10.

That is because a return to command mode causes the COS output bug to kill all input modes except EXEC; the relevant section is at D1A to D21, where we had

```
!   LDA #40
!   AND 878;      INFLAG
!   STA 878;      INFLAG
```

and clears everying but EXEC. All we have to do is *D1B:C1 so that it does not re-set bit7 or bit/0.

If you have the rest of COS, you could try adding new words to the command table. It would then end with

***(08)BYE(1F)ASM(1C)(83)(1A)FP(0F)INT(0D)HELP(00)

or, in Hex values,

... AA AA AA 08 C2 D9 C5 1F C1 D3 CD 1C 83 1A C6 D0 0F C9 CF D4 0D C8 C5 CC D0 00.

The new commands will not work satisfactorily, however, until you find a solution to last month's problem.

The reason for the trouble was that the command decoder omitted to change the operating MODE flag when it read a command, and when a further return was received, it repeatedly decoded the same command.

The cure for that is to insert a STA 879 at some point in the decoder. I do not want to do that, as we will still need to know whether it was a keyboard command or CTRL-D printout, for some commands. Make the change yourself if you like, but save the existing COS first.

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As the Buyers' Guide is now being revised and updated in preparation for a new series which will appear on our Prestel pages, please send us information confirming the details contained in the entries and any new facts which you may possess.

ACORN COMPUTERS

Acorn. Single Eurocard-sized microcomputer with 6520 processor, IBK RAM, 16-way I/O. Max size; a second Eurocard adds hex keypad and CUTS cassette interface. Monitor and machine code programming now, Basic and disc operating system in the future. "Highly cost-effective basis for a computer or an industrial development system". Available from Acorn (0223) 312772 or Microdigital (051) 236 0707. *£74.75 kit, £86.25 assembled*

ALAN PEARMAN LTD

Maple. Z-80A, 16- 64K RAM, S-100 bus, CP/M, Micro-APL and any CP/M languages, 8in. single/double-density discs, RS232 serial and parallel ports. APL(0244) 46024. *From £1,510*

ALPHA MICROSYSTEMS

AM-1010, AM-1011, AM-1030, AM-1031, AM-1050, AM-1051: 64K-16MB RAM, WD16 — 16-bit — S-100 bus, Basic, Pascal, Lisp, Assembler, Fortran, floppy discs to 4 × 90Mbyte hard disc, RS232, up to 20 ports. AM(01-) 250 1616. *From £7,500 to £19,000*

APPLE COMPUTERS

Apple II Plus. Min size: 16K memory, 8K ROM, keyboard monitors; mini assembler; colour graphics; Pal card; RF modulator; games; paddles and speakers; 4 demo cassettes. Max size; Expandable to 48K memory; floppy discs and printers are now available. Two versions of Basic, PASCAL; Assembler; games; business packages. An American system regarded as suitable for any kind of applications. Maintenance contracts offered. Microsense Computers is the sole U.K. distributor and has a national dealer network. Tel: (0442) 41191/48151 (24-hour answering service). *From £695.*

ATTACHE

Attache: Min size: system with 10 slots, S100 bus, 8080 processor and 16KB housed in desk-top case with built-in keyboard. Max: 64KB, parallel printer interface, two single or double density 8" floppies, video screen. Disc Basic. Full business system includes all software. Sole U.K. distributor is Friargrove Systems Ltd. Tel: 01-353 3196. — *From £1737. Full business system £7000*

BASF

System 7100. CPU: Z-80A, 64K RAM, internal BASF, 5¼in. discs, single-sided, single-desnity, RS232, BOS BASF operating system, Basic assembler. Sole U.K. dealer MPR, Tel: Paul Curran 01-837 6332. — *From £4,937*

BILLINGS

Billings Microsystem (BMS): Z-80A, 64K RAM, 12" screen, QWERTY keyboard, range from double density 8" floppies (600KB), to 200 MB hard disc. Software includes COBOL (ANS174 with extensions), FORTRAN, Extended BASIC and MAC80 Assembler. The microsystem could be used as a program development aid. Availability: Mitech Data System Ltd, Woking (04862) 23131. — *From £4295*

B L MICROELECTRONICS

Biproc. Z-80 or TMS9980 kit, 1K RAM expandable, 2K monitor plus line-by-line assembler, TTL receivers and drivers, RS232C to cassette or UHF modulator. BLM(0494) 443073. — *From £150*

BRUTECH ELECTRONICS

BEM-CPUI. Single-board processor with 6502 and no RAM. Applications software. Available from Data Precision Equipment (04862 67420). (Reviewed March, 1979) — *£133 exc. VAT*

BYTRONIX MICROCOMPUTERS

Megamicro. 8080A/Z-80 processor. 64K. Double-sided discs, two-page addressable VDU, 140 cps printer. Software includes Basic, Fortran, Cobol and Pascal, all running under CP/M. Applications include automatic letter writer, sales ledger and stock control, payroll and bought ledger. Self-diagnosis utilities. Aimed at business and university user. Available from Bytronix (0252) 7?5814. — *From £6,080.*

COMART

Microbox: Chassis with three to six PCB sockets for S100 boards, plus fan. Several S100 boards available. Aimed mainly at OEM industrial users and perhaps the serious hobbyist. It will take Cromenco, North Star and other processors. Available from Comart (0480) 215005. — *£195*

VDM Board: Adds word processing power to the S100 bus by providing on-board screen storage. Generates 16 by 64 character lines from data stored in a 1024 byte on-board memory. — *£145*

COMMODORE SYSTEMS DIVISION

Pet. Single unit containing screen, tape cassette and keyboard. Floppy disc, printer and full-size keyboard are options, as are external cassettes. Basic; games; business packages. The British subsidiary of Commodore Systems of the U.S. sells Pet for home, educational and small business applications. About 80 distributors. — *£460-£795 exc VAT*

Kim-1. processor (6502 chip); small calculator-type keyboard; LED six-digit display; built-in interfaces for audio-cassette and Tele-type; IK RAM; 2K ROM (can add up to 64K). No software available, but it has three good manuals. An American import which gives Pet-type capabilities with a maximum configuration. For the hobbyist but used mainly as an evaluation board for the 6502 chip. Twelve to 15 dealers. (Reviewed October, 1978). — *£99.95*

SHOPWINDOW

COMPUCOLOR

Compucolor II. Packaged system including 13in. eight-colour display with alphanumrics and graphics, 72-key detachable keyboard, 8KB, and built-in mini-floppy. Max size: 32KB. Extended disc. Basic in ROM, graphics programs and games. The system now ranks fourth behind Pet, TRS-80 and Apple in personal computer sales. Abacus (01-580 8841) is sole U.K. agent and is arranging distributors, including the Byte Shop and Transam. (Reviewed June, 1979).
From £1,390

COMPUCORP

610: desk-top unit using Z-80 and incorporating screen, 150KB floppy, 48KB. Up to 60 KB memory, four floppies, printers. Basic, Assembler, DOS, text editor, file manager; business packages. Nine dealers.
From £3,890

COMPUTER CENTRE

Mini kit: Z-80 CPU, CTC, USART, serial and parallel I/O, 16 bytes memory, Western Digital disc controller, SA400 5in. drive plus CP/M, cables and connectors.
Mini kit: £786

Maxi kit: As above but with DRI 7100 8in. drive instead of 5in. drive. All (33) volumes of CP/M user group library available for cost of media. Library includes utilities, games. Basic compilers/interpreters and Algol compiler. Microsoft Basic, Cobol, Fortran also available. Computer Centre (02514 29607).
Maxi kit: £886

COMPUTER WORKSHOP

System 1. Typical size: 40K memory; dual 8in. floppy disc, total storage capacity 1.2MB; Ricoh daisywheel printer.
System 1, £5,000 plus

System 2. Typical size: 24K memory; dual minifloppy discs of 80K bytes each; Centronics 779 dot matrix printer; VDU.
System 2, around £3,000

System 3. 12K memory, cassette interface: 40-column dot matrix printer. Editors, Assemblers, Basic, games, information retrieval package. The systems were designed and built in Peterborough and are suitable for educational and small business users and perhaps the more serious hobbyist. Twenty-five dealers.
System 3, from £1,300

CROMEMCO

Single-card computer: 4MHz Z-80 CPU, S-100 bus, 1KB RAM, sockets for 8K ROM, 20mA/RS232 serial interface and parallel bidirectional interface. Basic in ROM and Z-80 monitor. For OEM and industrial users; used with backplane for "full computer compatibility" (Reviewed February 1979).
£225 (in kit form) to £260

Z-2: Min. size: chassis, 31A power supply, motherboard, Z-80 processor, 16KB memory. Max size: 512KB, 21 sockets, three minifloppies or four 8in. floppies. Basic, Fortran, Cobol, assemblers. For serious hobbyists, OEMs, educational applications, and industrial/scientific users.
£360 (in kit form) to £3700

System Two. 4MHz Z-80A, 64K/512K RAM, S-100 bus — 21 slots — CP/M, Fortran, structured Basic, Cobol, Assembler, DBMS, RS232 serial interface, parallel printer interface, daisywheel printer interface — standard — multi-channel interfaces available — digital and analogue — VDU, two 5¼in. floppy disc drives — 180Kbyte each, hard disc up to 70 MB.
£587
£2,126

System Three. 4MHz Z-80A, 64K-512K RAM, S-100 bus — 21 slots — CP/M, Fortran, structured Basic, Cobol, Assembler, two or four 8in. disc drives — 512Kbytes each — hard disc up to 70MB, ports as above. Sold by Microcentre (031) 556 7354 and Comart.
£2,995 to more than £8,000

DATA APPLICATIONS

DAI Personal computer. 8-48K RAM, 24K fast Basic + systems programs ROM, colour graphics — variable to 255 × 355 — PAL output to TV/monitor, compatible with more than 20 Eurocard Industrial Interface Modules, upper- and lower-case QWERTY KB, RS232 interface included, machine code utility, scrolling screen editor, 3 oscillators with volume control, to TV or stereo, 60-character screen width, dual cassette interfaces, 6-game paddle inputs. Sole U.K. Dealer: Data Applications Ltd, 168 Dyer Street, Cirencester, Gloucestershire, GL7 2PF.

From £998

DIGITAL MICRO SYSTEMS

DSC-2. 64K RAM Z-80A and more than 1MB on two Shugart 8in. disc drives, four programmable RS232 and one V24 parallel interface. CP/M and Basic included in price. Additional utilities available including Z-80 code assemblers and re-locating loaders file sorting, text and word processing. High-level languages available include C Basic 2, Cobol, Fortran, and Pascal. Add-on 14MB and 28MB disc-system available.

From £4,695

HDS 4000. Floppy/hard disc microcomputer, 64K RAM more than 1MB or optional more than 2MB on 2 Shugart 8in. floppy disc drives and 13.7MB or optional 27.4MB Winchester technology hard disc. All enclosed in one cabinet, and includes standard CP/M operating system. Sole U.K. distributor: Modata (0892) 41555.

From £8,995 (13.7MB) £10,195 (27.4MB)

DYLE HOUSE

Business Computing System 2000. Z-80A. Dual 8in. discs, 140 cps 132 char printer. Dyle House Business Basic, and disc operating system. Accountancy, payroll and parts control suites, Applications: Sales acknowledgments, sales invoices, delivery notes, purchase orders, customer statements, remittance advice. Dyle House Ltd (01-529 2436).

No price announced

EACA

Video Genie EG3003. Z-80, 16K-48K RAM, S-100 bus via expansion box, Microsoft-compatible operating system in 12K, CP/M 5¼in. floppy discs via expansion box, all address and data lines from CPU, RS232. Lowe Electronics (0629) 2430.

£369.56

EQUINOX

Equinox 300. Min size; 48K memory; dual floppy discs giving 600K bytes of storage; 16-bit Western Digital m.p.u. Max size; up to 256K memory; up to four 10MB hard discs. Basic, Lisp, PASCAL, Macro Assembler, Text Processor. All software bundled. The system is a multi-user, multi-tasking, time-sharing system for two to 12 users. Application software available for general commercial users. Sole distributors Equinox Computers Ltd (01-739 2387).

£5,000-£40,000 plus

EURO-CALC

Euroc: 8080A CPU, 64KRAM, two times double-sided single-density 8" floppy disc drives with approximately 1 MByte capacity. 15" screen with 80 by 25 characters, QWERTY keyboard, CP/M operating system 140 CPM tractor feed matrix printer. Software: C-BASIC 2. Supplied with accountancy package for sales, purchases and nominal ledgers and initial stationery. Sold through Euro-Calc, 55/56 High Holborn, London W.C.1. Tel: 01-405 3113.

£8,000

EXIDY

Sorcerer: based on Z-80, 16K and 32K; cartridge and cassette interfaces; 79-key keyboard; 256-character set (128 graphics symbols), 12in. video monitor; expandable with Micropolis floppy discs. Basic, Assembler and Editor; games, word processor. Other pre-packaged programs plus EPROM Pack for your own programs on cartridges. Factor One is sole distributor for U.K. (Reviewed March, 1979).

From £760 without VDU to £1,200 with floppy discs

HEATH SCHLUMBERGER

H8. 8080 CPU. 4664K PAM. Serial/cassette I/O; front parallel monitor; keypad; optional parallel I/O; serial multiport; breadboard I/O and disc system. Basic, Ext. Basic, Microsoft Basic, HDOS, CPM. — *From £262 (in kit form)*

WH89. All-in-one computer Z-80 processor plus Z-80-controlled VDU. 16K expandable to 38K, user-accessable. Two RS232 I/O ports. Operating system includes Benton Harbour Basic, two-pass absolute assembler, text editor, utility programs, Microsoft Basic and Fortran word processor package. Heath Schlumberger (0452 29451). — *About £1,600*

HEWART MICROELECTRONICS

Mini 6800 Mk II. IK monitor; IK user RAM, IK VDU RAM; CUTS. Upper- and lower-case VDU with graphics option. 128-byte scratchpad; decoder/buffer; power supply; Basic in ROM; monitor command summery. SWTPC programs; Newbear 6800; Scelbi 6800 Cookbook. Markets are small business, education and home user. Cash with order to Hewart. (0625) 22030. — *From £127.50 plus VAT*

6800S. 16K dynamic RAM; IK Mikbug-compatible monitor; room for 8K Basic in ROM; upper- and lower-case graphics; single floppy disc drive; printer and high-speed tape interfaces. "Mountains of software available." Test tape with CUTS test tones, test message and games with kit. — *From £275 plus VAT*

IMSAI

VDP 40: 32K or 64K RAM memroy; 9in. display screen, standard keyboard. Two 5¼in. floppy disc drives; serial I/O. Full software support, and packages available for the VDP 42, which has larger disc capacity. Packages for VDP 80 could be converted for smaller systems. This would be from about £700 per package. Two main dealers in the country. — *£4,507 for 32K model. £4,950 for VDP 42*

INTERTEC

Superbrain. CPU Z-80A, 64Kbytes, RAM, 256bytes static RAM, 1Kbytes ROM, floppy disc storage capacity formatted on 2 Shugart double-density drives, optional external 10 to 300 megabyte hard disc storage using optional 5100 bus adaptor, RS232, CPM, Microsoft M Basic 5, Cobol, Fortran, C Basic. 4 U.K. distributors. — *From £1,950*

ITT

2020. Identical to Apple II. Min. size: 4K memory; 8K ROM; keyboard, monitor, colour graphics, mini assembler; Powell card; RF Modulator, games, paddles and speaker; Max size: 48K with floppy discs and printers. Basic, Assembler, games, business packages. Generally suited to any type of application. Fifteen wholesalers, including Fairhurst Instruments. — *From £827 to £3,003 for 48K, two floppies and Printer*

KEMITRON ELECTRONICS

UBS 3000. Z-80, 1K to 64K RAM, Kemitron bus, operating system from 1K machine code monitor in ROM to full disc system, CP/M, Basic, Fortran, APL, Pascal, 5¼in., 8in. and hard discs, as many ports as required up to 256. Kemitron (0244) 21817. — *Bareboards from £640 rising to £4,000 for full system*

LUXOR

ABC 80. Min size: 35K with keyboard, CPU 12in. screen and cassette. Max size: 40K RAM with discs. Z-80 processor, loudspeaker with 128 effects, real-time clock. Options: printers, plotter, discs, module cards, digitiser, modem. 60 compatible I/O memory boards. Software: Basic with resident editor; assembler; games; business and educational packages. Personal computer aimed at home market, small business and education. CCS Microsales is U.K. agent and is looking for distributors. — *£795 plus VAT*

MICROMATION

Z-Plus Systems 1,2,10 and 20. Z-80, 64K RAM, S-100 bus, CP/M(3), MP/M(14) Cobol, MBasic, Fortran, APL, PL/1, Pascal, floppy discs and 8in. and 14in. hard, two serial and six parallel ports. Rostronics 01-870 4805. — *£3,950-£8,550*

MICRONEX

Pixelplotter MX-100. Z-80A, 64Kbytes program plus 32Kbytes graphics store, program store expandable in 74Kbytes increments to 16MB, S-100 bus, CP/M — 2,0 FDOS standard — Pixel graphics display system, 8in. dual drives, option of 5MB cartridge disc and 5MB fixed platter, four parallel and three serial RS232. Micronex 027-589 3042. — *From £3,485*

MICRONICS

Micros. Typical size: 1K monitor; 47-key solid state keyboard; interfaces for video, cassette, printer and UHF TV, serial I/O, dual parallel I/O parts; 2K RAM; power supply. 2K Basic; British-designed and manufactured system. Claimed to be the cheapest data terminal — a system with an acoustic coupler and VDU for £1,020. Prospective applications for small businesses, process controllers and hobbyists. Manufacturer is sole distributor (01-892 7044). — *From £400, assembled*

MICRO V

Microstar. Single box with twin 8in. floppy discs, 64K RAM, three RS232 serial inputs, STARDOS operating system enables system to have three VDUs, plus a fourth job running simultaneously. Word processing software available. Packages being developed include invoicing system, payroll, accountancy type system. Price includes a reporter generator language. Imported by a Data Efficiency subsidiary, Microsense Computers, Microsolve is London agent; other distributors being arranged. — *£4,950 machine and software*

MIDWEST SCIENTIFIC INSTRUMENTS

MSI 6800. Min size: 16K memory Act I terminal; cassette interface. Max size: three disc systems — minifloppy system with triple drives of 80 bytes each and 32K memory, large floppy system with up to four 312K-byte discs and 56K of memory mounted in a pedestal desk, or hard disc system with 10MB and 56K. Basic interpreter and compiler; editor; assembler; text processor on small disc system. American-designed system being manufactured increasingly in the U.K. — *Basic system: £1,100 (£815 as kit); Minidisc, £2,500; floppy disc £3,200; hard disc, £8,000-£12,000*

MSI 6800A System 7. 56K RAM. Dual micropolis mini-floppy disc drives each with the capability of storing 320Kbytes of information, and runs as a standard 3 operating system: Flex, MSI, DOS, SDOS, full supporting system software is available for each of the three operating systems. — *From £4,500*

System 10. System 7 with 107B hard disc. Sole U.K. agent is Strumech (SEED). Tel: (05433) 4321.

MODULAR BUSINESS SYSTEMS

Tutor. 8085A, 32-64K, Intel Multibus, CP/M, 2K ROM bootstrap loader — transparent — option of 512 × 250 graphics, 2 × 164K 5¼in. floppy discs expandable to 4 × 256K 8in. Two serial RS232C ports, 24-bit parallel TTL programmable port. — *From £2,500*

Elite. 8085A/8086/series 3000 bit slice, 32-256KRAM, Intel Multibus, CP/M, 2KROM bootstrap loader — transparent — 512 by 250 graphics, 5¼in. floppy discs to 24MB hard, RS232 and 24-bit TTL programmable port. MSBL (0532) 505719. — *From £5,400 to £25,000*

NASCOM MICROCOMPUTERS

Nascom I. Min size: CPU; 2K memory; parallel I/O; serial data interface; IK monitor in EPROM. Max size: CPU, 64K memory, up to 16 parallel I/O ports. Mostly games, but also a dedicated text editor system written by ICL Dataskil. Nascom is working on large versions of Basic, and 8K Microsoft Basic should be available soon. Eleven distributors in U.K. Nascom is negotiating to increase the number. (Reviewed January, 1979). — *£165 exc VAT*

Nascom 2. Z-80A, 1K RAM, Nasbus, 8K Basic and 2K monitor plus 2K character generator, Basic and assembler, low- and high-resolution and colour graphics, 5¼in. single or twin floppy discs, parallel port, serial port RS232, one Kansas City cassette port. Nascom (04427) 74343. — *From £295*

SHOPWINDOW

NATIONAL MULTIPLEX

Pegasus. Min size: 48K, Z-80; double-density floppies (320KB); S100 bus; 12in. CRT; 58-key keyboard; two serial and one parallel interfaces; bi-directional printer. Options: 8in. drives; 1-2MB additional drives; digital recorder 9,600 baud. Assembler, Cobol, Fortran, Extended Basic, General business package available as well as text editing and mailing list. All run under CP/M. Suitable for education, business and home users. London Computer Store (01-388 5721) sole supplier.

£2,700 exc VAT

NETRONICS

Elf II: single-board computer in kit form or assembled, RCA Cosmac 1802 processor, hex keyboard, 256 bytes RAM; options include up to 64KB, ASCII keyboard, cassette and RS232 I/O, and video output. Machine code or Tiny Basic. Promoted as a teaching system in minimal form, but expandable for more general use. Sole U.K. distributor HL Audio (01-739 1582).

Basic kit £79.95. Assembled £99.95 I/O board £35

Explorer 85: Min size: 4K. Max size: 64K. 8085A processor, VDU board, ASCII Keyboard, S100 expansion. Cassette, RS232, TTY interface on board. I/O ports, programmable timer. Disc software, Microsoft Basic on cassette, 8080 and Z-80 software can be used. Aimed at hobbyist, OEM and small business. Available from Newtronics (computer division of HL Audio).

From £297 plus VAT

NEWBEAR

7768: CPU board, 4K memory, cassette and VDU interfaces. Range of Basics and games. British manufactured system for hobbyists. Expandable to 64K memory available only in kit form. From Newbear in Newbury and Stockport.

From £45

NORTH STAR

Horizon. Min size: 16K memory; Z-80A processor, single minifloppy disc drive (180KB). max size: 56K memory, tour minifloppy disc drives (180KB), any acceptable S100 peripheral boards. Basic (includes random and sequential access), disc operating system and monitor. Options: Basic Compiler, Fortran, Cobol, Pilot, PASCAL and ISAM. The system is suitable for commercial, education and scientific applications. Application software for general commercial users. Twenty distributors. (Reviewed April, 1979).

£995 to £2,500

OHIO SCIENTIFIC

Ohio Superboard II. Min size: 6502 processor, 8K Basic in ROM; 2K monitor in ROM; 4K RAM; Cassette I/F, full keyboard; 32 × 32 video I/F, 8K Basic in ROM, Assembler/Editor; American single-board system with in-board keyboard. Aimed at hobbyist/small business. Ohio makes games, personal maths tutors, and business programs. This and other Ohio products have six U.K. distributors. (Reviewed June, 1979).

From £150

Challenger Range. 6502, Z-80 and 6800, 4K-56K RAM, OSI 48-line bus, 2K Basic support and 8K Microsoft Basic, 161 fixed graphics characters, 5¼in., 8in. and 10-74MB hard disc, up to 16 ports. CTS (0706) 79332.

£155 to £7,500

PANASONIC

Panasonic. 8085 CPU, Integral 24 × 80 video. Full keyboard with 21 programmable control keys, 10-key numberic pad, cursor controls. 3 × RS232 I/O channels, dual-floppy integral discs. 56K RAM, 4-channel DMA, models vary as to disc drives. JU 700 2 × 5¼in. SD/SS = 140K £4,150, JU 740 2 × 5¼in. DD/DS = 580K £4,500, JU800 2 × 8in. SD/SS = 500K £4,750, JU840 2 × 8in. DD/DS = 2MB £5,500. Main U.K. dealers: Panasonic Business Systems 01-262 3121.

From £4,150

PERTEC

System 1300. Min size: 32K memory; dual minifloppy discs 71 bytes each, formatted; serial interfaces. Max size: 64K memory; four serial parts. Basic (single and multi-user), Fortran, Cobol. The hardware for compelec Altair systems is from Pertec but the software is Anglo-Dutch. Sole distributor Compelec (01-580 6296).

£3,000-£5,000

PROCESSOR TECHNOLOGY

Sol. 808-based S100 microcomputer packaged with cassette and video interfaces (including graphics), keyboard with numeric pad, and 16KB RAM. Basic, assembler, word processors. Floppy disc systems available. Several distributors including Comart (0480 215005), which can offer nationwide maintenance contracts. (Reviewed July, 1979).

From £1,750 (excluding monitor and cassette). Complete floppy disc systems with word processing about £5,000

RAIR

Black Box. Min size: 32K memory dual minifloppy discs, 80K bytes each; two programmable serial I/O interfaces. Max size: 64K memory; eight serial interfaces; IMB disc storage (or 10MB hard disc); range of peripherals. Basic, Fortran IV, Cobol, Hardware distributors are being signed and agreements made with software houses to add software.. A warranty and U.K. wide on-site maintenance is given. From manufacturer (01-836 4663) and systems houses.

From £2,300

RESEARCH MACHINES LTD

380-Z. Min size: 4K memory; 380-Z processor, keyboard. Max size: 56K memory. Options: cassette, single or dual minifloppy discs, dual 8in. double-sided discs (IMB); serial interfaces; parallel interfaces; analogue interface; printer available. Basic Interpreter, Z-80 Assembler; interactive text editor; terminal mode software; data logging routines; CP/M, DOS, text processor, CBasic, Fortran, Algol, Pilot, Cobol, CP/M users' club library. Sold principally to higher and secondary education, and for scientific research, data processing and data logging. Available from Sintel and the manufacturer. (Reviewed December, 1978).

From £830-£3,500

280-Z. Board version of 380-Z system, 4K or 32K (identical in performance to the 380-Z). Interfaces; software as for 380-Z.

4KB version at £722

RCA

Cosmac. 1802 micro with hex keypad and output to TV screen. Assembler and Machine code programming; options include Tiny Basic. Available by mail order from HL Audio (01-739 1582).

Kit £79.95 Assembled £99.95 exc VAT

ROCKWELL

Aim-65. Kim-compatible with full keyboard and on-board printer. 1K or 4K RAM. The 4K version is described as a development system rather than a personal computer. Assembler, editor, Basic. Available from Pelco, Microdigital and Portable Microsystems. (Reviewed July, 1979.)

1K — £249.50
4K — £315

SCIENCE OF CAMBRIDGE

Mk 14. SC/MP processor, 256 bytes user memory; 512-byte PROM with monitor program; hex keyboard and eight-digit, seven-segment display; interface circuitry; 5V regulator on board. To this can be added: ¼K RAM (£3.60); 16 I/O chip. (£7.80); cassette interface kit (£5.95); cassette interface and replacement monitor (£78.95); PROM Programmer (£9.95). No software provided but a 100-page manual includes a number which will fit into 256 bytes covering monitors, maths, electronics systems, music and miscellaneous. Based on American National Semiconductor chips. Science will soon have a VDU Interface and large manual on user programming. Mail order from manufacturer (0223 312919) and by selected dealers. (Reviewed May, 1979).

£39.95 basic

SHOPWINDOW

MICRO ADS

are accepted from private readers only, pre-paid and in writing, 20p per word, minimum charge £2.

Nanocomputer plus power supply, unused. £240 o.n.o. Phone John Reid, Aylesbury 86500 (work hours).

Acorn System I, (6502), Hex keyboard, 7 Seg. display, cassette interface, PSU, for machine code programming. £80. — 059682 345.

APPLE II SOFTWARE On screen shape designer/shapetable maker. Excellent program. Big timesaver. £5. G. Kennett, 5 Bramdean Gardens, Lee, London SE12.

Unused Thomas Electronic Organ, cost £600 (Exchange value negotiable) offered in full or part exchange for micro-computer. Ring 0253 36646. If no reply evenings ring mornings and vice versa (Shift worker).

TRS-80 Level I 16K RAM For Sale. Numerous games tapes, manuals, tape player. Plugs straight into your own TV. Worth over £600. Offers around £420. Almost new, still boxed. Phone: 01-668 6450 Evenings.

EXIDY SORCEROR 32K with BASIC rompac, video, manuals, games cassettes, etc. Bought June 1979. Used only by owner. £800 o.n.o. R. Cullyer, Chandler's Ford. 69565 after 6 p.m.

OSI Superboard + UK101. Programs — Startrek*, 3D Space Maze* (£3.00); Tank Battle, Zombies, Life (£2.50); Disassembler, Bioplan (£2.00) and many more. Peripheral Interface kit comprising Cassette Control Unit + Parallel Port + Programmable Sound Generator — £48.95. (*not available for UK101). Velvet Software, 26 Colesbourne Close, Worcester.

Nascom 1. 8K Microsoft Basic, 16K Memory, Vero Case, Keyboard Cabinet, PSU. Documentation . . . £325 o.n.o. Phone 0704 28472.

KITS MY HOBBY! Ultimatum from wife — Sell! Nascom II £180 ZX80 £85 SWTEC 68 £600 Heathkit HW14 £350 7768 Boards half-price many S100 boards two thirds price, Aim 65 VIM I KTM 2 all two thirds, 9900 CPU board £100, Cherry Keys 15p. Softy £80, 8K Memory Board 32/64 Pin Male Socket £60, almost new Scopex 4D25 oscilloscope £400, no offers. Gem 365L organ £350. Loads TTL chips, no fish, could possibly arrange payment Barclaycard. Phone Bedford 46032.

Texas Instruments TI-58 Programmable calculator with technical books. £50. 13 Rectory Drive, Wootton Bridge, I.O.W. Tel: 0983 882801.

Sorcerer 32K + Development pack + TV Interface. £595. Tel: Reigate 48906.

SHOPWINDOW

Applesoft Card £75; Apple Language Card (Pascal) unused £180; Autostart ROM£18. Tel: 01-898 6621 Evenings.

ASR33 TELETYPE £220, Cossor VDU £85, TTY35 Printer £28, IBM selectric printer £175, phone Edinburgh 031-669 3758.

8K Pet virtually unused £400 o.n.o. With renewed service contract £450. David, Evenings 02514-20812 (Fleet).

NASCOM I, 2 memory boards. 40K memory 2400 Baud cassette, case, Beefy Power Supply £300. Blackpool 692261 or 67091.

PLEASED WITH YOUR COMPUTER? As a business aid it can almost certainly do more. Send brief outline of requirements: Maurice Tait, Systems Contractor, 11a Old Town Street, Plymouth. (0752 21851, 0626 5815).

FED UP WITH YOUR COMPUTER? Bad for your business? Maybe I can help. Send outline of problem to Maurice Tait, Systems Contractor, 11a Old Town Street, Plymouth.

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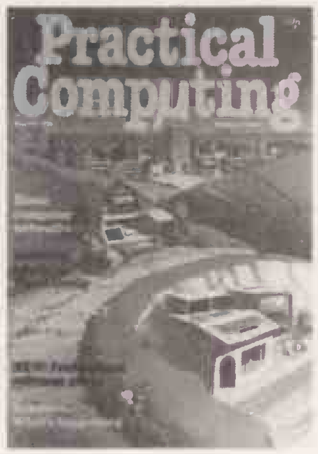

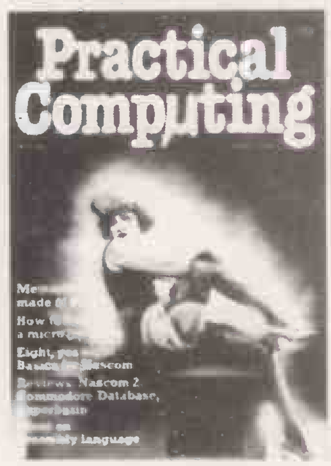

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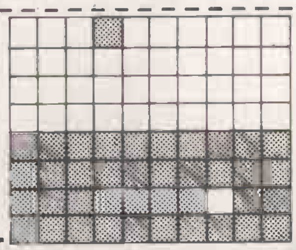

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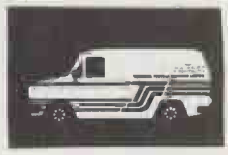

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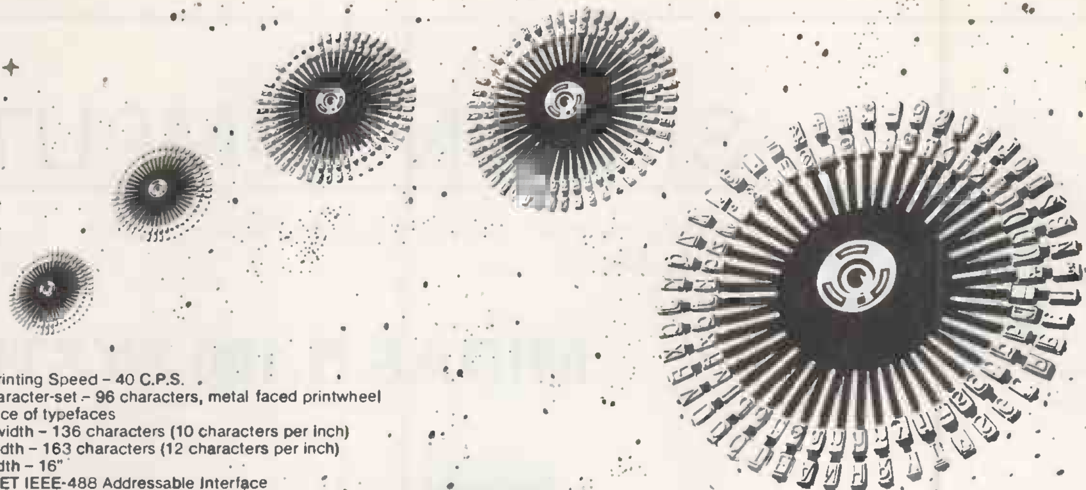

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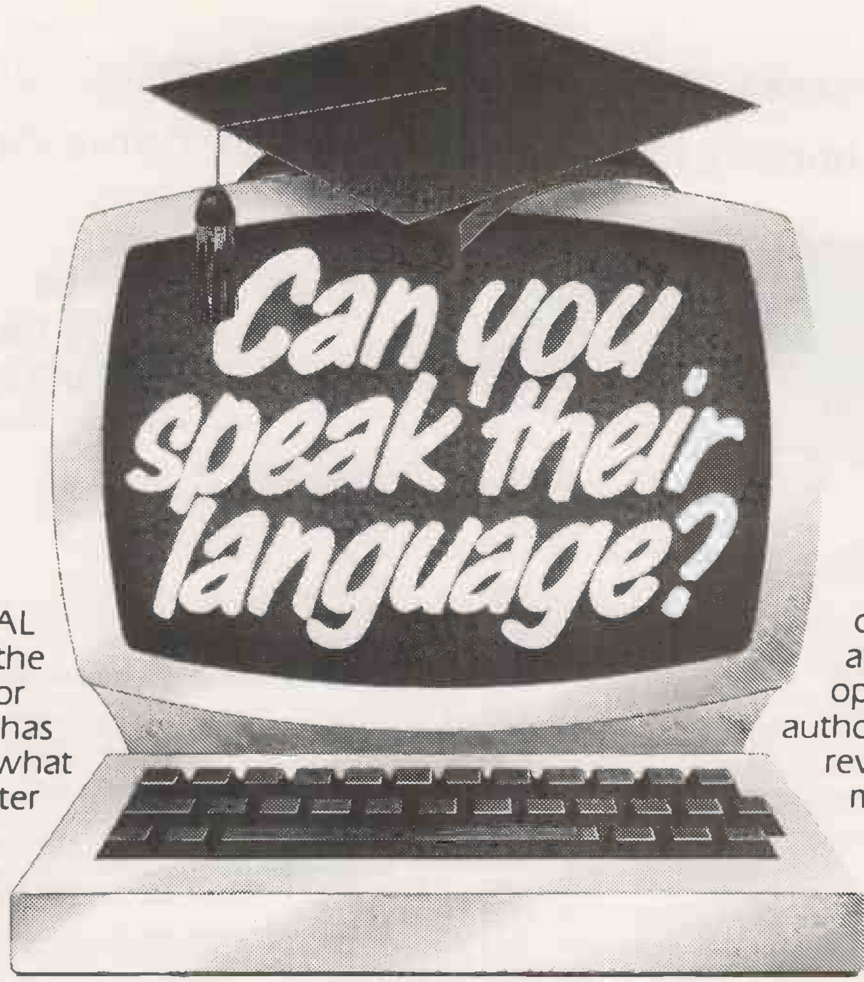

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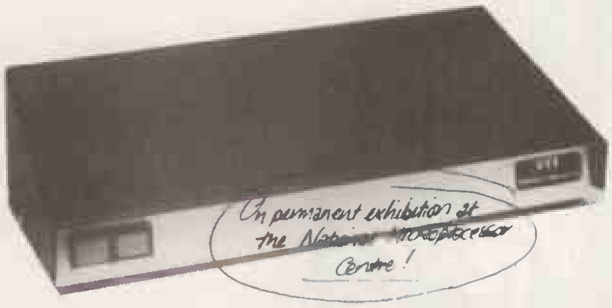

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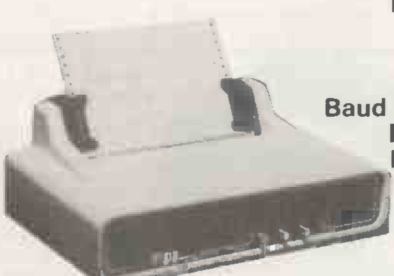

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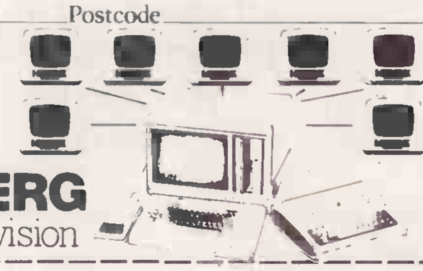

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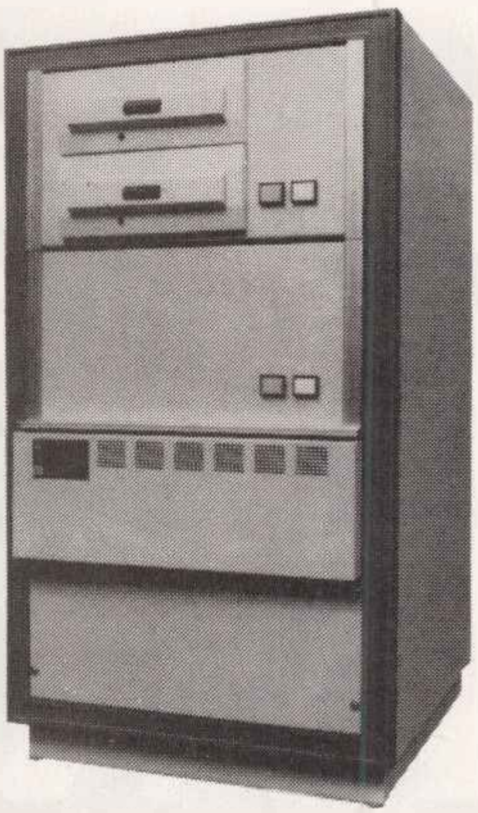

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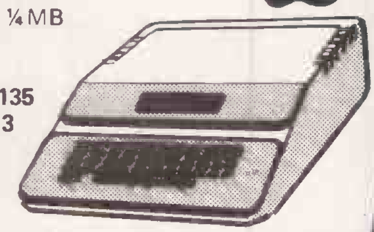

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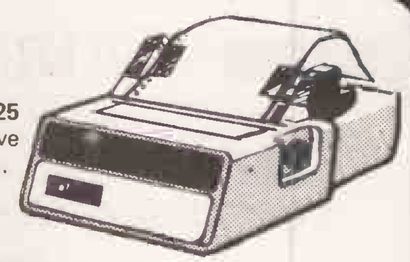

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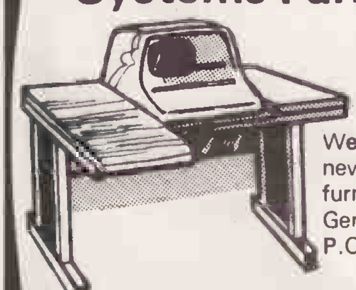

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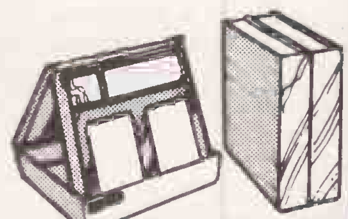

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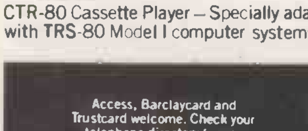

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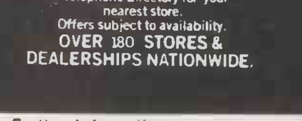

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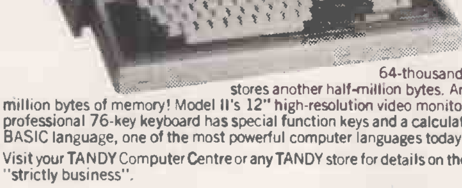

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☐ PASCAL/Z – Z80 native code PASCAL compiler. Produces optimised portable reentrant code. All interfacing to CP/M is through the support library. The package includes compiler companion macro assembler and source for the library. Requires 56K and Z80 CPU. Version 2 includes all of Jensen/Wirth except variant records .... £155/£15
Version 3 Upgrade with variant records and strings expected 2/80 .... £205/£15

☐ Ⓜ Ⓛ PASCAL/MT – Subset of standard PASCAL. Generates ROMable 8080 machine code. Symbolic debugger included. Supports interrupt procedures, CP/M file I/O and assembly language interface. Real variables ... NEW be BCD, software floating point, or AMD 9511 hardware ...ing point. Version 3 includes Sets, Enumeration and Recor... data types. Manual explains BASIC to PASCAL conversion. Source for the run time package requires MAC (See under Digital Research). Requires 32K. .... £135/£20

☐ TINY C – interactive interpretive system for teaching structured programming techniques. Manual includes full source listings .... £45/£30

☐ Ⓜ BDS C COMPILER – Supports most major features of language, including Structures, Arrays, Pointers, recursive function evaluation, linkable with library to 8080 binary output. Lacks data initialization, long & float type and static & register class specifiers. Documentation includes "C" Programming Language book by Kernighan & Ritchie .... £60/£10

☐ Ⓜ WHITESMITHS' C COMPILER – The ultimate in systems software tools. Produces faster code than Pascal with more extensive facilities. Conforms to the full UNIX Version 7 C language, described by Kernighan and Ritchie, and makes available over 75 functions for performing I/O, string manipulation and storage allocation. Compiler output in A-Natural source. Supplied with A-Natural. Requires 60K CP/M .... £325/£20

☐ Ⓜ POLYVUE/80 Full screen editor for any CRT with XY cursor positioning. Includes vertical and horizontal scrolling, interactive search and replace, automatic text wrap around for word processing, operations for manipulating blocks of text, and comprehensive 70 page manual .... £70/£12

☐ Ⓜ POLYTEXT/80 Text formatter for word processing applications. Justifies and paginates source text files. Will generate form letters with custom fields and conditional processing. Suport for Daisy Wheel printers includes variable pitch justification and motion optimization. .... £45/£10

☐ Ⓛ ALGOL 60 Compiler – Powerful block-structured language featuring economical run time dynamic allocation of memory. Very compact (24K total RAM) system implementing almost all Algol 60 report features plus many powerful extensions including string handling, direct disk address I/O etc. Requires Z80 CPU .... £110/£12

☐ Ⓜ Z80 Development Package – Consists of (1) disk file line editor, with global inter and intra-line facilities; (2) Z80 relocating assembler, Zilog Mostek mnemonics, conditional assembly and cross reference table capabilities; (3) linking loader producing absolute Intel hex disk file for CP/M LOAD, ODT or SID facilities .... £50/£12

☐ Ⓜ ZDT – Z80 Debugger to trace, break and examine registers with standard Zilog/Mostek mnemonic disassembly displays. Facilities similar to DDT £20 when ordered with Z80. Development Package .... £30/£7

☐ DISTEL – Disk based disassembler to Intel 8080 or TDL/Xitan Z80 source code, listing and cross reference files. Intel or TDL Xitan pseudo ops optional. Runs on 8080. .... £35/£7

☐ Ⓜ DISILOG – As Distel to Zilog Mostek mnemonic files. Runs on Z80 only .... £35/£7

☐ Ⓜ TEXTWRITER III – Text formatter to justify and paginate letters and other documents. Special features include insertion of text during execution from other disk files or console, permitting recipe documents to be created from linked fragments on other files. Has facilities for sorted index, table of contents and footnote insertion. Ideal for contracts manuals, etc. .... £75/£3

Software with Manual / Manual Alone

☐ Ⓜ POSTMASTER – A comprehensive package for mail list maintenance that is completely menu driven. Features included keyed record extraction and lab... NEW ...roduction. A form letter program is included which pro... neat letters on single sheet or continuous forms. Compat...le with NAD files. Requires CBASIC-2 .... £85/£10

☐ XASM-68 – Non-macro cros... NEW assembler with nested conditionals and full range of ...do operations. Assembles from standard Motorola MC68... mnemonics to Intel hex .... £115/£15

☐ XASM-65 – As XASM-68 for ...S Technology MCS-6500 series mnemonics NEW .... £115/£15

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☐ SMAL/80 Structured Macro Assembley Language – Package of powerful general purpose text macro processor and SMAL structured language compiler. SMAL is an assembler language with IF-THEN-ELSE, LOOP-REPEAT-WHILE, DO-END, BEGIN-END constructs .... £40/£10

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☐ CPM/374X Utility Package – has full range of functions to create or re-name an IBM 3741 volume, display directory information and edit the data set contents. Provides full file transfer facilities between 3741 volume data sets and CP/M files .... £125/£7

☐ Ⓜ BASIC UTILITY DISK – Consists of (1) CRUNCH-14 Compacting utility to reduce the size and increase the speed of programs in Microsoft Basic and TRS-80 Basic. (2) DPFUN – Double precision subroutines for computing nineteen transcendental functions including square root, natural log, log base 10, sin, arc sin, hyperbolic sin, hyperbolic arc sin, etc. Furnished in source on diskette and documentation .... £30/£10

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EFFECTIVE MARCH 1980

•Circle No. 306

July

●1-4 **Digital image processing.** Venue: London. Provides comprehensive introduction to latest digital image-processing techniques. Fee: £470 + VAT. Contact: ICSP U.K. LTD, Pebblecoombe, Tadworth, Surrey, KT20 7PA. Tel: (03723) 79211.

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●3-4 & 17-18 **Introduction to microprocessing.** Venue: Bedford. Introductory course on microprocessor using the TMS 9900 minimum system. Designed for engineers and technicians, non-technical, high-level language programmers, technical authors and instructors. Fee: £95 + VAT. Contact: Mike Hughes, Microprocessor Training Centre, Texas Instruments Ltd, Manton Lane, Bedford, MK1 7PA. Tel: (0234) 67466 Extn. 3718.

●7-9 **Second steps in microprocessors.** Venue: Portsmouth. Follow-up course to First Steps, or for those with a knowledge of microprocessors and includes extensive hands-on training. Fee: £99. Contact: Mrs A P Sizer, Department of Electrical and Electronic Engineering, Portsmouth Polytechnic, Anglesea Road, Portsmouth PO1 3DJ. Tel: (0705) 27681 Extn. 30.

●7-10 **Mirosoftware.** Venue: University of Sussex, Brighton. Techniques used in the implementation of software for microprocessor-based equipment will be reviewed and typical problems outlined, together with their possible solutions. Designed for engineering staff who are required to design and develop microprocessor-based equipment. Fee: £150 + VAT for non-members, members of SERT, IERE, or IEE, £125 + VAT. Contact: Janet Firmin, Society of Electronic and Radio Technicians, 57-61 Newington Causeway, London SE1 6BL. Tel: 01-403 2351.

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●9-11 **Microprocessor Pascal run-time support.** Venue: Bedford. For system designers, project engineers and programmers who can write single-process Pascal programs. Covers the use of the Texas Instruments Microprocessor Executive in the design and implementation of stand-alone, multi-processing systems. Fee: £250 + VAT. Contact: Mike Hughes, Microprocessor Training Centre, Texas Instruments Ltd, Manton Lane, Bedford MK1 7PA. Tel: (0234) 67466. Extn. 3718.

●10-15 **Microprocessor system design.** Venue: Portsmouth. Deals with the development of a microprocessor-based product from conception through to the completed hardware. Fee: £150. Contact: Mrs A P Sizer, Department of Electrical and Electronic Engineering, Portsmouth Polytechnic, Anglesea Road, Portsmouth PO1 3DJ. Tel: (0705) 27681 Extn. 30.

●11-12 **London Computer Fair.** Venue: Polytechnic of North London. Contact: Robin Bradbeer, The Polytechnic of North London, Holloway, London N7 8DB. Tel: 01-607 2789.

●14-18 **Introduction to the design of microprocessor-based systems.** Venue: Cambridge. Designed to give the basic techniques necessary for the design of microprocessor-based systems; 40 percent of course time is given to lectures with 60 percent hands-on practical design work. Fee: £240 + VAT. Contact: Course Registrar, Cambridge Microcomputers Ltd, Cambridge Science Park, Milton Rd, Cambridge. Tel: (0223) 314666.

●14-18 **Program Design: Advanced techniques workshop.** Venue: London. Includes advanced techniques of the data-structured-design method, and shows in detail how the method handles the special problems of on-line, real-time, and database systems. Fee: £495. Contact: The Registrar, Infotech, Nicholson House, Maidenhead, Berkshire. Tel: (0628) 39101.

●14-18 **8085 course: part 1.** Venue: London. Designed for engineers, teaching the fundamentals of microprocessors, with particular stress on the Intel 8085. Fee: £200. Contact: Robin Bradbeer, The Polytechnic of North London, Department of Electronic and Communications Engineering, Holloway, London, N7 8DB. Tel: 01-607 2789.

●15-17 **Computer-aided classroom instruction.** Venue: Salford University. The aim of the course is to show how desk-top microcomputers can be used to enable school children to explore problems in science, even if they have no knowledge of programming. Fee: £27. Contact: The Administrative Assistant, short courses, Room 110, Registrar's Department, University of Salford, Salford M5 4WT. Tel: 061-736 5843.

●16 **Introduction to computers and their application.** Venue: Polytechnic of the South Bank, London. Designed to give an awareness of the potential for computer applications within the small company. Participants will have the opportunity to use mainframe and microcomputers in informal, small groups. Fee: Members £50 + VAT. Non-members £60 + VAT. Contact: Training Department, LCCI, 69 Cannon Street, London EC4N 5AB. Tel: 01-248 4444.

●17-18 **16-bit microprocessors.** Venue: Portsmouth. Describes and contrasts, through lectures, demonstrations and hands-on sessions, the TMS9900, Z8000, M68000, M6809 and 8086 microprocessors. Fee: £95. Contact: Mrs A P Sizer, Department of Electronic and Electrical Engineering, Portsmouth Polytechnic, Anglesea Road, Portsmouth PO1 3DJ. Tel: (0705) 27681 Extn. 30.

●19-20 **Programming in Basic course.** Venue: Hallam Tower Hotel, Sheffield. Designed for those who possess or are considering using a microcomputer or minicomputer in their business and wish to learn how to write programs using the Basic programming language. Fee: £115. Contact: Dean Consultancy Ltd, 45 Canterbury Avenue, Sheffield, S10 3RU. Tel: (0742) 303054.

●22-24 **1980 Microcomputer Show.** Venue: Wembley Conference Centre, London. Fee: £1.50. Contact: Online Conferences Ltd, Argyle House, Joel Street, Northwood Hills, HA6 1TS, Middlesex. Tel: (09274) 28211.

●23-25 **Assembly-language programming.** Venue: Bedford. Follows the course on introduction to microprocessors. Centred round the programming of the TM 990/101-M microcomputer module in assembly language. Fee: £250. Contact: Mike Hughes, Microprocessor Training Centre, Texas Instruments Ltd, Manton Lane, Bedford MK1 7PA. Tel: (0234) 67466 Extn. 3718.

●25 **Microelectronics and microcomputers.** Venue: Worcester College of Higher Education. Practical course dealing with electronic systems, particularly with regard to microcomputers. No previous knowledge of electronics or computing necessary. Fee: £39. Contact: B H Whalley, head of educational technology service, Worcester College of Higher Education, Henwick Grove, Worcester WR2 6AJ. Tel: (0905) 422131. Extn. 53.

●30 **Practical introduction to microprocessors.** Venue: Cambridge. Covers the basics of microprocessors and how to use them, starting from first principles, with use of individual Nanocomputers. Fee: £50 + VAT — free if you buy a Nanocomputer. Contact: Course Registrar, Cambridge Microcomputer Ltd, Cambridge Science Park, Milton Road, Cambridge, CB4 4BN. Tel: (0223) 314666.

Books

Beginners' guide to microprocessors and computing

by E F Scott, published by Bernard Babani (Publishing) Ltd.
Paperback, 121 pages, £1.75.
ISBN O 900162 87 2

THE AUTHOR'S preface describes it as an introduction to the basic theory and concepts of binary arithmetic, microprocessor operation, and machine language programming for CSE and O level examinations, technicians, engineers and hobbyists. I cannot really recommend it for any of these purposes.

The book consists of three chapters, a glossary, an appendix describing some of the INTEL 8080 instruction set, and 12 questions and answers. There is no index. Chapter one describes binary arithmetic, Binary Coded Decimal, ASCII and the difference between serial and parallel data transfer. Chapter two describes basic microprocessor architecture and chapter three programming.

The hardware descriptions and machine-language programming examples are extremely basic and not very well explained, but they are, at least, accurate. The high-level language section is poor.

Conclusions

● A newcomer to computing deserves a far better introduction than this.

A hitch-hiker's guide to the Pet

By C Preston. Petsoft 1979

A HITCH-HIKER'S guide to the Pet is a useful collection of software facts intended for those who want to do something a little out of the ordinary with their Pet. It should be of value to adventurous programmers in both Basic and assembler.

There are three sections. The first describes 21 useful memory locations and gives examples of the effects which can be achieved by inspecting and modifying them. The second describes 28 ROM subroutines and shows how they can be exploited.

The third section describes file handling on the Pet, showing how files can be read and written from assembler programs using ROM subroutines. An appendix explains how memory is used by Basic and gives the token values for Basic keywords and symbols.

The hitch-hiker's guide is well-written and easy to use, although prospective purchasers should be warned that it only refers to Pets with the new ROMs — old ROMs are completely different in the subroutine addresses.

Conclusions

● If you want to extend your use of a new-ROM Pet, the book can be thoroughly recommended for its detailed explanations and its lucid and straightforward style.

Case studies in systems analysis

By J P A Race, published by Macmillan, 112 pages.
Paperback, £3.25
ISBN O 333 23733 1.

SYSTEMS analysis is the study, design and implementation of computer-based systems. Typically the systems analyst's job may be to investigate the way a company performs part of its operation — order processing, stock control, sales-receipt analysis, fraud prevention — and to write a report describing in some detail a computer-based system which will meet the requirements.

The systems analyst must be able to absorb considerable detail about a firm's commercial operations; to identify and understand the essential elements by reading reports and talking to key individuals; to conceive, design and cost a suitable computer system; and to present his ideas effectively.

Case studies in systems analysis is designed to develop those skills, by providing 10, detailed case studies which can be used in the second half of a course in systems analysis, with groups of students formed into syndicates to address the chosen case study and with active tutorial support from the course teacher.

For those purposes, the book is excellent, although the necessity of issuing all the material in a single volume means that the author's notes on the case studies cannot be concealed from the students, which is a pity.

It also has great strengths as a self-study text. Read quickly, from cover to cover, it provides a good insight into the nature of systems analysis and can be recommended to anyone thinking of training in the profession.

Conclusions

● If you think you may be interested in systems analysis, £3.25 is a small price to pay to find out. Recommended both for entertainment and for serious work.

Martyn Thomas

A PRACTICAL GLOSSARY

Continuing the terminological gamut from T to W

TTY
Abbreviation for Teletype — and sometimes by extension for Teletypewriters in general.

Turnkey
A turnkey system is theoretically complete and ready to go — the user need only turn a key to start work. In practice, most small business systems are indeed started by a key, though some just have an on-off switch.

The essence of turnkey is that the user has minimal involvement in the protracted and technical process of designing, developing, testing and implementing the computer system which he or she will eventually use.

So the product sold to the customer should consist of a ready-programmed computer, complete with operating instructions and training as well as all relevant manuals. That is the way most computers are sold today — after all, you don't have to understand how a typewriter or a car works to use them.

In practice, it is rarely as simple as that. The user has to be sure that the all-in system on offer does in fact match all his requirements and that there will be no contractual problems when the software writers starts bickering with the hardware supplier. Still, it works reasonably well.

Two's complement
This is another esoteric idea; it's a method of expressing binary numbers where the negative of a number is generated by complementing the number and adding 1. The effect is such that you can then perform signed arithmetic with binary numbers.

UART
Universal Asynchronous Receiver/Transmitter. It is a serial-to-parallel and parallel-to-serial converter.

UNIBUS
A trademark of Digital Equipment, the top maker of minicomputers. The UNIBUS is the single high-speed bus in the PDP-11; it is a classic approach to minicomputer design, especially good because it really simplifies the connection of additional peripherals, more memory and upgraded processors.

Yet it has limitations — it is slightly complicated for micros, and the LSI-11 does not use the UNIBUS technique. That type of bus cannot cope with very complicated systems, so the larger Digital computers don't use it either.

Unit record
Normally means a thing which holds a whole record — the thing typically being a punched card or a ledger card.

A unit-record computer is a little-used term to refer to a visible-record computer, an outdated type of business computer which stores its information on ledger cards.

Univac
Today it is Sperry Univac, part of the big Sperry group and one of the top four computer manufacturers in the world. The original UNIVAC was the world's first commercially-produced, stored-program computer, bought by the U.S. Bureau of the Census in 1951.

The word is an immodest acronym for UNIVersal Automatic Computer.

You may note that these days, few people are prepared to describe the average computer as really universal or fully automatic.

USART
The Universal Synchronous/Asynchronous Receiver/Transmitter is an improvement on the UART in that it may be programmed to operate as a synchronous communications link.

USASCII
More popularly known as ASCII, though one stands for U.S.A. Standard Code for Information Interchange and the other is the American Standard Code for Information Interchange.

Users' group
It is obvious that a users' group is a bunch of people who own computers from a particular supplier, or who have some other kind of computing interest. This entry is to emphasise how valuable that kind of association can be, even when it is a manufacturer-inspired mouthpiece designed primarily for marketing purposes.

Users can discuss problems, swap solutions and programs, band together to obtain discounts on bulk-buying consumables, like paper and discs, and if necessary present a coherent front to force some action from the supplier. Buy a computer which has a decent users' group; then join it and use it.

Utility programs
They are a collection of programs for routine tasks — some systems offer utility subroutines as well, helpful functions which can be called by a user program.

Value
It is a number assigned to a variable.

Variable
A symbolic unit which can take a variety of values. In practice, it is anything which can be altered, measured or controlled and which can, therefore, have different values at different times.

VDU
Visual — or sometimes video — display unit. It is a screen-plus-keyboard terminal.

Vector
An address given to the processor which will direct it to a new area of memory. A vectored interrupt is an interrupt which causes a transfer to a particular interrupt-handler routine starting at the location specified — rather than leaving things to some generalised interrupt routine.

Verification
Checking input data to make sure it was entered correctly.

Viewdata
The Post Office leads the world with Prestel — that is the trade name for its viewdata system. In fact the Post Office coined the name viewdata originally for its service, but international committees intervened and decreed that viewdata should be the generic term.

So it is the generic term for a centrally-run information retrieval service whereby subscribers with the appropriate equipment can dial the computer, access particular pages of information on its database by using a numeric keypad, and obtain the information displayed on a modified TV set or a special terminal. Simple idea, but quite hard to implement.

One day, it will not be difficult to use screen-based personal computers as viewdata terminals. Then, maybe, we shall see a significant step towards the global village, an electronically-based, information-using society rather than merely an oil-based, energy-using one.

Virtual memory
This is a really clever operating systems technique whereby the programmer appears to gain a much larger memory space in which to work than is actually available.

What happens is that the operating system extends the possible addressing range to some or all of the disc-backing storage. It does this by transferring chunks of programs between disc and main memory automatically.

In theory, the program can address the whole address space without having to worry whether memory or disc is being referenced.

The problems are such that virtual memory is feasible only on reasonably large computers. The super-clever operating system needs a good deal of memory for a start, the disc transfers have to be quick and the processor itself must also be speedy.

Volatile
Non-retentive, usually applying to memory — MOS semiconductor memory loses its contents when you switch-off the power; that is its biggest problem. Core, is non-volatile, which means it retains its data. Some of the newer, and more expensive memory technologies are also non-volatile.

VSLI
Very Large Scale Integration. The next step up from LSI, usually taken to mean more than 10,000 circuits per chip.

Wafer
A lump of silicon is cut into thin slices on which semiconductor chips are fabricated. Those slices are also called wafers.

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nascom-2

nascom-1

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HARDWARE ● Industrial standard 12" x 8" PCB, through hole plated, masked and screen printed. All bus lines are fully buffered on-board.
INTERFACES ● Licon 57 key solid state keyboard ● Monitor/domestic TV interface ● Kansas City cassette interface (300/1200 baud) or RS232/20mA teletype interface.
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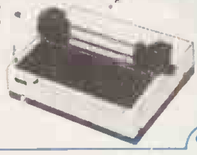

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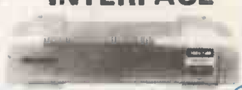

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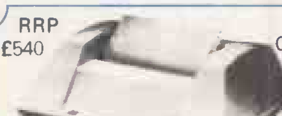

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The cassette interface is Kansas City standard at either 300 or 1200 baud. This is a link option on the NASCOM-2.
The RS232 and 20mA loop connector will interface directly into any standard teletype.
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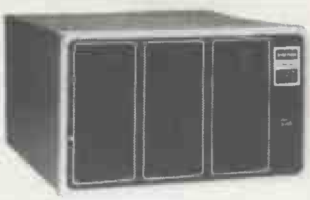

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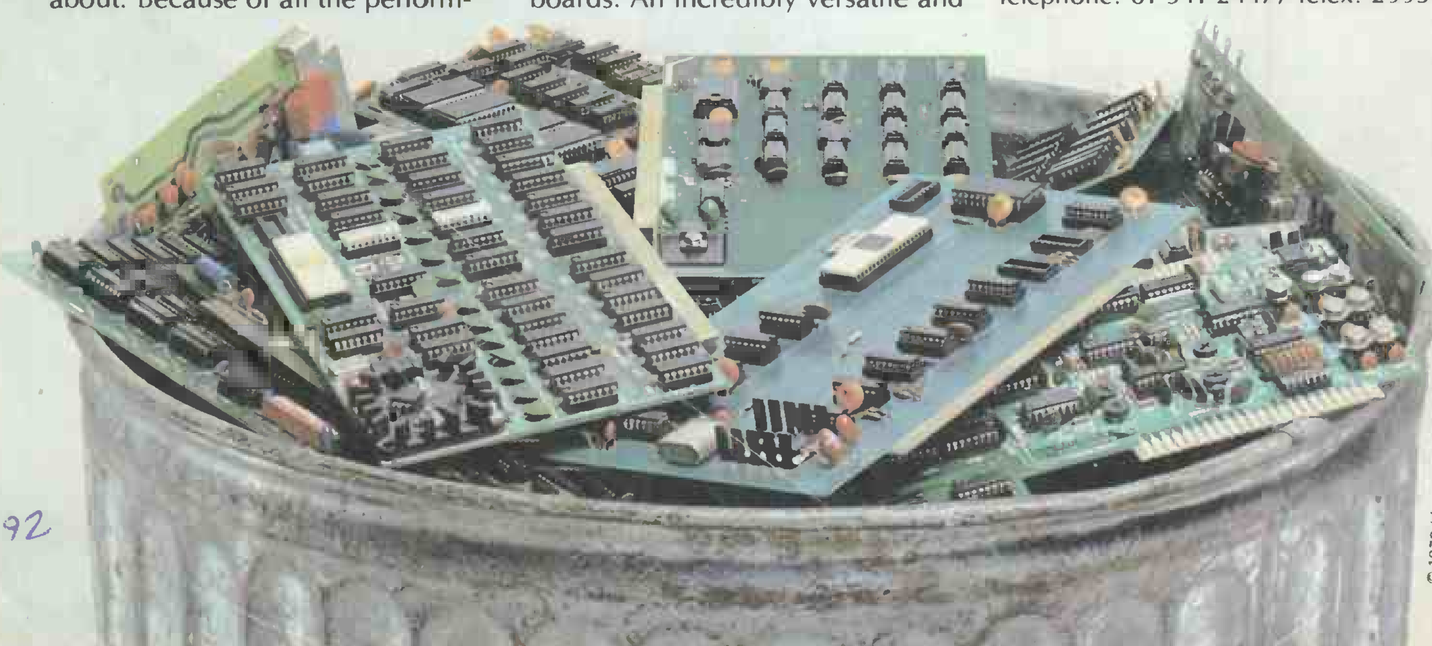

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