Practical Computing

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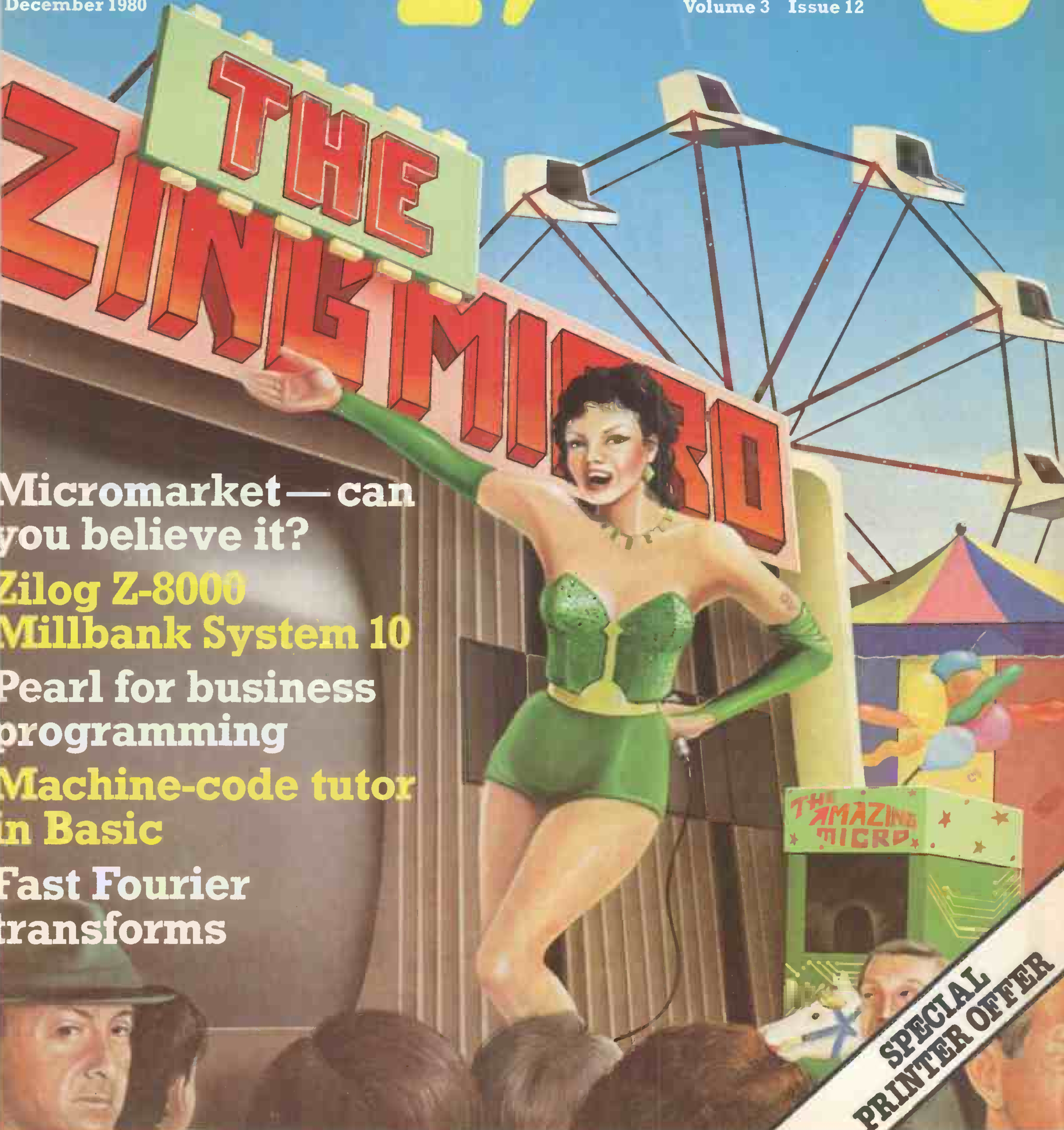

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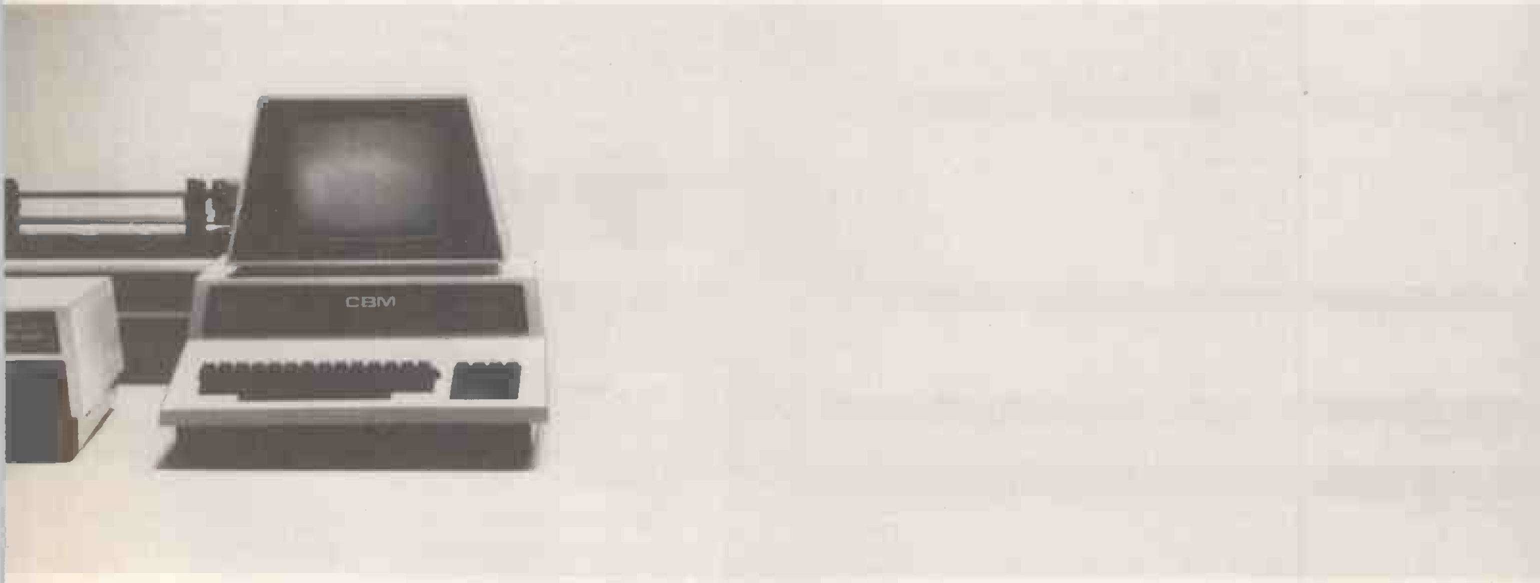

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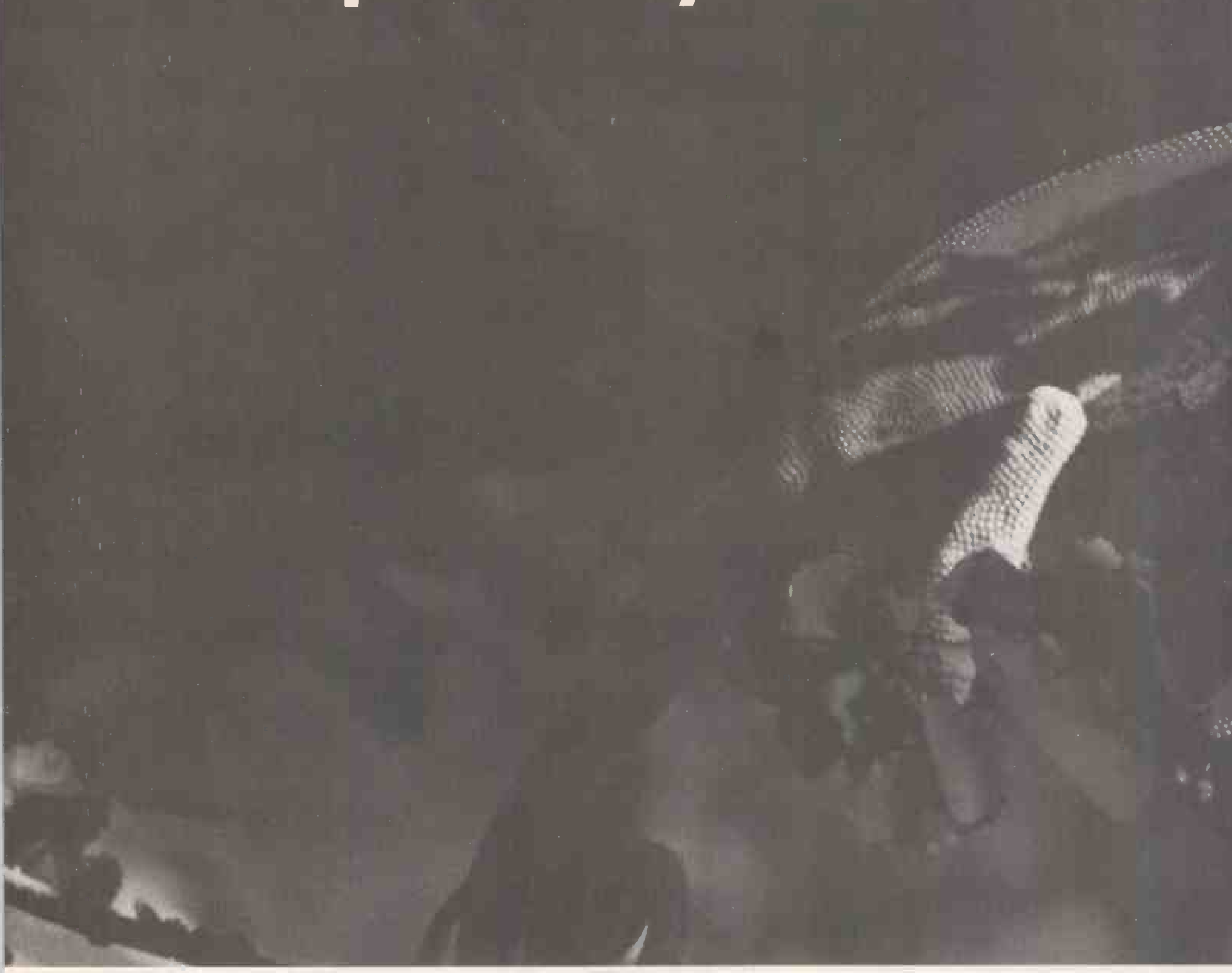

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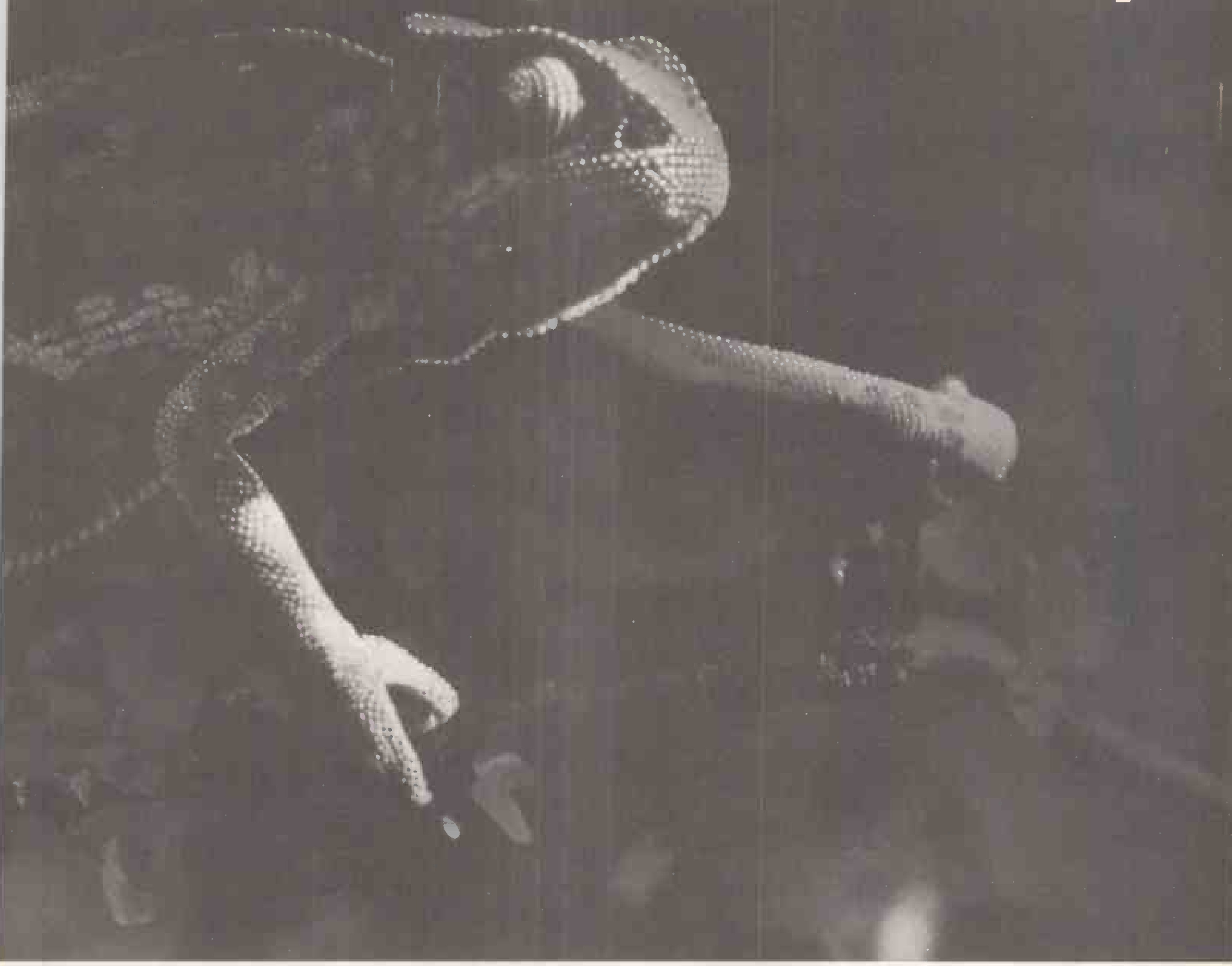

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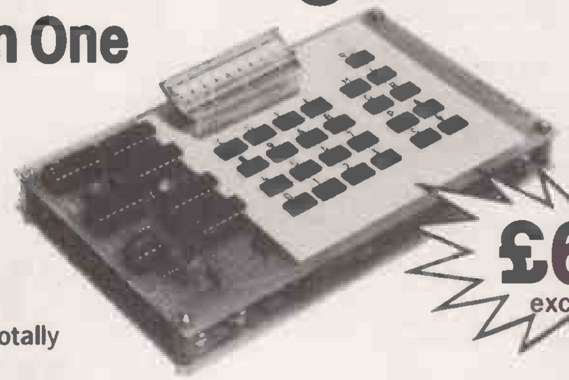

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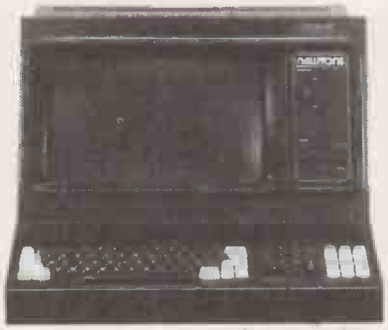

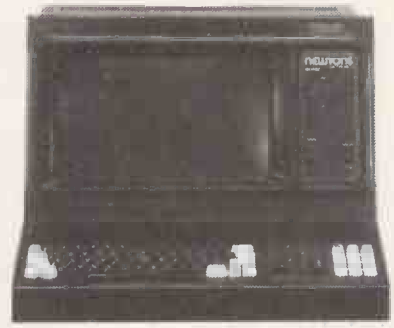

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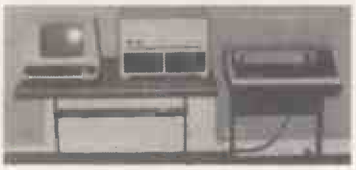

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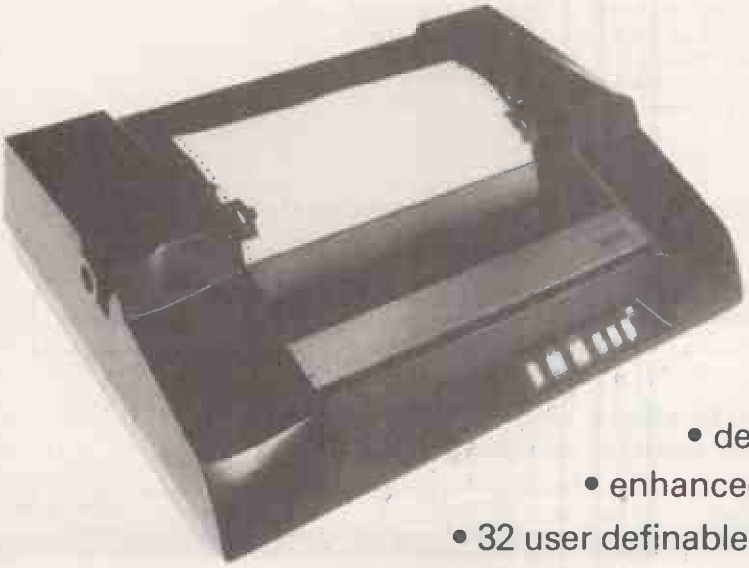

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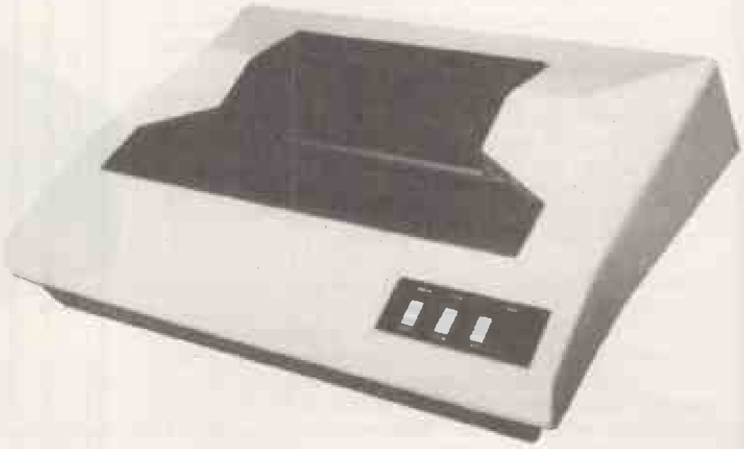

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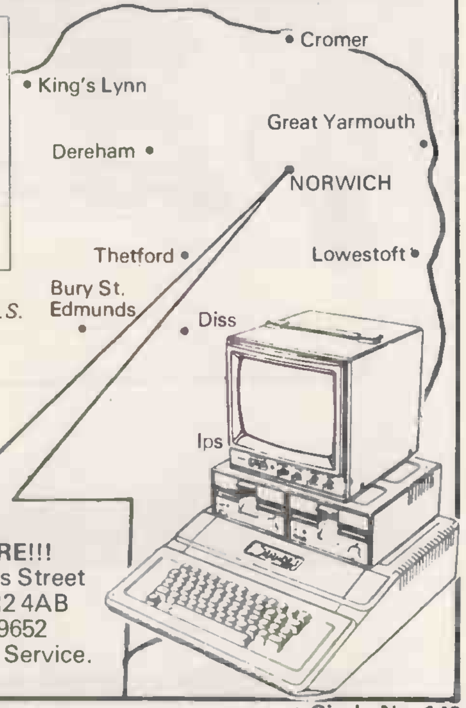

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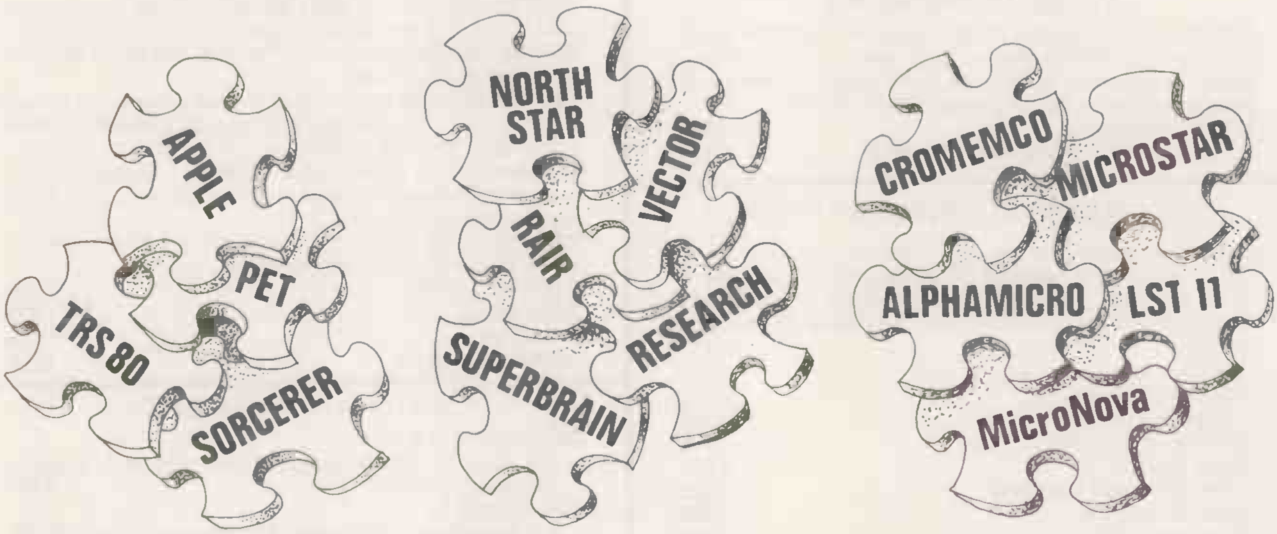

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Microcomputing in the recession

ALL AROUND us, industrial giants are wallowing and bellowing in the slime; their bones sinking down to be unearthed by future generations of industrial archaeologists. Big closures are announced in chemicals and consumer electronics and thousands of people lose jobs they probably assumed were recession-proof — solid, high-technology jobs which could not go wrong before the year 3000.

Is this the steepening of the descent into the final chasm of capitalism's total collapse, or is it just the winnowing of antedeluvian businesses which would have gone under one way or another? After all, when you think about it, the businesses which are going bust are the ones which seemed most threatening to a civilised way of life. Cars, nylon carpets, television sets — precisely the things whose very profusion seemed likely to make life unbearable.

More economical

In fact, economics seems to be forcing us to do what the conservationists have long been pleading. Since we cannot afford deluges of things, we must perforce save the materials which would have gone to make them. Since we cannot afford energy to waste in our homes or our cars we must make do with less; we must insulate, be more economical, use the train, walk — all very good things whether we are poor or rich.

Yet all that has a special importance for us in microcomputing. We are, for the moment, insulated from the slide. Microcomputing has grown from nothing to a £20 million industry in two years flat. Without a penny of Government money, support, comprehension or even awareness of our existence.

The darker side

There is a darker side to the micro story. The business started by satisfying the passion in some 20,000 breasts for computing. The announcement, two years ago, of kitchen-table computers for a few £100 caused a stampede. Now, the micro industry looks for its future to small businesses. There are, after all, more than one million of them in the U.K., and an enormous number abroad to which we may well sell our hardware and software.

Yet what, as they say in the advertising business, is our unique selling proposition? Very roughly it is this; a small business which spends £4,000 or less on a suitable micro and software can either fire an employee who costs £4,000 a year, or increase its productivity without taking on more staff.

Enormous flaw

The emergence of the micro is beginning to expose a great flaw in the public presentation of computers. They have, up to now, been such expensive, complicated machines which even their owners, the managers of big companies, never touched. They never learned the truth about computers — that they are work-hungry morons. Instead they were sold the myth that these machines are super-brains. They are not.

They are very good at doing very simple boring jobs. They are good at doing jobs which people in a civilised country ought not to have to do. The penetration of micros into the business world can only mean that less people have to copy-type contracts, type envelopes, look for flawed parts on the production line, tap out messages on Morse keys, sit gazing over a bank of TV monitors for lonely eight-hour shifts.

That is all very well, says the shop steward, "but my members would just as soon have a boring job as no job at all". One cannot fault him; but do they have to have no job at all?

Negative aspects

We should not be too alarmed if a set of jobs perishes which devoured natural resources. We can replace them with other jobs which deal in materials less burdensome to poor Mother Earth — which deal in information and ideas, in pleasures and emotions. That is our business in microcomputing. If, at the moment, our contribution is eliminating the negative aspects of industrial employment rather than improving the positive aspects that too, is not all bad — there is plenty of leeway to make up.

Providing, that is, that we can persuade ourselves, and later the world, that we are creating jobs. Any activity whose main contribution is job destruction is going to find itself, before long, in deep trouble. What can we say about job creation? If we believe that the micro business turns over £17 million, that implies 3,400 jobs of some kind or another, somewhere or another, that did not exist two years ago. That may not sound much, but we have hardly started.

Small businesses

If we reckon that small businesses employ eight million people, and that in the next five years, each five of them are to buy a micro, worth, say, £3,000, we ought to produce 960,000 jobs in our industry alone, let alone new jobs in businesses which would not have existed without computers to do the dirty work.

Another bonus is that many jobs in microcomputing will go to the young simply because they have the energy and adaptability to cope. We should also soon start to find substantial numbers of young people leaving school who have at least overcome humanity's first natural fright of VDU and keyboard. Many of them will be expert programmers already since it seems that nature intends 16 year olds to be machine-code programmers — later, they wake-up to the possibilities real life has to offer.

Job creation

We may also create some new jobs which would not have happened without computers to do the dirty work. The nearest analogy which springs to mind is the massive pop music industry which developed rapidly on the back of cheap, powerful semiconductor audio amplifiers. Just what those new jobs may be is not so easy to predict. We would very much like to hear from anyone who has created a genuine new job — not in the micro industry itself.

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.

Creativity exists

YOUR SEPTEMBER editorial paints a depressing picture. No creativity — nonsense. I believe that you were being deliberately controversial. I work as a consultant outside the commerical field and I know that the micro has made it possible to extend computing power to every industrial enterprise. We can do things now that were either commercially or technically impossible a few years ago.

I give you a few examples of graphics-orientated software packages which are the fruits of the great surge you deny exists. Those programs are of interest to the process designer or operator.

Mimic Diagram Generation — a program which, using a joystick to move high-resolution shapes and text, positions the shapes, e.g., valves, vessels, etc., and joins them. The resulting diagram may be stored as a text file on disc and may be dumped to a suitable printer.

Multi-vessel heating/cooling system simulation — a program which models the dynamic temperature status of up to 12 stirred vessels. Interactive process control of batch processes. A combination of all three which gives a visual representation in real time of the progress of a batch process.

Any of those programs may be run on a system costing about £2,000 with which any number of users can communicate over the international telephone network, miles away if necessary. Although the programs are rather technical, they have a general interest within a specific field. The creativity is being practiced but not published perhaps, or advertised.

Colin Grace,
Saffron Walden,
Essex.

Communication barriers

I AM an engineer myself and write in response to your editorial in the September issue. In the last few years, we have seen the cost of personal computing power fall as no other commodity since the German mark in the years of hyperinflation.

In relative terms, the cost of a sophisticated programmable calculator has fallen to a level where almost every university student, even sixth-form schoolboy can afford one. The advent of the mass-produced MPU has caused the same thing to happen to the microcomputer. The minicomputer has, however, not taken such a dramatic fall in price.

The control which the big computer manufacturers exercise in that field is enormous and they have prevented any of the fierce competition which has been instrumental in bringing down prices in the other fields of computing. Herein lies one of the factors which have prevented the real imaginative innovation in today's software market.

That lack of imagination was more than adequately demonstrated in the August *Practical Computing* software guide. A total absence of anything but commercial applications, word processors, stock-control programs and the like is a far cry from the expectations expressed by the pundits 12 months ago.

The hopes of the past have not come to fruition, lost or mislaid along the line, pushed out by the novelty of Space Invaders and chess games. It is a sad fact that the microcomputer market will die or dry-up unless new applications can be developed. The market cannot be sustained solely on inadequate stock control programs or the novelty of Star Trek and battleship games.

The scope for future development is almost endless. There is one application which one might have expected to have surfaced already and it is in the field of engineering. The lack of commercially-available software in that market is probably due to a language barrier. The language of the software designer has been for the most part commercial, both in terms of the computer language and the language used by the people involved, that between the designer and the end-user.

The engineer talks only of engineering, if he talks at all of computers or programming, 10 times out of 10 it will be in Fortran. In some respects, that has not been a bad thing, the limited exchange of engineering programs has not been hampered by any language barrier, unlike that in education where everybody speaks a different form of Basic.

If he talks of the hardware involved with computing, it will be a mainframe or at least a mini and that will probably be PDP-11. He still believes the micro has nothing to offer him, believing that they still work in either machine code or a very simple form of integer Basic. Neither of which would be of any use to him.

The engineer wants to use the computer as a tool, he is not interested in the computer itself and the intricacies of the program are probably meaningless to him. It is the end result which matters, a computer is just a means to that end. For the development of the market both in volume and quality the range and complexity of the user must be expanded.

To sell to the engineering market, the engineer needs to be convinced that the new developments in microcomputer hardware can provide him with a worthwhile and useful tool. The software to go with the hardware must also be developed. It must be dedicated to engineering applications, reliable and preferably in Fortran.

If the younger engineers are to be enticed into the home-computer market, the software must also be cheap. £75 for CP/M and a further £200 for a Fortran or Pascal compiler cannot really be justified with the number of systems in use today.

Communication between the software designer and the end-user is the only route to a better environment for us all.

R J Campbell,
Northallerton,
North Yorkshire.

Fostering pessimism

I READ with interest your depressing editorial in the September edition and the article on the financial failure of several firms by Martin Hayman.

I must say that as a commercial user of both micro and minicomputers, I am not at all surprised by the current pessimistic outlook. To some extent, it is fostered by publications such as yours. The following points may illustrate why that is so:

- Your constant presentation of machines such as ZX-80s, Pets, Apples, Tandys, etc., obscures the point that those installations are not suitable for more than the simplest of operations.
- You seem to ignore the mini market such as Digico Micro 16 although that type of equipment is not much more expensive in real terms and is certainly much more reliable and usable than the small equipment.
- Very many people are quite frustrated by the type and quality of the programs advertised and discussed in your magazine. Most of them are unusable and irrelevant in the average office.
- Your apparent insistence that programming is now a skill all can develop is quite incorrect and offputting. Proper programs need specialist skills just like any other profession. There are many disillusioned amateurs who have discovered that fact.
- The type of peripheral equipment pushed by the micromarket is virtually useless to the commercial user. It is generally unreliable, floppy discs, or too slow — the daisywheel printer.
- I do not think you are really interested in the one-off system.
- A serious approach to successful applications is needed if your publication and others like it are not simply to serve the

(continued on page 44)

SIX OF THE BEST

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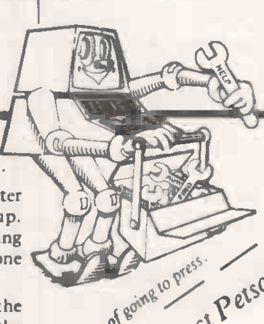

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(continued from page 42)

fun market. Perhaps that is, however, where you see your future.

To sum up, I think the sooner a more responsible and realistic attitude is adopted by the computer industry to actual applications, the better it will be for the expansion of computer usage. Perhaps your magazine could be re-named, Impractical Computing.

Martin Hawkins,
London WC1.

Mis-shapen compiler

I AM annoyed about an article in the September issue. Frankly, I feel that I have been misled by you, and I think that you have been misled by the author of the two-page article, *The shape of things to come.*

The article was not the only reason for my having bought your magazine, yet an important one, because I own and use an Apple Plus and a good shape-table compiler would have been very valuable.

Admittedly, the presentation of the article was good, but there are obvious mistakes in the program listing, e.g., line number 2000 instead of 1000. There are omissions, like a goto 200 after line 290, which are less obvious. That annoys me.

After spending a good deal of time debugging, it becomes clear that the program cannot do what is said it could do, because there are serious omissions in the algorithm.

For example, after, in one shape-table byte, one plot and one move, one again goes into plotting mode; the program tries to store that action into the same byte, which, in fact, is impossible. Also, a move-up, as the third action in one shape-table byte, cannot be used, a situation not covered in the program.

If the third action after starting a new byte is a plot, it does not fit in that byte and must become the first action in the next byte, leaving the seventh and eighth bit in the current byte at zero. That the program does, but, when the second action in that byte has been moved-up, leaving also the fourth, fifth and sixth bit to zero, the plotting routines will ignore those bits, so that this move-up should be repeated in the next byte, before other moves or plots. Again, the program fails.

Those situations, which will arise in every shape which contains moves as well as plots, are fully and clearly described in the Applesoft reference manual, and omitting them means that the shapes produced by the program are not the shapes you try to compile. It is my guess, that the author of the program never really tested it, or even worse, knew it does not work properly. I take it, that *Practical Computing* has not tested the program.

Yet the point I want to make is this. Thousands of people spend money on your magazine. Again, hundreds of people will sit down at their computers and try to make the program work for them.

It is not acceptable in that situation, that *Practical Computing* builds a two-page article, very attractively, from an untested and as shown, very incapable program. So, please take more care in the future; the rest of your magazine is worthy of it.

Dirk Rietveld,
Amsterdam, The Netherlands.

Re-compiled shape table

AFTER spending a few days working through the manuals supplied with my new Apple, I decided to implement Malcolm Banthorpe's shape table compiler — September issue — to design a lower-case character set.

Apart from the obvious typing errors, which I corrected while inputting the program — the first line 2000 should be 1000, > is missing from line 380 — I found a number of errors when I tried to run it: the high-resolution shape was not displayed long enough to see it;

When a shape was cancelled, the space it occupied was not released for re-use; the compiled shape was too large and rather distorted; even after correcting those errors, there was still something wrong, which became noticeable when I tried to draw the letter "f". Dry-checking a shape through the program showed that, under certain circumstances, the plot/move marker was being applied to the wrong vector.

I, therefore, re-designed the part of the program which creates the shape table, here are the amendments. Apart from the fact that, barring typing errors, this version works correctly, I believe that the use of a three-word array to construct the three vectors per byte makes it simpler to understand. That is just as well, since the line numbers are so closely spaced that I did not have room for REMs.

Incidentally, although Banthorpe recommends plotting small shapes and using the SCALE facility, that should be done only where space is at a premium or the shape consists solely of horizontal and vertical lines. That is because SCALE uses the vector associated with a plotted point to determine in which direction to expand. Try plotting an x on a five by five grid and displaying it with a scaling factor of 10. These amendments cure all the errors found and cancel the shape automatically if an illegal sequence is input — three consecutive upward moves or two upward moves followed by a plot.

```
101 DIM A(2)
290 A(J) = F*4 + C : J = J + 1
292 IF J < 3 GOTO 200
294 IF A(2) < 4 AND A(2) > 0 GOTO 300
295 Q = A(2) : A(2) = 0 : KEEP = 1
296 IF A(1) > 0 GOTO 300
297 KEEP = 2
298 IF A(0) = 0 THEN A$ = "X" : KEEP
     = 0:J=0: GOTO 355
300 POKE I, A(0) + A(1)*8 + A(2)*64 :
     I = I+1
310 A(0) = 0 : A(1) = 0 : A(2) = 0 :
     J = KEEP : KEEP = 0
312 IF J > 0 THEN A(J—1) = Q
315 GOTO 200
320 POKE I, A(0) + A(1)*8 + A(2)*64 :
     POKE I + 1, 0 : I = I + 2
325 A(0) = 0 : A(1) = 0 : A(2) = 0 : J = 0
330 HGR
335 HOME : INPUT "SCALE ?"; A$
355 IF A$ = "X" THEN N = N — 1 : S = S
     — 2 : I = TI : GOTO 130
410 GOTO 335
```

Apple owners with a disc drive may delete lines 2000 to 2080 and replace lines 419 to 510 with a simple display of the start address and size, which is all that is required to BSAVE the table.

Neil Lomas,
Crewe, Cheshire.

List-proofing Pet

I WOULD like to add some information to the note about list-proofing programs in your September issue Pet Corner. The note gives a technique of making programs list-proof by changing the line link in memory location 401. It is said that the line links are not used when the program is run, so that method of list-proofing will not affect program operation.

However, that seems to be true only if the program does not contain any GOTO or GOSUB instructions. For example, the following program, when made unlistable by the technique given, will not run. In fact, it will crash the Pet.

```
  Ø REM
 10 GOTO 100
100 PRINT "HELLO"
```

The note is also incorrect in claiming that the changed line links will be maintained when the program is saved and reloaded.

Glenn Kleiman,
Toronto, Ontario, Canada.

Microline 80 outlined

CONCERNING the Microline 80 printer made by Oki, on the hard-wired board in the printer are four movable jumpers, S1, S2, S3 and S4. Some of them are obliquely mentioned in the operators' instructions.

Without going into immense detail, the four jumpers, each having two positions in addition to being unconnected, give 36 possible combinations. What they provide as printed output is:

Eight combinations: English upper- and lower-case and numerals.

Four combinations: Japanese Kana script, with numerals.

Six combinations: Japanese Kana script, with other symbols.

Five combinations: overwritten script. 13 combinations: auto-test. In that mode, the printer prints continuously, not under software control. Output is either English characters, numerals, and graphic characters; or Kana characters and graphic characters; or English characters, Kana characters and graphic characters, depending on the combination of jumpers.

I should be happy to provide anyone with tedious detail on the combinations should they wish it; but I should be most interested to hear from anyone running a Microline 80 in a Z-80 system and who has managed to run the graphics characters under software control.

Robert Tasher,
Caersws, Powys.

Nascom's buyer brings cash and new projects

NASCOM has at last found a buyer — and the good news is that the buyer is prepared to inject more cash into the company to keep the existing machines going, and to develop and market new ones.

The buyer is Allteck Technology Initiatives which deals with "new products for industry generally" — among them, a Prestel adaptor which has now been transferred to the Nascom side of the business as part of a big drive to develop the company, restore confidence in the industry and among users, and to broaden its marketing base, particulary overseas.

Head of Allteck is Peter Mathews, who recently outlined his plans for the company and previewed some of the machines the new company is developing. Nascom will in future be known as Nascom International, which will probably be headed by Martin Tomlins, partner in Microprocessor Developments who has skills both as an accountant and as a software development engineer and would hence bring an unusual blend of talent to Nascom. In particular, Allteck will be looking for "financial discipline".

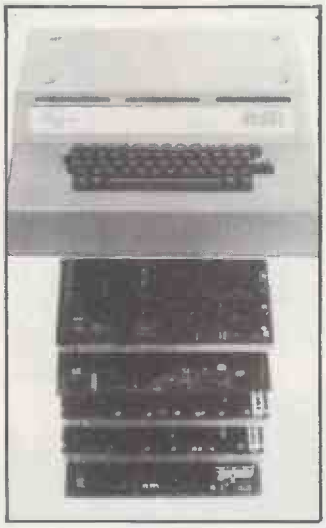
Nascom International will be a holding company; the U.K. side of the operation will be known as Nascomputers Ltd and a software house, Nasoft, is likely to follow soon.

Micro industry watchers had been expecting that a buyer would probably want Nascom only for its assets, which it would break-up and sell in small lots. Estimates of the value of Nascom at the time it was declared bankrupt — in March of this year — varied widely.

On the basis of the receiver's, Cork, Gully, figures, some put its value as low as £40-50,000. One of the criticisms was that there was an extremely unbalanced stock inventory, and that is confirmed to *Practical Computing* by Peter Mathews.

Mathews denies emphatically that he had gone by the receiver's figures in assessing his bid. Mathews reveals that he had raised his original bid of May in August, but will not say how much he finally paid to acquire the company, though informed sources believe the figure to be around £100,000.

Enthusiasts of the Nascom — and, as John Margetts' Users' Club effort to raise finance to buy the company showed, there are many — will be pleased to learn that Allteck is to continue with its kit models, even though it is to build a new low-cost machine with 64K RAM and standard ½MB memory to crack the business market, and a Post Office-approved Prestel interface.



The Nascom System 80.

It is also proposing to set the talents of the many hobbyists to use, and is inviting anyone who has bright ideas, either for hardware modifications or for complete software packages, to contact it. Peter Mathews says this is in an attempt to broaden the base of the Nascom applications and to involve users. Areas of particular interest are medical, commercial — cash registers — robotics, artificial intelligence, and automotive and other process-control applications.

In the medium term, says Mathews, Allteck would be able to finance much of its ambitious programme of development, which included a big thrust into Europe and the Middle East, and possibly the U.S. It is searching for European partners and is expecting to announce the identity of an overall sales manager shortly.

The level of operation which Mathews envisages is going to be costly and he has already talked with four other potential backers, including a government agency. Backing might well take the form of management expertise as well as cash.

Two of the top priorities, he says, were to establish a comprehensive library of software — he invites anyone who had converted packages for other machines to run on the Nascom to submit them — under the company name of Nasoft Ltd; and to improve the quality control at the assembly stage. He was aware, he says, of quality criticisms of recent Nascom products but was unable to confirm whether the Scottish assembly plant would continue. The Chesham office and plant would continue "for the foreseeable future".

Just how long the foreseeable future is, only time will tell. At the time of the announcement, Mathews and his team had been in charge for only a few days and had not yet even costed the existing products. There seems little likelihood, though, that there will be a reduction in any prices; the Nascom 2, as priced at the beginning of the year, is reputed to have had an extremely slender profit margin.

The Nascom International proposed range of products in detail:

- A disc-controller board which is Nas-Bus-compatible and capable of driving four Siemens double-density, double-sided 5¼in. mini-floppy disc drives.
- A write-protected dynamic RAM card, also Nas-Bus-compatible, with up to three banks of 16Kbytes.
- A programmable character-generator board with 2Kbytes of static RAM.
- Visiontel 1000, which converts a standard TV into a Prestel receiver with automatic dialling and the option of connecting either a cassette recorder to a small plain paper printer.
- A light pen.
- A programmable stereo sound generator.

Those products, as well as the Nascom 1 and 2, will progressively become available through the 23 Nascom dealers.

'New information technology department should be formed'

INFORMATION technology in all its aspects should be brought under one head within one Government department, the Cabinet has been told by a committee of high-ranking advisers. Computing, telecommunications and information processing are handled by various Government departments and should now be properly coordinated, the Government Advisory Committee for Applied Research and Development has told Prime Minister Margaret Thatcher.

The Government has accepted the conclusions of the report and is re-organising the Industry Department to form a new information technology department under a deputy secretary, Roy Croft. The committee had urged, though, that the head of the department should have full ministerial status, and points out that the world market for information technology is £500 million a year and rising by 10 percent every year.

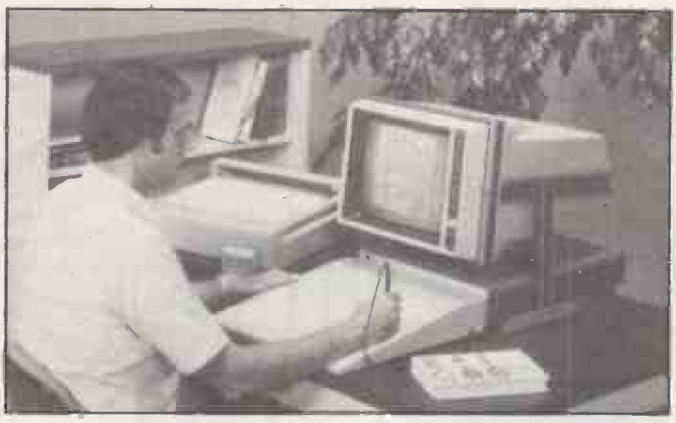
Among its potentially contentious recommendations are that the British Telecom should be able to borrow sufficient money to make it world-competitive if the tax payer cannot afford it; and that legislation — which would presumably also mean data-privacy legislation — should be handled by the new department.

U.S. chips to dominate

THE States will still be the dominant world manufacturer of chips in 1985, though its share of the world market, worth $38 billion, will decline slightly from 71 to 67 percent, predicts a report from a microelectronics consultancy.

World consumption of microchips will rise on average by 27 percent a year, and firms in Japan, the Far East and the Caribbean will take much of the business.

The report, from Mackintosh consultants, does not hold high hopes for European manufacturers. During the five-year forecast period, chip demand will rise by only 15 percent, while production as expressed as a percentage of the world market will fall from its present six percent to four percent.



A new graphics input tablet, suitable for drawing on a CRT, tracing graphics documents, or selecting from a menu, has been introduced by Hewlett-Packard. Interfaced through HP-IB — the Hewlett-Packard implementation of IEEE standard 488-1978 — the tablet is compatible with most Hewlett-Packard computers including the HP-85 personal computer. In the interactive-graphics mode, the tablet can be used as a CRT cursor mover to create or locate graphics data on a display, as in the case of an engineer using a computer to design electronics schematics or mechanical structures. In the graphics entry mode, line-drawings and charts can be traced on the tablet and then stored for future use. The tablet costs £1,071. Details from Wokingham (0734) 784774.

ZX-80 ROM withdrawn

THE ZX-80 8K Basic ROM promised by Clive Sinclair for the end of October has been withdrawn and orders for the chip are not being accepted. Clive Sinclair has denied that bugs in the new software are responsible and claims that he wants to incorporate some extra functions into the chip such as a printer drive. He says that he wanted to avoid ZX-80 owners the bother of having to buy yet another new chip next year.

The 8K Basic ROM was launched originally as a plug-in replacement for the 4K ROM Basic and was going to incorporate many extra functions such as full floating-point arithmetic with nine digits. The ROM will now be re-launched some time in the early spring in 1981.

Two new Chess Challenger models released for Christmas period

THE NUMBER of computer chess games on the market grows apace with two new versions of the Chess Challenger being released in time for the Christmas rush. The Sensory 8 Chess Challenger and the Voice Sensory Chess Challenger feature a touch-sensitive playing surface instead of the familiar built-in keyboard and display window. The new games see each move and record it automatically. A tiny light on each square of the chess board lights up according to which piece is being moved, showing the from-and-to position for each piece as it is played.

The Sensory 8 Chess Challenger features eight levels of play from beginners' to experts' and can be switched to any level at any time — even mid-move.

The Voice Sensory version Chess Challenger is similar but has nine levels of play and can speak all its own moves. Fortunately its Dalek-like tones can be switched off at any time.

It has a repertoire of 64 book opening variations, each averaging 15 moves into the game. It can also duplicate 64 of the world's greatest chessgames by players such as Morphy, Capablanca, Spassky and Fischer, or tell you each time you make a move which differs from that played by the master.

Both the games can operate from batteries or the mains supply and there is an optional printer unit to provide a hardcopy printout of every move made for later study. The Sensory 8 will sell for £129.95 and the Voice Sensory for £279.95.

The voice sensory Chess Challenger.

Micro threat to future of TV

SATELLITE broadcasting of English-language television programs, video tape recorders and the BBC are not the only things with which the independent television channels in the U.K. have to contend. According to a worried document just published by Granada television, entitled "Who'll be watching Coronation Street in 1984", droves of television addicts will start using their televisions for more productive entertainment such as playing with their home computers, Prestel and teletext channels.

Granada believes that by 1984 there will be 1.7 million television, Prestel or computer units in Britain and that the loss to the television channels will be around 300,000 of their audience.

APL versions available for Black Box and Superbrain

A VERSION of APL is now available for the Rair Black Box, priced at £150. Most of the primitives are implemented including innerproduct, monadic and dyadic format, and the ability to subscript arrays with arrays. Files are handled by the standard method of Shared Variables. It is capable of accessing memory by systems functions. Existing users of Softtronics APL can purchase the upgrade for £12.

APL can also be bought for the Superbrains with 64K of memory, with a conversion kit available for £475. Prospective users of the Superbrain who will need APL can buy a Superbrain complete with APL for £1,995 from Alan Pearman Ltd, Maple House, Mortlake Crescent, Chester CH3 5UR.

Government takes decision on data-privacy laws

THE Government seems to have reached a decision on the issue of data protection — but there is confusion as to which department will be responsible for framing suitable laws and enforcing them.

The U.K. representative on the Council of Europe's Committee of Ministers has undertaken to sign the European convention on data protection on January 28. It commits the U.K. to pass laws which enshrine a set of general principles, which include the right of a subject to look at files which may be held on him, to correct any mistakes in such files and — most importantly — to know if such a file exists.

Though the convention will be signed by Donald Cape of the Foreign Office, it is William Whitelaw's Home Office which will draw up U.K. laws on data protection. So far, there is no indication of what form such a law would take.

The EEC Committee of Ministers is relying on voluntary co-operation on the part of signatories to the convention, and admits that there may be disagreement as to whether the general principles are adhered to by a particular country.

Yet the issue has gained in importance with the Cabinet since a report by its own technical advisers, chaired by Sir Robert Clayton of GEC, urged the U.K. to introduce data-privacy laws without delay.

Since Sir Robert's committee includes high-ranking members of British industry, it is thought that the report will have more influence on speeding such laws than the Lindop Committee, which reported on the subject more than two years ago.

Industrialists are concerned that the lack of data privacy in the U.K. has earned the country the reputation of being a "dirty data" haven. Our European partners are prohibited by law from trading with U.K. firms which are thereby losing business.

The Lindop Committee, on the other hand, addressed itself more to the civil rights aspect of data protection, and the National Council for Civic Liberties has adopted the case by drafting what it believes would be suitable legislation.

The Cabinet advisers also recommended that all aspects of information technology be centralised under one head. At present, responsibility is shared among several Government departments and other public bodies. The Government is thought to incline towards appointing a Junior Minister within the Department of Industry who would, presumably, relieve the Home Office of its responsibility for data-protection laws, though the Home Office is not likely to relinquish its control of such a sensitive area of public security without a struggle.

Certain information already held on individuals by Home Office and police computers is thought to contravene the general principles of the EEC Council of Ministers convention. The final outcome is likely to be a compromise. New laws will be made to comply with EEC requirements, though the Lindop Committee's recommendation of a separate Data-Protection Authority is unlikely to be implemented for the moment.

More State involvement in micros urged by Labour report

A LABOUR report has urged greater Government involvement in the U.K. microelectronics industry and suggests that the biggest U.K. electronics group, GEC, could well be ripe for nationalisation.

The discussion document, published by a working party of the Labour National Executive Committee, and chaired by Dame Judith Hart, severely criticises the U.K. microelectronics industry, past governments' lack of foresight in grasping the initiative in the field, and urges much more Government intervention in the design, development and marketing of microelectronics — as well as a thorough programme of public education.

The report in particular criticises the "malign influence" of U.K. giant GEC and blames much of the decline of investment in development on the closure by GEC of Elliott Automation in 1971, "effectively ending the U.K. stake in the mass market from that day to this".

It contrasts other countries' policies with our own and concludes that the key to U.K. success in the rapidly-expanding world market must be increased Government backing, particularly for our own chip production.

Without our own production capability, it says, we shall be in an increasingly precarious supply position, and our manufacturers will not have available the kind of chips needed to build products that will succeed in the world market.

It strongly recommends that Inmos should receive more money if needed, and casts doubt on the ability of the traditional financial institutions — the City and the U.K. companies — to provide the backing or the planning to make a viable semiconductor industry: "Where private industry does not or cannot spend, Government must — a point accepted by the governments of every advanced economy but our own", it claims.

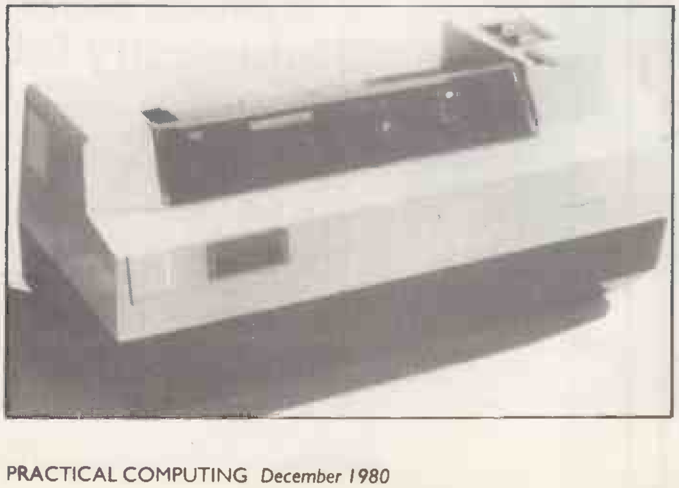
The document goes on to illustrate how a Labour policy would frame its objectives, in particular emphasising the need for planning agreements which take union needs into account and stressing that microelectronics technology should be directed towards "uses which have a social value" rather than those which have a military value. At present a great deal of British chip production and research and development funds are channelled towards defence needs.

Such planning control would go hand in hand with a widespread programme to improve public awareness.

Microelectronics, a Labour Party discussion document, published by the Labour Party, 150, Walworth Road, London SE17, price 80p.

Unihammer single-needle has full graphics capability

A SINGLE-needle matrix printer, the Unihammer, manufactured by Seiko, is now being sold in the U.K. for £199. The Unihammer speed is only 30cps, and it has a 128-character set, prints 80 character per line and has full graphics capability. It prints on ordinary listing paper and can produce up to three copies. It is only 32cm. long and weighs about 2.5kg. The price includes a Centronics interface, cable connector and manual and other interfaces including IEEE488 and RS232 are available. Details from Mitrecrest, 61 New Market Square, Basingstoke, Hampshire RG21 1HW.



Accurate high-speed drawing with latest package for Apple II

A GRAPHICS package for the Apple II microcomputer has been developed and launched by Personal Computers Ltd of Bishopsgate in London. The system enables a user to generate at high-speed a finished and accurate drawing, chart map or plan. The package is priced at £3,250 for a 48K Apple II microcomputer, CRT, disc pack, graphics tablet, an A3 personal plotter and the software.

Designs drawn on to the graphics tablet can be dumped into the system and altered via the screen or reproduced immediately via the personal computer plotter. To speed the procedure, the user has a choice of 16 predetermined shapes and a further selection of at least five user-definable or purpose-designed shapes which may be stored by the system.

They are generated merely by pointing to the appropriate symbol on the graphics tablet with the electric pen. The shapes vary from circles to triangles or more complex forms and can be used in combination with freehand drawing. All the details created can be retained on disc.

For a further £300 the package can be used as a remote-transmission unit by means of a modem linked to a conventional line through which the system can communicate with a plotter at a different site. That facility is expected to prove useful to surveyors and architects working on location. Details are available from Personal Computers, 194-200 Bishopsgate, London EC2M 4NR.

Junk market in computers

THERE is no need to wait 100 years to start trading in the antique market for computers as the business has started already with the opening of the Computer Junk Shop, in Widnes, Cheshire. The items on sales will be mainly unused surplus stock bought from electronic manufacturers and second-hand items. You can find the junk at 10 Waterloo Road, Halton, Cheshire.

It's *vive la micro différence* at France's Sicob exhibition

THE characteristic differences between the managers in the mainframe game and the personal micro enthusiasts are obvious, and Sicob, the major French computing exhibition, went to considerable effort to emphasise those differences.

It sectionalised its personal computer and micro exhibits into a show tent, or boutique, outside the main five exhibition floors. Apart from being innately tinnier than the rest of the show, the annexe was free, and therefore drew an altogether more informal and relaxed crowd to its stands.

Sicob — *Salon International Informatique, Télématique Communication, Organisation du Bureau et Bureautique* — is the second of two elephantine European shows dedicated to computing and to office equipment, and running annually. The first is Cebit which is held at Hanover in the spring, and is followed by the Sicob, which appears in the autumn.

This year, there were 736 stands at Sicob varying from modest orange-box structures to ostentatious multi-storey stands like the Olivetti one. Approximately 2,240 products were shown, from around 30 countries, the exhibits varying from the latest in nasty furniture from Pierre Cardin to new personal computer systems developed and built in France. Indeed, despite its international tag, Sicob remains quite emphatically a French show.

A number of exhibits at the boutique drew large crowds, most conspicuously the Sharp stand, which was busy demonstrating the MZ-80, and the PC-1211, and also LogAbax with its latest LX-500 personal computer system.

While Apples prevail Tandy and Pet equipment were equally in evidence, and some new pioneering small French companies had also ventured into the small-business equipment systems market.

Mercure Informatique of Strasbourg has built its own small system, the Mercure 2000 which it claims to be an entirely French product, or there is intentionally no mention of the origin of the components apart from the Z-80 microprocessor. The system supports Micro-Cobol, Basic and Cobol.

Survey-analysis program helps process gathered data

COMPILING questionnaires and conducting interviews for market research and other surveys is child's play compared to the problems of analysing the information gathered. A Bristol-based management consultancy, Mercator, is now selling a survey-analysis program which will help devise and then analyse survey data.

The user can form individual questionnaires in the program, specify the questions and valid ranges of the answers. Production of tables is carried-out interactively with the survey data held in memory. Facilities are available for filtering, hole-count analysis, cross-tabulations, totals, row and column percentages.

It is claimed to be suitable for the analysis of all survey data irrespective of the method of collection although ideally a survey should be based on about 1,000 interviews. The program could be used by market research companies, advertising agencies or by schools.

Written in Microsoft Basic, the program requires a minimum of 27K of user memory and 90K of disc space. A printer is an optional extra since all the tabulations are prepared on the VDU before any printing is required. Details from Mercator, 6 Vyvyan Terrace, Clifton, Bristol. (0272) 33636.

A new range of specialised cleaning products for computers has been launched by the U.K. company, Automation Facilities Ltd. The products will clean anything from discs, disc heads, tape drives and tape-head drives. For details contact AFL, Blakes Road, Wargrave, Berkshire. Telephone (073522) 3012.

System Bs for university lab

ESSEX University has opened a new microcomputer teaching laboratory with the installation of 17 Vector Graphics System B units. They will operate under UCSD Pascal, especially implemented by the University. The new laboratory will handle up to 300 students per year and will concentrate on the initial teaching of programming to undergraduate students.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Nascom—rise, demise and future

A NUMBER of City analysts who looked at Nascom while it was on offer, reached the conclusion that they could not see, under the policies of the then management, any prospect that it would ever show a reasonable return on investment injected into it.

That view may be a considerable surprise to the many who saw the sales of the Nascom 1 rise easily to become — at the end of 1979, at least — the most popular single-board computer in the country as well as those who had seen the Nascom 2 and the plans for the associated System 2 peripherals and had decided that they were spot-on for market requirements.

Nevertheless, the fact is that of the many groups, large and small, which went to Chesham in Buckinghamshire to put substance to the rather vague offer-for-sale-as-a-going-concern package assembled by the receivers, Cork, Gully, very few stayed to make a firm offer.

To understand Nascom, you must remember that its genesis was in the buying and selling of components. Managing director John Marshall belongs to the same family which owns Marshalls of London's Cricklewood, Edgware Road and other places. In fact, his main activity now appears to be Interface Components. His long-term associate Kerr Borland had been 10 years in the components business before Nascom Microcomputers started.

Definitively suitable

Nascom 1 was invented not by a dedicated hardware freak but by Marshall and Borland. The finished design was the responsibility of Chris Shelton. It was launched officially in January 1978. By the end of the day of the launch, 300 units had been ordered and paid for — and all without having a working board to demonstrate. Almost immediately there were 7,000 enquiries.

It is easy to see now that this is where the troubles started. Nascom 1 was superbly — even definitively — suitable for market conditions at the time.

Up to and beyond the £550 and £600 mark were the three stalwart finished-and-cased personal micros — the Pet, Apple and TRS-80. The Nascom 1 mixture of not-too-difficult construction, full alphanumeric address, the possibility of VDU hook-up, the upgradability — and the price, less than £200 — was intoxicating. No wonder the money flowed in, but the results were devastating.

Unlike most start-up operations, Nascom never really had to worry about raising finance or cashflow. As a result, insufficient attention may have been paid to fundamental costing. Nascom 1 was sold to dealers at around £105; material costs, including documentation, were about £83. The margin seems inadequate — from that had to come salaries, office overheads, research and development — essential for any company in the field — and profit. Most new companies would also have had to add a hefty extra simply to repay loans. Nascom, though, seems to have been awash with cash in the latter half of 1978 and the first half of 1979.

The second effect was that it may have been insulated from the need to market properly. All a salesman had to do was to explain to retailers why they could not have as many units as they had ordered — Kerr Borland talking to Kay Floyd, *Practical Computing* July, 1979. Others had seen Nascom's success and, whether they had already had similar ideas in development before Nascom 1 was launched or simply climbed hastily on the bandwagon, during 1979 the single-board market suddenly became very competitive.

At the same time, the retail prices of the finished personal micros were falling. When they were first launched, the Apple, Pet, and TRS-80 were almost twice the U.S. price, the result of decisions by the U.K. distributors that this was the way to optimise profits. Towards the end of 1979, however, competition forced a price war — one which is by no means over.

Nascom apparently failed to see beyond the initial bonanza. Once the rivals had appeared, once the finished products started dropping in price, once the original generation of enthusiasts had learned all they wanted to — what should Nascom have attempted? Finally, it seems that like many other businessman suddenly and unexpectedly successful, the directors of the Nascom may have convinced themselves they did not have to bother about planning in an essentially unplanned market.

One of the great puzzles of the Nascom trading account for the year to the end of June 1979 is the purpose of a management charge of £154,030. In the previous financial year, the comparable figure was only £25,000. The management charge was in addition to research and development costs of £23,255 and consultancy fees of £17,571. Sales in this period were £894,955 and the company ended with a loss of £183,948. At the same time Nasco, an associated components company which had sales of £184,438 received management charges of £147,040.

At the time of Nascom's collapse the stock of the company was grossly unbalanced — certain vital components were in short supply and, indeed, obtainable only against cash as Nascom was already in debt to the manufacturers — while others were stocked in large quantities.

Nascom 2 is an attractive machine and at its launch, interest was high. Critics now say that perhaps it is a little over-engineered, going for a 40-pin solution where 24 might do, but many are pleased with it. For a company which had far smaller reserves than it perhaps realised and had borrowed heavily to make Nascom 2 happen, mistakes were made.

Firstly, the micromarket had moved on. The Nascom 2 was merely a good buy among the Superboards, UK101s, Tangerines, Titans, and Acorns. Evaluation of its good features now became a sophisticated exercise. Nascom 2 entered a buoyant enthusiastic market, but it was no longer the only seller there.

In a sense, Nascom knew that and priced down without being absolutely certain it could afford to do so. Replicating the experience with Nascom 1, it advertised far ahead of availability, hoping for a good inflow of cash. Now, however, the customers had other micros to consider, many of them available ex-stock. The design of the board required a certain type of memory chip and, as the launch of the Nascom 2 approached they were not available.

Add-on board

An add-on board, capable of handling more common memory chips was hastily readied, but for three months hardly any Nascom 2s could be sold. When they finally appeared with their free memory board, it was at the cost of the already very slim margins. The Nascom directors may not have known it, but they were losing money. The costs of Nascom 2 — materials, documentation, packing — was £142. Its main dealers bought it from them at £157.50.

This time, in addition to overheads, the company had to support interest charges — or at least make provision for them even if payment was not instantly required — and research and development.

Again, as Nascom pondered whether to try to sell wired-and-tested versions, it had allowed the development of more than eight separate Basics, all of them more or less incompatible. To be successful beyond the hobbyist market, a micro needs a good deal of software, preferably published by a variety of outside houses.

Towards the end, Marshall started shedding personnel rapidly and by the time Cork, Gully arrived, only a skeleton staff remained. For the immediate future no new micro is ever likely to have the same deceptive and destructive runaway success of Nascom 1 so perhaps there will never be another spectacular crash.

In the meantime, Nascom 2 is a good product and the new peripherals seem well conceived — the receiver allowed development to continue. If the new Nascom owner — Allteck Technology Initiatives — can avoid price rises which lose customers, and if it makes sensible plans beyond Nascom 2, the company has a chance of survival.

We review Pearl, a package which could help cut programmers' fees by writing bug-free business programs for the experienced and simple systems for the beginner.

```
PEARL LEVEL 2 (PEARL) VERSION N.00
MAIN SELECTION MENU-01/01/80
MINIMUM FREE SPACE=(20064)

0. RETURN TO CP/M
1. SYSTEM INITIALIZATION
2. EDIT SYSTEM DEFINITION DATA
3. FILE DEFINITION
4. DATA ELEMENT DEFINITION
5. DATA ELEMENT ARRAY VALIDATION MAINTENANCE
6. REPORT PROCESSING
7. SYSTEM GENERATION
8. CHANGE SYSTEM DATE
ENTER DESIRED FUNCTION BY NUMBER:
```

Initial system design by Pearl, program-writing package

SINCE THE invention of the tabulator, people have been striving to invent computers which are self-programming and can communicate with the end-user without the intervention of programmers.

At the very start of the history of true computers, all programming was done in machine code and mostly by engineers, giving rise to the early image of the white-coated programmer/scientist. Machine code seems now to have been relegated to use by designers of the computer hardware or to situations where speed and compaction of code is essential.

The next step was to provide an assembler language for each machine. That type of programming language provided the programmer with short cuts to machine-code programs. The essential functions of an assembler were to provide the programmer with chunks of regularly-used machine code and group them together under an easily-remembered key word.

Code libraries

That process was carried on as programmers realised that there were groups of assembler instructions which were also used time and time again. Initially, individual programmers would build-up libraries of code which they could use several times when the situation arose.

High-level language development has taken two diverse paths: firstly, there has been the ever-increasing sophistication of the existing languages, coupled with the introduction of completely new types such as APL. Secondly, there has been the growth of the non-procedural type of system.

Relationship emphasis

They, and I include both databases and systems such as RPG, tend to place the emphasis on the relationships of data. They are results of a philosophy different to the one behind procedural languages but have such an advantage in terms of writing speed, debugging, etc., that they are gaining considerable ground in the large installations.

However, in the world of the micro we are still, by and large, using Basic or in some cases Cobol or Pascal. There have been some attempts to write general information storage and retrieval systems, but while acceptable in some applications, they are not suitable in complex systems.

The problem of obtaining accurate and fast programs has been tackled in a different way by Computer Pathways Unlimited Inc with its package, Pearl.

Pearl is a program which writes programs, in this case in CBasic. CBasic is a Basic which runs under CP/M on any micro that can support the operating system. As most micros can be used to run CP/M, it is reasonable to say that CBasic is used in a large number of installations.

The main reason that CBasic is popular is that until recently it was the only Basic on micros which could be compiled. Compiled Basic has two advantages; they are that it is fast to run and that it is difficult for people to pirate the code with any hope of being able to maintain it.

As more and more people are able to buy micros, the need for an easy-to-use programming system has become more and more acute. With the average cost of a programmer in the region of £400 per week, a large number of businessmen, inexperienced in programming have been tempted to try and write their own systems.

Pearl attempts to solve the problem by providing a package which can be used by the experienced programmer to produce bug-free programs, and at the same time, can be used by the inexperienced person to create a simple system with the minimum of knowledge about CBasic.

Powerful technique

In writing a system of the type used on a micro, there are five steps:

1. Systems analysis
2. File design
3. Processing requirements
4. Reporting needs
5. Testing the system

Pearl is not much help in the analysis phase, which is a pity as however well the system is written, if the analysis is incorrect, the resultant system will not perform in an acceptable way.

It is arguable that the design of files within a system will make the whole project stand or fall. Pearl helps the user in

```
LOADING SELECTED PROGRAM: UPDATE CUSTOMER CONTACT
          CUSTOMER CONTACT FILE (CF100) VERSION 1.0
        CUSTOMER CONTACT UPDATE MAINTENANCE-01/01/80
                 MINIMUM FREE SPACE=(NNNNN)

0 TO RETURN TO MAIN MENU
1 TO ADD RECORDS TO FILE
2 TO EDIT OR DISPLAY EXISTING RECORDS
3 TO DELETE RECORDS
?
```

two ways: firstly, Pearl provides a very powerful file-indexing technique of use both to the first-time user and to the more experienced programmer, and secondly, it provides an easy question-and-answer session for the newcomer to programming.

Definition of the file itself consists of telling Pearl the name of the file as it will be known to Pearl, the external name, the access method and where you want the file to reside. Obviously, you should ensure that each file has its own name.

Within the file, you then have to describe the fields of data you want to be able to store. An extra complication which arises at this stage of the development is the need to describe not only how the data is held on the file but also how it is to be input from the screen and what, if any, validation is required.

There are four default methods of automatic input validation:

1. Yes or no
2. Numeric range
3. Via the contents of an array
4. Date validation

The user can also specify that certain fields are not to be displayed on the screen, or that they should be displayed but the user cannot alter the contents. The two file organisations that Pearl adds to the normal Basic functions are direct and indexed.

Indexed organisation

In particular, the indexed organisation gives the user the ability to access his files by, for example, customer name. The indexing system will support duplicate keys provided the user writes a routine to determine which of the records with the selected key is required. If the file is very active, e.g., an invoice file, it will require routine re-organisation from time to time. The required program to do that is included in the Pearl system and can be included as part of a program.

The Pearl system is menu-driven as are the systems it generates for the individual projects. Having defined the files you require, it is then necessary to tell Pearl how you want those files included into your programs and the type of structure the whole system is to have. That again is done via a question-and-answer session involving such information as user name, system name, terminal type, message levels, etc.

There is no processing in the Pearl-generated program with the exception of data-input validation and some simple report writing. If your system requires extra input validation, conditional processing, complex file relationships or complex report lay-outs, it is up to you to code, in CBasic, your own modules.

Pre-coded modules

Pearl helps in two ways: firstly, you can insert any code you require into the generated program, and secondly, there are a large number of pre-coded modules which may be called by your program.

Some examples of the functions that can be called are:

1. Prompt the user on the screen and return the input
2. Centre a string within a variable
3. Allocate keys in an index file

The ability to obtain and add to the generated program provides the experienced user with a framework on which to build, and the first-time user with an example of how to code and structure a program.

The reporting ability of Pearl is limited to simple lists of the file contents. Routines are provided for page counts and paging, the report headings are taken from the file definition and column spacing is automatic.

One of the problems of general-purpose software is in the region of screen handling. Although CP/M allows the program to run on any system which supports CP/M, most VDUs have totally different screen-format characters. For that reason, almost all packages running under CP/M stick to simple scrolling formats and screen clear. Pearl can be configured to run on the following screens:

Sol
Hazeltine
Beehive
Soroc
Intertec

If your screen is not one of those, you must supply the sequence that clears the screen for your particular VDU.

The documentation is extensive at more than 150 pages. It is divided into two parts, the first for non-programmers and the second for more experienced users.

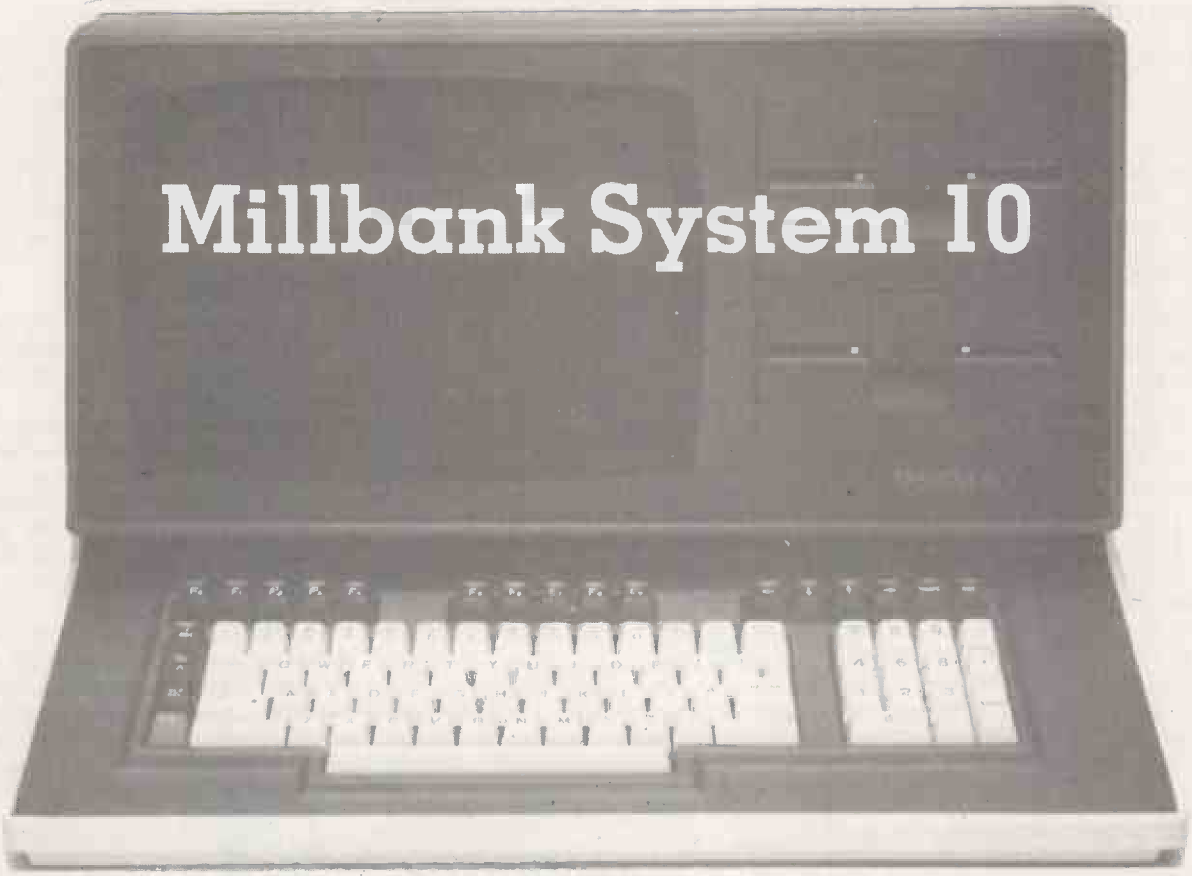
Conclusions

- **I tested version two of Pearl, but there are two further versions available — one a subset aimed at small projects and the other at programmers.**
- **The system is well presented and planned and has one big advantage to all users in that it will force an ordered approach to the writing of programs and the documentation of, say, file lay-outs.**
- **I can see it being of use to the first-time user as a practical way of seeing how to write and control his system.**
- **For the existing user, it will provide a structured format to assist in the writing of large integrated systems, particularly where there is more than one programmer.**
- **Add that to the ability of the system to create error-free code and generate indexed files, and you can see that Pearl can be an enormous help in most types of system design.**
- **Unless you are prepared to write a certain amount of CBasic for your project, the system is really of any use only in very simple, e.g., lists, applications. For the person who does not want to learn to program but wants to create a simple system, there is a number of database and information retrieval systems available under CP/M that are far simpler to use.**
- **However, for the first-time user who wants to create an initial system and to have it up and running in a short time, and is then prepared to learn CBasic and gradually add the bells and whistles, Pearl could well be the best package to buy.**

```
                         XYZ COMPANY                          PAGE     1
                 CUSTOMER CONTACT MASTER LIST
                      PEARL CONTACT FILE
                           01/01/80

CUSTOMER NAME                                 CUSTOMER ADDRESS          LOCATION
PHONE            CONTACT DATE    BUSINESS

ADAMS, MARIE                                  7899 EAST STATE           SALEM, OR 97303
392-8793         04/07/80        OTHER
DOE, JOHN                                     1099 THIRD STREET         SALEM, OR 97301
392-6299         04/05/80        EDUCATIO
JOHNSON, RICHARD                              6540 EAST PEARL STREET    SALEM, OR 97304
988-2780         04/07/80        WHOLESAL
JONES, SAMUEL                                 3369 OVERTON DR.          SALEM, OR 97302
399-8923         04/28/80        RETAIL S
MILLER, DANIEL                                2333 CONOVER DRIVE, NE    PORTLAND, OR 97222
992-2034         04/14/80        WHOLESAL
SMITH, MARY                                   4329 WESTHAVEN RD         SALEM, OR 97302
322-6390         04/14/80        GOVERNME
THOMAS, MICHAEL                               3250 97TH AVE., SE        ALBANY, OR 97322
872-2300         04/21/80        FARMING
```



Millbank System 10

THE FIRST thing you notice about the Millbank System 10 microcomputer is the anti-glare screen across the front of the VDU. Made from a kind of silk material, it is stretched over the front of the screen making it one of the most relaxing machines to work with I have experienced.

The whole machine is very well engineered; from the number of sockets at the back to the keyboard and general appearance of the front panel it has a solid businesslike feel. The lay-out of the computer is, what has now become, the almost industry standard of screen to the left, integral discs on the right-hand and a fixed QWERTY keyboard. I wish more manufacturers would build detachable keyboards — when you work in an office

by Nick Horgan

with a crowded desk it is a great benefit to be able to relegate the screen to some remote corner and have the keyboard on your knee.

However apart from that minor niggle,

Summary specifications

CPU: Zilog Z-80
Memory: 65K read/write RAM, 2K PROM with disc boot and diagnostics.
Discs: dual double-sided, double-density 5¼in. with 700K capacity
Keyboard: normal QWERTY keyboard plus four cursor control keys, 16-key numeric pad and 10 user-definable function keys
Display: 12in. screen with separate 8085 processor; selectable baud rate to 48,000 baud; 24 datalines of 80 columns
Interfaces: two RS232, one RS449, high-speed parallel interface to X comp controller, optional IEEE 48 parallel interface.

I liked the general appearance of the Millbank System 10 as much, if not more, than any other micro I have used. After a day working on a normal screen, the System 10 anti-glare screen was the nearest thing to heaven, and still a computer, that I can imagine.

The fundamental system uses the Z-80 processor, a well-tried and familiar CPU to anyone in microcomputers. The screen is a standard 80-column VDU with good resolution. The only disadvantage of the anti-glare screen is that form a side view the screen becomes very hazed.

To the right of the screen are two mini-floppy drives. They are 5.25in. double-sided, double-density, soft-sectored discs giving 700K of on-line storage.

Two neat features are that the software will turn off both the screen and the disc drives if they are not used for a length of time. The screen is turned back on either by a display from a program or by the operator touching any key on the keyboard, the drives re-start as soon as an access is requested.

The machine may be powered-on or off with the discs *in situ*, although I could not bring myself to do it.

Both the screen and the keyboard have their own CPUs, allowing the user on the keyboard to allocate his requirements to the function keys, and on the screen, full cursor control and functions such as erase to end of line. Using the keyboard and the screen functions allows the programmer to write very neat and fast input routines.

The system is supplied with CP/M as standard, Wordmaster and CBasic as options. CP/M is an operating system in use on the majority of medium-size micros. It allows software to be machine-independent, and, means, therefore, that there is a large amount of software available which can be bought over the counter. If you do not have the time or expertise to generate your own systems, CP/M-based machines can be of great benefit.

There are many 64K-based CP/M supporting machines on the market, and to rise above the general standard, your machine has to offer a new approach. Millbank System 10 has, as they would say in California, hung its flag on communications. At the back of the machine is a neat row of output connectors, they can include:

Two RS232 ports
One parallel interface
One IEEE port
One RS449 port for networking

The software supports the following protocols:

Async
BIsync
HDLC
SDLC

From that combination, you can see where the Millbank System 10 is aimed. From mainframes to laboratory instruments, the user can interface with it, giving a flexibility unknown outside minis or do-it-yourself micros.

The attitude to communications is echoed in the resident monitor which, apart from the normal memory display, also allows you to monitor the output ports.

There are some very useful utilities provided over and above the normal CP/M ones. Both the serial and parallel ports can be tested with TSERIAL and TPIO. For the port to be tested, the user must insert a loop-back plug; the wiring requirements are included in the manual.

With other routines the user can check the following:

The VDU screen, PROM and RAM
The disc drives
The direct memory addressing, DMA
Interrupt generation

As an option the user may specify the inclusion of an arithmetic processor board. That allows the system to do 32-bit arithmetic and is particularly of use in Fortran or other scientific situations.

Background

The Millbank System 10 is based on a micro manufactured by a small independent company, based in San Diego, California, called Gnat. Millbank Computers is run by two men, Alan Miller and Tim Mott. Alan Miller used to run an office stationery business and became involved with the micro when he tried to do his stock control on a Nascom kit; he found it insufficiently flexible or powerful. The militating factors were the lack of disc drives and expansion boards. As a newcomer to computing, he found trying to write in machine code a harrowing experience. That was not necessarily a disadvantage from the personal point of view: "It was like going back to school, getting the old grey matter going again".

After a visit to the States, he decided he could market the Ohio Challenger 3, since to him it seemed to represent an ideal solution at the right price for the small business. That was negotiated through the main U.S. distributor, American Data of Washington.

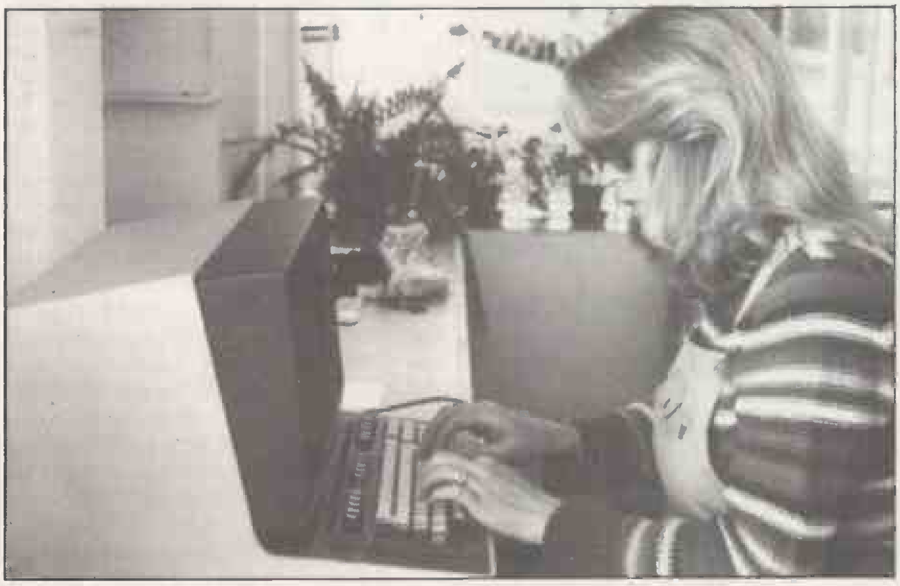
In November 1979, he was introduced to Tim Mott, a market consultant who was looking for a buyer and — entirely with his own cash made from the office stationery business — established Millbank Computers — changing the name of Mott's operation from Millbank Computing.

One of their first profitable moves was to start distributing the Qume printer. Millbank had co-operation from Qume, and it was also, it says, selling only to the trade and giving dealers a respectable margin. It now sells about 30 a month and provides service back-up.

It is on the System 10, that Millbank's principal hope rests. The System 10 is built by a small independent in San Diego with which Miller seems to have a good understanding, so much so that in the event of the Millbank needing more than 200 units a year, it has secured Gnat's permission to assemble in the U.K. Millbank could even build the machine from the original Gnat blueprints. Liaison also extends to technical co-operation and Mott is already talking about replacing the drives with Corvus 5¼in. hard discs though that is so far only an idea.

Millbank found Gnat through a dealer in the States who still acts as a shipper, collecting the units from the factory gate and delivering them to the expediter. It says it has been assessing the machine for four months before it started to market it and say that it is now reliable. Since the machine runs on CP/M, there should be little problem with software portability.

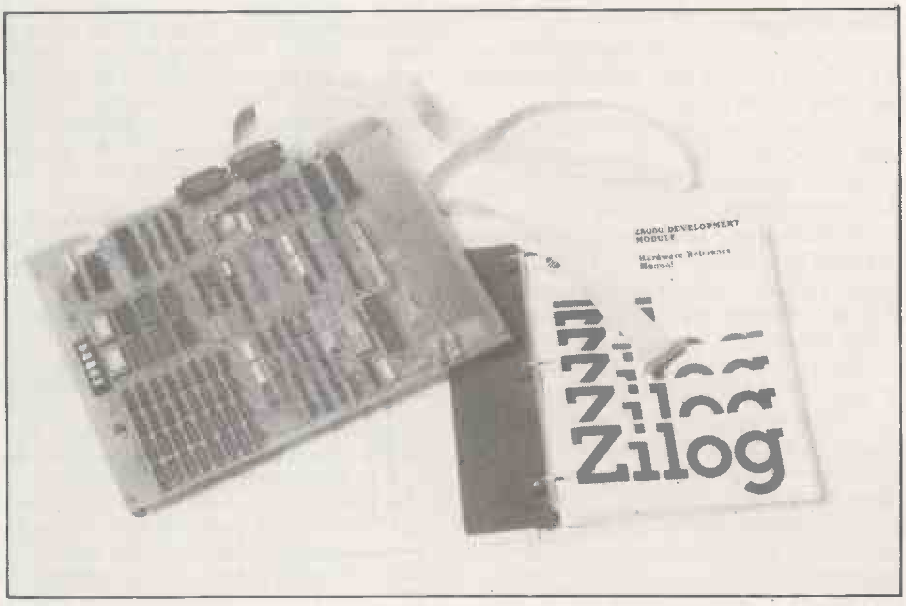
Alan Miller feels that his new baby offers the same kind of performance as the Sord or the Superbrain; only time will tell whether the reliability is better. Price, all-in, is £2,995 plus VAT, complete with manuals, CP/M, C Basic or Pascal, and Wordmaster, the professional word processing package by Wordpro.



Conclusions

- **All in all, a very well-assembled microcomputer priced at £2,995, with one year's warranty.**
- **As the system runs under CP/M, there is an enormous range of commercial software available for it — so much it would be difficult to know where to start to describe it.**
- **Although, of course, the system could run as a stand-alone commercial micro, and do very well, it would seem a pity to waste all the effort that has been put into the design of the interfaces which are standard.**
- **I suspect that this machine is going to sell very well to the scientific and engineering users who will be prepared to dig into all the options offered on this well-designed micro.**

The Zilog Z-8000 development module



THE ZILOG Z-8000 non-segmented, 40-pin version, the Z-8002, is configured as a single-board computer and marketed by Zilog as the Z-8000 development module. Zilog recommends the use of the Z-8000 development module in conjunction with a host system, e.g., ZDS or MCZ systems. We test the module only in the stand-alone role.

The Z-8000 development module is a single printed circuit board measuring approximately 37 × 28 cm. — 14½in. × 11in., slightly smaller than an opened *Practical Computing*. On first sight, the board is unremarkable other than the 48-pin socket which is for use with the full Z-8001 — the segmented version of the Z-8000.

On closer examination, the board supplied by Zilog U.K. had 16K words of RAM on-board. Although 16K may not seem much in today's terms, they are 16K words which make 32K bytes. In fact, the

by Vincent Tseng

board is laid out with sockets to accept a total of 32K words or 64K bytes.

A power supply was attached to the module giving the +5V, +12V and —12V required by the board — the current ratings as stated in the manual are 3A, 1A and 200mA respectively. There are two 25-pin D-type connectors providing two serial interfaces via a Z-80 serial I/O, and there is a small area of board to allow for the addition of components by the user.

As the development module is supplied ready-built, all that is required is the attachment of a power supply — already connected — and that of a suitable terminal, which may be a normal RS232/V-24 VDU or a Teletype. There is, however, a slight problem, especially if the VDU can be set for various transmission/receive standards in terms of the number of bits, parity, stop bits and baud rate.

The baud rate is set easily enough since the selector switch positions are listed in the manual, but what about the remainder? One can discover them by trial and error, but that is not really satisfactory. I found them by looking up the monitor listings — it needs 8-bit characters, no parity and two stop bits which is the normal way a Teletype communicates.

The documentation was not clear which of the two connectors was the required one referred to as channel B. It required reference to the lay-out diagram to confirm which it was.

The Z-8000 development module communicates with the user only via the serial interface and there is no built-in keyboard/pad and display. On powering-on, provided a VDU terminal is connected correctly to the module, and the re-set button is pressed, the VDU displays a prompt character of " < " to show that it is in monitor mode.

There was no consistent power-on re-set, sometimes the prompt character would be displayed on switch-on, sometimes the re-set switch was required. On examination of the documentation and circuit diagrams, there seemed to be no power-on re-set.

Using the monitor via the VDU showed that this was, in fact, a very simple and primitive program, despite the fact that the board featured a microprocessor which is claimed to be one of the most powerful available. There are 15 commands available under the monitor:

Break — for setting of break point
Compare — for comparing memory blocks
Display — for displaying and altering memory
Fill — for filling memory with a word pattern
Go — branch to last PC address
I/O Port — I/O read/write
Jump — Branch to an address
Move — move memory block
Next — for single-stepping automatically
Punch — for punching paper tape
Quit — to transfer control to an MCZ or ZDS microcomputer — Z-80-based — if connected to the module, also used to terminate other commands
Register — for displaying and altering the registers
Tape — for reading a paper tape
Load and Send — commands for data/program transfer between the module and the MCZ or ZDS microcomputers.

The list is not exceptional, although, to be fair, the essential commands are there. In use, it was, however, extremely frustrating not to be able to correct an entry even if the error in typing was noticed before the return/enter button was hit — the rub-out key appeared to have no effect. It seems that one has to accept the fact that the erroneous line has to be entered and wait for the "?" error message to return, then re-type the line again.

If an incorrect command was typed — like "F" for fill, easily done, since "F" is a valid Hex character — to make sure that the command is aborted, jibberish had to be typed and entered.

There are some useful features; for example, any number of break points may be set manually by using the unimplemented instruction of OEOO Hex which will cause an unimplemented instruction trap to suspend the processor execution.

The break-point command is also useful in that it is conditional, allowing the user to specify the number of times the address location can be passed before the trap is effected. "Next" is an automatic step command which will execute from the last set PC a number of times — set by the user, from 1 to FFFF Hex steps — displaying all registers.

A small but vital piece of information — set the FC register, flag and control

Summary Specifications

Z-8000 Development Module

CPU — Z-8002 40-pin, non-segmented version of Z-8000, socket provided for the Z-8001 48-pin segmented version. Clock rate at 2 to 5 MHz selectable for 3 to 9 MHz.

Memory — Sockets for 32K words, 64Kbytes, of 4116-type dynamic RAM with 16K words installed.

Monitor — in 2K words, 4Kbytes, two 2716-type EPROMs, 15 command types including communications with ZDS or MCZ microcomputer systems.

I/O — two serial I/O via Z-80 serial I/O parallel I/O provided via multi-pinned corrector.

Display/keyboard — not built-in, provided for via serial I/O to RS232/V-24 or Teletype standard.

The MPU — Z-8002

16-bit word operations with instructions for single-bit, byte and long-word, 32-bits, manipulation.

Instruction set — more than 200 types including signed multiply and divide, instructions with auto-increment/decrement and repeat.

Memory capacity — 64Kbyte on Z-8002 non-segmented version — on Z-8001 up to 8Mbytes.

word to 5000 Hex with the RFC command — was not given in the manuals. That omission prevented the execution of a user -written program in RAM, so that even using the example given in the monitor listings, all the module succeeded in doing is hanging-up with no way of obtaining a response except by the re-set button. Furthermore, the program which one had laboriously entered was totally lost.

The monitor did not seem impressive and, as one of the new generation of big microprocessors, seemed perhaps somewhat primitive. The monitor is contained in 2K words of ROM — 4Kbytes. Contrast that with Nas-Sys 1 for the Nascom 1 or 2 based on the old Z-80 which is contained in only 2Kbytes, or the AIM 65 very comprehensive monitor for the 6502 in 8K bytes which contains mnemonic entry and dissassembly.

As mentioned, there is an enormous amount of RAM on-board — 32Kbytes, 16K words, installed. I cannot see many people wanting to or capable of filling the RAM area with that size of program manually with the monitor. The start address for user RAM is at 4480 Hex. The RAM area between 4000 and 447F Hex is for system usage, but it is useful to know that a wrap-around keyboard input buffer for 128 bytes starts at 40B0 H, so that one can perform a limited recall of the last few commands to see what one has done.

Display command

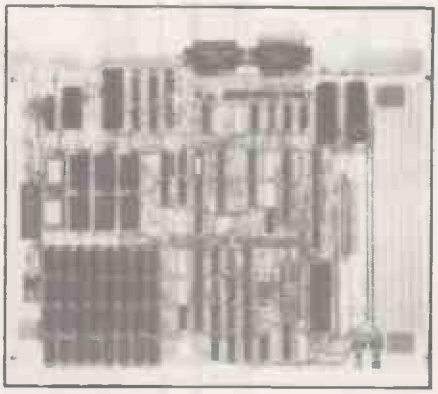
The display command will display a line of eight words or bytes, specified by the user, with the ASCII representation of the bytes if applicable, so that although the input key buffer is stored in Hex, the ASCII characters are displayed, making it easy to see the last few entered command lines.

The non-maskable interrupt, NMI, is connected to a button next to the re-set button, and its use is for a warm-start, i.e., without jumping into re-set and losing the registers. It is also used in going into transparent mode used in communication with an attached MCZ or ZDS system.

The NMI does not, however, seem to be as non-maskable as one would assume. For instance, when the module hangs-up due to the non-setting of the FC register, the NMI button has no effect. That is exactly when it would be useful; not only to see what went wrong but also to preserve the program entered.

It appears that one pays very dearly for even very small mistakes on the Z-8000 development module — when a program hangs-up or the monitor loses control, the RAM seems to become corrupted. That is certainly not conducive to developing or debugging a program, since the slightest mistake could well mean total re-entry of the program.

The documentation seems inadequate in certain areas — there were many points which I had to clarify by deduction, and sometimes vital information was missing.



Examples were lacking, and they are needed especially for such a new and complex machine as the Z-8000. Many will be buying the board as an evaluation kit and the level of documentation will not allow them to do that easily.

Standard with the board was a Hardware Reference Manual which covered monitor commands and was accompanied by a separate book, dealing with monitor listings. A long example program showed the use of some of the monitor subroutines, but the program listing did not have absolute addresses; the user has to transpose — re-locate — it into the usable RAM area. The data area also needed relocating and the correct absolute addresses had to be referenced in the program. That increased the possibility of a fatal error.

There was no mention that the program and data area both needed manual relocation, so some users may even try to enter the example with the addresses as shown in the listings, i.e., trying to write into PROM.

Of course the Zilog concept of segmentation is more than just memory-bank switching. It has a memory management unit which, when used with the Z-8001, offers many extra facilities; one example is memory protection.

The version of the Z-8000 on the board was the Z-8002 — the 40-pin non-segmented version. Non-segmented means that this version of the Z-8000 can only address 64Kbytes, or 32K words, instead of the boasted 8Mbytes on the segmented version, the 48-pin Z-8001. Segmented addressing is like addressing more memory by bank-switching — simple but effective. Obviously, the Z-8000 has the instructions already implemented to do the segmentation and external additional hardware is not needed other than for buffering.

The data and address signals are multiplexed — they share the same pins, e.g., bit 1 data and bit 1 address share the same pin. Configuring the Z-8000, needs, therefore, the use of latches to separate the data from the address, which means that a minimum system still requires the use of the latches — unless special memory chips are produced with built-in decoding.

Microprocessors are no longer the poor cousins of traditional computers as far as the Z-8000 instruction set is concerned — enormous even by modern computing standards. It would take more than one article to describe all the instructions, so let us just take a look at some of the main features.

The Z-8000 has eight addressing modes, which give 14 distinct types in practice allowing for segmented and non-segmented addressing. There is true index addressing — where, as in the Z-80, although it is called index addressing, it is in effect a base-offset addressing. There is also base-address and index-base addressing. Relative addressing would be especially useful for the segmented version on re-locating programs.

Manipulation instructions which can handle bits, bytes and words and, more significantly, long words — 32 bits — are available for most operations. Load decrement/increment and repeat are the equivalents for compare, so that block moves and compares can be made with very few instructions.

Input and output instructions also have the increment/decrement and repeat versions, very useful for scanning or sequential signalling. Signed multiply and divide with the long-word versions are available.

Privileged instructions, as Zilog calls them, allow for multi-processor operation as well as for the attachment of co-processor units which in effect can extend the instruction set.

There are more than 200 instruction types alone and that is not counting those with, say, the various combinations of registers.

Conclusions

- **The Z-8000 is a very complex machine in terms of its instruction set.**
- **That complexity might prove confusing in machine-code work for the majority of users.**
- **Its full potential should be realised when there is available a good and well-implemented, high-level language for it.**
- **The instruction set and processing power make it comparable to today's modern minicomputers, but a chip is a long way from a usable implemented system.**
- **The development module is disappointing because the monitor does not seem to do the powerful CPU justice.**
- **One of the main purposes of buying the module, to evaluate the Z-8000, might not be fulfilled easily.**
- **The module may be more suited to be attached to a ZDS — Zilog development system — where cross-support products exist and the prime use of the Z-8000 development module is for execution of the programs developed and stored on the ZDS system.**
- **At around £800, it seems a trifle expensive.**
- **If one wants to learn more about the Z-8000, Zilog has recently announced a postal correspondence course in five lessons which test your understanding.**
- **The lessons are useful for learning about the Z-8000, and are a good investment and good value at less than £20.**

The U.K. experience

Kerr Borland looks back at the U.K. micromarket in its infancy and speculates on the competition to come.

WITH hindsight, the micro revolution, U.K.-style, must make you smile if not laugh. I am sure that it was the same in the States a year or so earlier. In Europe, the languages, regulations and more fixed ideologies made the innovations less acceptable if they were not packaged and guaranteed.

Thankfully, the U.K. still retains a sense of adventure even in these hard times and it was this that, in 1978, allowed the U.K. to join the club as a competitor in some areas rather than as a distributor.

Of course, the main systems originated in the States both in the hobbyist and the embryo small-business area. The States had had one to two years' start. We in Europe produced a kit and board market which never developed in the U.S. — that gave us the chance to catch up.

By that, I mean that the micro-revolution is a revolution of youth. Advancement in both hardware and software is predominantly in the hands of people aged from 18 to 28. Certainly, their age would exclude them from traditional decision-making teams. Yet their production, their energy and their lack of tradition has put the U.K., even with its present economic climate, ahead of all richer European neighbours.

Dealer phenomenon

Another phenomenon of the last three years that the micro has spawned is the hundreds of dealers. Incredibly it would seem, when millions are desperately clinging to their jobs, these visionaries left their employment, hired shops and offices and went in search of a product.

By 1980, some could claim to have made a clear and sound business decision. Before that, they were caught in the same whirlpool which swept all before it. Of course, some dealers evolved from the calculator or mini markets but they form a very small proportion.

Lastly, there was the U.K. manufacturer. I was one in a small way and can assure everyone that they should all be certified. For a country which badly needs new industry, we have some crazy rules. For example the import tariff on components is 18 percent. The import tariff on complete computer boards is six percent. Therefore, anyone making U.K. systems either has his boards made in the U.S. or pays 10 percent more. The kits reflect a lower price because of smaller margins, not necessarily cost.

Remembering that we are talking about a whole industry developed in three years, maybe five in the U.S. which has exploded a mass-market product into true mass-marketing, you have the obvious problems of catching-up. Manufactured PCBs should be tested. Test equipment costs many £1,000. With a huge home market in the U.S., assembly manufacturers invested in test equipment. In the U.K., that is, in general, still being discussed. With the tariff restrictions, it is not surprising.

Our home-based component production is not geared to micro needs of LS ICs and buffers. Bulk purchasing takes much longer through U.K. distributors or owned marketing companies and certainly costs more proportionately.

On the other hand, the U.K. has certainly produced more hardware peripherals and add-on hardware per head of population than anywhere else. We have a genius for producing 40 different products for the same need. That, of course, just complicates the choice and adds to the fun and cost.

Name acceptance was critical. Those few, Tandy, Apple, Pet and in the boards, Nascom, became recognisable quickly

The Compukit UK101.

and, therefore, were the pace setters. Interestingly, the States-side market share reads Tandy, Apple, Pet. When they invaded Europe, Tandy and Apple continued their successful U.S. formula. Commodore had a European marketing genius in Kit Spencer.

He knew that the European and certainly the U.K. market would not respond as well to an imported campaign as to a tailor-made one. With a domination of the small end in 1980 of far more than 50 percent of the U.K. market and achieving sales for Commodore which represent more than 25 per cent of its world output, he proved that you can import technology but not custom.

On the retail side, Chris Cary of the Compshop is the indisputable king. Again, he had a good understanding of the marketing involved. With little knowledge, the buyers needed a range to choose, simple instructions for purchase and an apparent good buy.

The UK101 showed another interesting market development. Its similarity to the Superboard, except for its Nascom-format screen display amazed everyone in 1979 and, in theory, might have been the UK101's downfall. With its finance and production power, Ohio Scientific should perhaps have won on paper.

The immediacy of the new market area is perhaps the problem with which the recognised electronic groups have difficulty in coping and why so few familiar names have reached the point of sale.

Marketing generally is supplying the stimulation of demand with an emphasis on your product. In micros, the new concept of managing the demand was fully explored and proven to be practical and profitable. Many products in those three years should have survived. Their producers were very competent and the products well made and needed.

Sadly, engineers generally are as bad salesmen as salesmen are engineers. The assumption that good products will sell themselves is true. The salesman merely allows the buyer, whom he has found and stimulated, the opportunity. Undoubtedly, the marketing manipulators won.

1980 must go to Clive Sinclair. With that special quality that for 20 years has kept him in front of the world, he immediately proves me wrong in saying that engineers do not make good salesmen.

Business trend

In the three years, we had forgotten that the microchip is a low-cost, mass-produced, no-value commodity. Our drive towards business computers, etc., left one market area without solution. That market was the thirst for knowledge created by the mass media.

No-one learns to drive in a Ferrari. Most people's first banger costs less than the ZX-80. The banger serves the most important need in driving, to learn how; the ZX-80 does the same for the microchip. I think that everyone who is thinking of starting computing at a slightly older age should buy a ZX-80 tomorrow. As with your first car, pound for pound, no future computer you buy will every teach you as much. We all await the 1 Megbyte for the ZX-80.

So you will, I hope, forgive my smile. We seem to have a world of adolescents working day and night, foregoing all wine, women and song to produce products which they sell, perhaps give or abandon on a dealer network which gave-up perfectly good jobs in or out of electronics to follow the 40-pin star.

Collective redundancy money was ploughed-in by the team who then did their particular deal and gained exclusive rights to hardward that no-one else had realised was brilliant. Add an increasing number of U.K. manufacturers who plan in volume up to 100 in a market which needs 10,000 immediately if the product is successful, and you burst into joyous laughter.

1980 was a year of consolidation. Having had a market for three years, that seemed sensible. Those who still remained saw little new hardware and started to concentrate on software. Youth still dominated, but noticeably, the software producers had spent some time in formal computer employment. The division between hardware and software is dispensed with in micro-computing. Everyone knows both, but has a leaning by choice.

Dominant idea

The machines gained bigger memories, faster outputs, larger discs, better printers. Operating systems of all shapes and sizes appeared. Applications started to be the dominant idea instead of machine.

Tandy, Apple and Pet produced new machines which startled no-one, reflected the newer electronics and the move towards low-cost business machines. Texas Instruments arrived with a colour computer; the Japanese arrived with similar machines which each had a selling point in the hands of a good salesman. Generally, the end of the beginning has been reached. What happens now?

I asked many micro people that question. They found a few areas of agreement. Firstly, the end of the beginning is the end of the obsession with hardware and the total dominance from now on by software. Secondly, that technology will strive on two fronts. The storage media which survive will be mass-producable and with a downward cost-curve regardless of an upward capacity. That the next stage of evolution rests with speech recognition. Thirdly, massive databases will appear for direct public access. Fourthly, the proliferation of outlets will not survive; some specialists will remain but retail micros will be obtainable in the U.K. probably from two or three chains.

With software engineering rather than the more normal micro definition of system engineering, we start using software for controlling fundamental hardware functions rather than writing user programs. For example, the new CP/M 2 operating system, allows the user a multiple choice of format on a single drive.

As drive A, the system will be expecting a single-sided disc and as drive B, using the same drive, the system will expect a double-sider. Or A could be single-density and B double-density. Obviously, there could be changes in format to restore, but it would seem perfectly feasible soon to read in a single-sided disc from elsewhere and to dump on to a double-sided, double-density disc used by the system. That is a large step towards transferable software.

The storage medium war is on with two apparent leaders. Winchester drives, though they must now be four years old, are improving their capacity to new highs. At the moment, they are running around 25Mbyte but are now talking of 250Mbyte as a possibility. Also a 5in. Winchester seems probable.

For the uninitiated, a Winchester is a sealed hard disc. You can write, read and erase but you cannot change the disc. That gives greater reliability and greater cost at the moment, but it is the start of the micro mainframe.

Bubble memory is high capacity, at the moment quite expensive, but unlike the Winchester, would lend itself to portability.

Speech recognition will put the finishing touches to the microrevolution. With speech recognition, you could probably justify 16-bit microchips. They are fast compared to the eight-bit, but have disadvantages which would seem to make them superfluous to a satisfied eight-bit marketplace.

Multi-tasking

Obviously, they facilitate multi-tasking. A few months ago, I saw a specification in *Byte* for a mini Basic written for multitasking on a 16-bit machine which ran in 8K.

However, it still seems practical to relegate the 16-bit projects to the big applications. To function fast and efficiently, they need plenty of RAM for use so that large blocks of data can be retrieved and interrogated instantly. With Winchesters or bubble memories, the storage could be massive and the slow search time considered.

For the 16-bit chip, the software has yet to be written although conversion from 6800 or Z-80 to the equivalent 16-bit chip would seem possible. There is already a Motorola Pascal available for the 68000.

Again, the hardware will no doubt be plentiful but nothing will really happen until the software writers understand the chip and cope with the big systems that 16 bits attract.

Where are systems going? I already mentioned the big public database

(continued on next page)

The ZX-80 became the top-selling microcomputer of 1980.

(continued from previous page)
machines. It would seem very possible that each office will have its own database. That is already a fact with big operational minis and mainframes. Now it could be a year or so away for everyone. With 250Mbyte Winchesters, the storage for all information generated by a small office seems very practical.

Master micro

The master micro, possibly 16-bit, with some form of mass storage could be assembled for very little cost. It could have two types of terminal. Each typing station, account clerk, would have an on-line terminal with probably its own micro and user storage. Every letter and ledger would be stored. The other terminals would be portable rather like the Newbrain. They would be powered independently with a LCD display but with sockets to screen and printer.

That would give management a flexible use of the computer. Possibly, the portable would use bubble memory, to expand the volume retrievable at one time. The software is the entire problem. The hardware could be made now though at a higher cost.

Total information storage and retrieval for all has to be the aim for 1990. With systems like Prestel about to become available and, if one has the facilities to store the information when found off-line and use it through your own computer, relatively inexpensive.

The whole viewdata idea will take off in the next year once they resolve Catch 22. Prestel particularly has a lack of information providers because it has few end-users. They are not rushing to buy because there is insufficient information to retrieve.

At the moment, the user units cost too much, but by the New Year, that will have changed. Specialist Micro Designs has just finished a project which will make a unit available at slightly more than £100 or around £1.40 per week rental from the TV rental companies. The new user, who will raise the figures and interest new information providers who will pay the Post Office, will be faced with an installation charge for the jack. Why not, in fact, incorporate the jack in every telephone connection box on every wall on every future installation. That would encourage users.

The Post Office system still represents, if I remember correctly, 7,500,000 potential public information pages open to all. That should start to take computing into the 21st century.

Information providers like W H Smith are already offering shopping by computer. Soon, it should be possible to interrogate the computer as to which shops in any town to visit to buy the goods you require — that is if you want to see them first.

Same problem

Finally, and one feels as the first telephone salesmen must have felt, how about mail by computer? Obviously, everyone needs a telephone, a modem and a microcomputer. The same problem the first telephone salesman had; too few computers — but for how long?

Will computing become cheaper?

Julian Allason studies the latest trends in microcomputer retailing.

THERE is one question asked more often in microcomputer shops than any other: Shouldn't I wait — it's bound to get cheaper? Yet the fact of the matter is that a businessman can now walk into a computer shop, write a cheque for less than £2,500 and walk out again with a business system.

To break that figure down, we start with a Pet 8032 — it could equally be a Tandy TRS-80 or an Apple II — but at any rate, a 32K system. Price £695, less any discount wrung from the salesman.

Add another £695 for a 340K dual mini-floppy, and around £500 for a reasonable dot-matrix printer. For a shade less than £2,000, our businessman has brought a system.

Highest standards

It has been fashionable for dp professionals to snipe at the quality of the applications software available for the popular micros. Yet, some of the packages now available measure up to the highest standards of the industry, and at stunningly low cost, £325 for a word processor of remarkable sophistication, ledger suites with invoicing at around £500, two examples from many.

Obviously, there are more sophisticated microcomputer systems available — with higher price tags, but the answer to the question: will business systems become cheaper? must now be a qualified no for the immediate future.

The fall in hardware prices has now largely taken place, with the possible exception of printers and certain specialised peripherals. Chip prices could fall further, but with the shortage of production capacity, it is arguable whether any very striking reductions in the prices of the commonly-used devices will now occur. Indeed, recent increases in the price of gold and other component materials have raised production costs.

Even if semiconductor prices were to fall, it is doubtful whether end-user prices would be much affected, for the simple reason that they now represent only a minor proportion of the total manufacturing cost.

It is being suggested in the States that hardware developments will now have less and less impact on system performance. The proposition is that virtually all the major improvements in the immediate future will occur as a result of software enhancements.

It is perhaps worth noting that the Japanese are not entirely in sympathy with that argument. Cynics may feel that to be no more than a reflection of Japanese weakness in the software field.

What is not in doubt is the growing cost of developing applications software. Yet if microcomputers are to be priced competitively, the selling price of the software must remain low. That can be achieved only through volume sales, which is why the best of the new software is being developed to run on a small number of very successful machines.

In practice, we are talking about no more than six branded systems plus those which natively run under the CP/M disc operating system, or can be made compatible with it.

Parallel question

The second most frequently-asked question is the obvious one: "Which system should I buy"? For a retailer there is a parallel question: "Which systems should I sell"? The answers are not necessarily the same.

To a new dealer the soundest advice would be to stick to the established systems, like Apple, Pet, NorthStar and Cromemco, plus perhaps a few others — my personal choice would include BASF and the Act-800.

The reasons are largely commonsense. Those companies are secure financially, enough to ensure the survival of their systems, and their continued development. That is not, unfortunately, true of all the systems advertised. Indeed, it may be doubtful if more than two-thirds of them will still be on sale in a year's time.

Secondly, the computers I have mentioned are all general-purpose workhorses, capable of being turned to many different tasks. That means they satisfy a broader customer base. They have been around long enough to have the major bugs removed. That is also true of the production process itself. In other words, they should prove reliable.

Most importantly, the established systems are supported by a wide range of applications software from independent suppliers. That is important because it means competitive i.e., low, retail prices — hence higher sales — favourable dealer margins — 40 percent is the norm — and quality. No dealer will risk his reputation by re-ordering a poor program. Most important of all, it means choice; at least five good word processors run under CP/M, for example.

The list of top-selling microcomputers in 1981 will, with a few additions, closely resemble the 1980 list. The same will not be true of peripherals.

It is worth considering a question that newly-formed microcomputer companies always ask themselves: Should we search for a new product and import it?

New products

If that new product is to be a new computer then the short answer has to be no. The trade is suffering from a surfeit of new computers just now. Retailers need new systems like a hole in the head. They have more than enough difficulty keeping up with development of existing systems.

In 1981 more importers will probably go out of business than any other type of organisation in our industry. There are three simple reasons for that. Firstly, dealers are rightly reluctant to take on new and unproven systems from new and unproved suppliers. Secondly, importing is capital-intensive. The manufacturer will certainly require payment on release of goods which must then be airfreighted and cleared through Customs.

On the subject of capital, the would-be importer had better be prepared to grant extended credit to his dealer network. Microcomputer importers often find themselves financing stock for four months or more.

A third reason for not becoming a sole agent is the massive cost of establishing a new system in the market place. Advertising and promotion alone can run into five figures each month. On 20 percent gross margin, you need to sell many systems to recover an outlay of that magnitude.

It is certain that you will be up against some smart competition. For a new computer to succeed it must be shown to be better than the established system. Not easy — even when it is better.

Importing peripherals is a much better proposition, although the same caveats apply. However, as I mentioned, the peripheral market is in a state of flux. The present generation of printers is overpriced, and/or unreliable and/or produce poor results. Clearly, the market is open to a low-cost printer with typewriter-quality output, and the kind of reliability associated with solid-state devices.

When one considers the future market for low-cost modems, digitisers, speech synthesisers and the like, it is apparent there will be opportunities aplenty for those who know exactly what they are doing. Those who do not may be recommended to stick to retailing where the necessary education will be spoon-fed by the manufacturers.

The most assured means of profiting from the microrevolution is as a retailer, selling a limited range of popular brands supported by pre-packaged software. Dealers interested in profitability avoid custom software like the plague — which is why it is so hard to find a low-priced specialised program.

The advantage of sticking to well-known brands are numerous. Assuming the quality of the product and financial stability and competence of the suppliers, the dealer will benefit from a steady stream of sales leads; they are the result of national advertising by the sole agent. Some dealers never bother to advertise themselves; they would do very much better if they did advertise.

Pet 8000 series with wordcraft.

Apple has brought out its Apple III. It has been generally well received by the trade, although very few are yet in private hands. The important point to note is that it does not render the Apple II obsolete. It appeals in its various configurations to the programmer, the engineer and the businessman.

The price is not inconsiderable but fair. A very senior Apple executive told me he expected the new model to sell on specification alone. Perhaps he was forgetting what an excellent reputation Apple has.

The company is perhaps quietly and deliberately manoeuvering itself into an IBM-like position in the industry. More than 40 companies support Apple with peripherals, and there must be many more offering software. Plug-in CP/M or Pascal cards? You name it, Apple has it.

Similarly Commodore has its CBM 8032 with 80-column screen, which I dubbed the SuperPet. They will shortly begin to deliver the 8050 mini-floppy disc drive, which offers exceptionally good value at £895 for 950Kbytes of on-line storage. Like Apple III, it is an upgrade which does not render the original models obsolete. Already there is an excellent range of business software available, including some striking individual packages. The system will become one of the mainstays of microcomputing during the next year.

Ingersoll Electronics, a division of the Heron Corporation, is in the process of launching the Atari computer system. It has received a mixed reception in the U.S. With its excellent colour graphics and competitive price, it may make a significant impact in the U.K.

Let us look at Japan for a moment. The U.S. magazine *Electronics* projects that by 1985 the Japanese plan to sell $1.66 billions' worth of computers in the U.S. That is some 20 percent of total Japanese computer production and 60 percent of its export figure. The current figure is $298 million of total production of which only $93 millions' worth are shipped to the U.S.

What those figures conceal is the historical tendency of the Japanese to use Europe as a trial market from which to springboard difficult products into the States.

At present, 70 percent of Japanese computer exports are peripherals. That will change rapidly as the major electrical companies try to establish their brand names. One of the ways in which they will do that is by adopting CP/M to overcome their lack of software expertise. The other is through strong price competition. You can expect to see Japanese computers sold by most high street electrical outlets and through discount houses.

The Japanese usually test-market their products in their own country first. One cannot draw any definite conclusions, since the majority of the products so released never go as far as export. However, it is instructive to examine what is on sale there.

Software-compatible

None of the Japanese machines uses a standard bus, particularly the S-100. Many of them are software-compatible insofar as they have adopted Microsoft Basic. There are approximately 10 OEMs who have adopted CP/M for running Microsoft language processors for software development.

The roof of the Japanese software problem seems to be the absence of micro-software houses, such as Microsoft or Petsoft, and the language difficulty.

The outsider to watch for will be the NEC. It first saw light two years ago when a prototype was installed at a secret location in the heart of Silicon Valley. The Nippon Electric Corporation has produced a computer with better colour graphics and a more powerful Basic — written by Microsoft — than any other Japanese machine. It is as good as the very

(continued on page 67)

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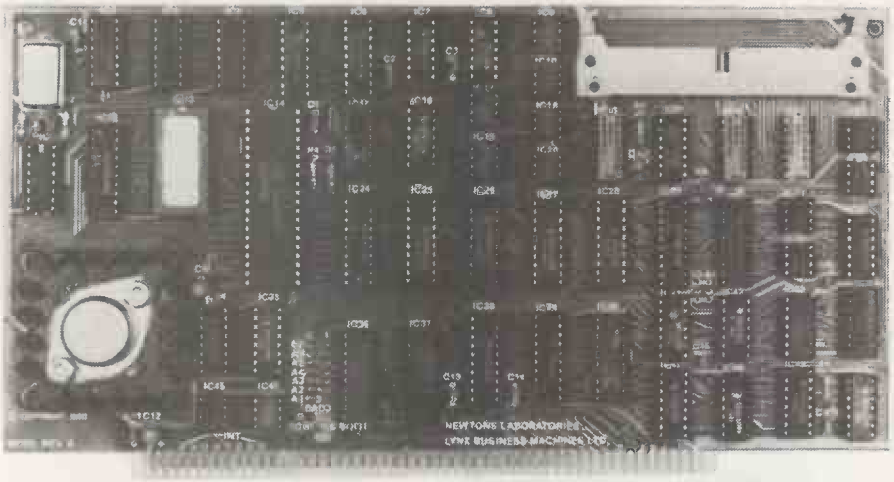

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NEWTONS Laboratories now supply ex-stock complete subsystems consisting of the controller and 10Mb AMPEX disc drive for £3995 (1-off end-user) including a rewritten BIOS for CP/M 2.2. The controller board alone costs £600 (1-off end-user). The disc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

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(continued from page 65)

best of the U.S. micros in the same class.

Most dealers will also carry one of the hand-held computers. Matsushita looks set to do well with their Panasonic and Quasar brands, as does Sharp — already selling well here. The current best-seller in the category is the Sinclair ZX-80, but it is being marketed direct by mail order only at present. As entry-level systems the hand-held computers should generate a good deal of revenue in 1981.

For systems houses who are selling on tailored software, the position is a little different. Yet even the smaller manufacturers will find it hard to compete with the price advantage of the large names where the economies of large-scale production are being harvested with a vengeance.

What we will see is a proliferation of badge engineering, particularly on machines of oriental origin. There is already some confusion in the area, with Radio Shack marketing the Sharp hand-held micro under the Tandy label, but at a higher price.

There is one completely new machine which attracted a great deal of attention when it was shown at the Consumer Electronics Show in Chicago. This was the National Panasonic RL-H1000, a brief-case computer complete with acoustic coupler, miniature 18-column printer, cassette interface, video interface and ROM and RAM expansion modules.

Whole new field

The computer is 6502-based, runs Basic and is to retail in the U.S. at $1,200 — including the brief-case. Panasonic are negotiating with Avon Cosmetics for the sale of several hundred units to be used by sales representatives. That is just one application in a whole new field.

There are now marked discrepancies in the storage capacity of different disc drives. Taking 5¼in. mini-floppies as a case in point, formatted storage capacity may vary between 75K and 1.6 megabytes. If I were a TRS-80 owner with less than 100K of disc storage, I would certainly be a hot prospect for the company offering a drive with 500K bytes or more.

The availability of really good database management software and integrated business packages for microcomputers may well push the demand for high-capacity disc drives through the roof.

A question mark hangs over the future of 8in. floppy drives, so well established in the word-processing and minicomputer markets. On the one hand, they are being squeezed by high-density mini-floppies offering up to two megabytes storage. On the other, the size of Winchester technology hard discs is declining.

There are a number of 5in. micro-Winchesters soon to be available; Tandon Magnetics showed samples of a five-megabyte unit with dual platters at this year's National Computer Conference.

Several manufacturers are now supplying larger hard discs, notably Corvus which offers an 11 megabyte IMI drive for the Apple, and imminently for the Pet also. Cromemco has introduced its Z-2H computer built around an 11 megabyte Winchester disc; it has an excellent specification. Equinox is starting to offer a cartridge drive with five megabytes fixed and five megabyte removable discs, thereby solving the back-up problem at a stroke. High-speed tape cartridge back-up is another growth area.

An important development is the arrival of the Exatron Stringy Floppy. It is a low-cost cartridge device fast enough to compete with floppy discs. In the U.S., it retails for $300, with versions available for most popular micros, including Pet, Apple, TRS-80, OSI and S-100.

I first saw the Stringy Floppy about a year ago when the operating system for the Pet version was under development in Palo Alto. Apart from its speed, the most striking thing about it was the size of the stringy floppying wafers — they are tiny.

The system should be successful for two reasons. Firstly, it represents a price/performance breakthrough that challenges mini-floppies and threatens to make ordinary cassettes obsolete as a means of storing data. Secondly, because there are versions for the most popular machines, it may create a *de facto* standard, although tapes recorded in one format will not be fully compatible with others. Furthermore, the concept is simple and easy to put over in advertising and promotional literature — definitely one to watch.

Sir Keith Joseph's scalpel-wielding does seem to have lit a fire under the Post Office newly hived-off British Telecom. It was even promised to reduce the waiting time for the installation of high-speed data lines from two years to one.

For most microcomputer users, ordinary telephone lines will be quite adequate for their needs. The speeding of the official approval procedure means that by the spring, there will be a number of low-cost acoustic couplers available with the necessary software.

Prices in the U.S. are now down around the $175 mark for the best selling Cat acoustic modem. At these prices, a large proportion of microcomputer users will be interested. What they do with them is another matter.

Mention has been made of the two principal microcomputer networks, MicroNet and The Source which has just been acquired by Reader's Digest.

For the extraordinarily low cost of around $5 an hour, plus the cost of a local telephone call, the user can hook into one of the major networks. Once signed on, he has access to major public databases, like the *New York Times* database, the latest stock market prices, computer dating, software sales, and extra storage.

The Nascom System 80.

Both MicroNet and the Source started as a means of utilising the slack time on existing big computer networks, principally in the evenings and weekends. So successful have they been that new equipment is being added to allow peak-time usage for business micro users.

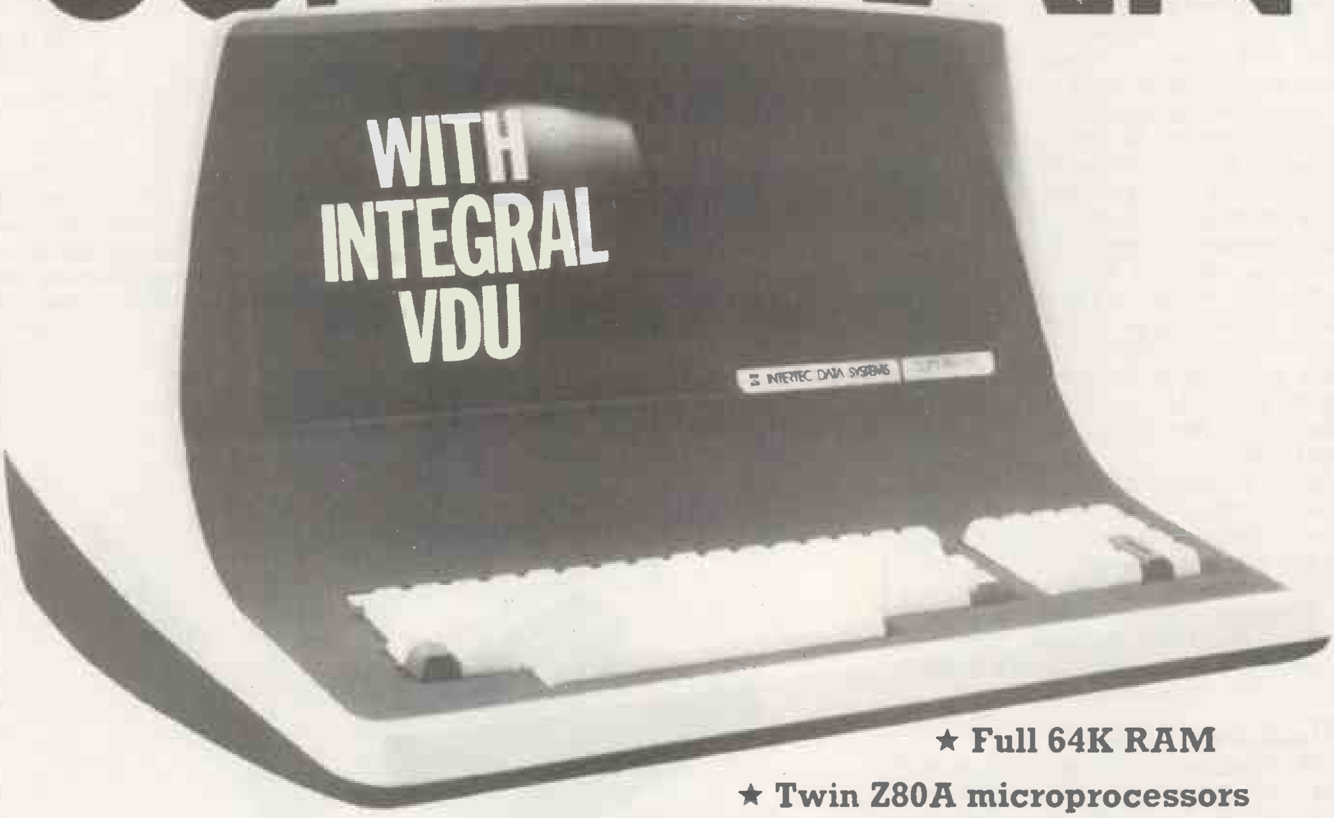
Micronetworking may well take a different form in the U.K. for a number of reasons, not the least of which is Prestel. The subject is likely to remain clouded with uncertainty for some time.

One development likely to play an important part in our lives is that of multi-user systems. Several companies, notably Altos, are beginning to supply hard-disc systems, supporting, in that case, up to four simultaneous users.

One of the very first was the Nestar Cluster One, which allowed up to eight Apples, Pets or TRS-80s to share a single 8in. floppy. One disadvantage was that it required one microcomputer to act as umpire, refereeing the system. The level of file handling also rendered Cluster One

(continued on page 69)

SUPERBRAIN



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more suitable for educational than for business applications.

Next year there will probably be continuing rapid development in the field. There are now two multi-user systems set to battle it out for the Pet market. The first is MuPet, a Canadian system which allows up to eight Pets to be daisy-chained to a single disc drive and printer. The second is the Multi-Pet System developed here by Sandy Livingstone of Taylor Wilson Systems. Those systems are relatively simple and inexpensive and one can expect to see their appearance on a number of popular computers.

I mentioned using the Source micronetwork to transmit electronic mail, and there is no doubt that the majority of microcomputers could be harnessed to that purpose. The question is not whether it will happen, but when.

It is likely that users of electronic mail will fall into two categories: existing microcomputer owners who decided to add a communications option to their system, and business customers with a specific need for high speed, high volume communications.

Small number

In practice, there are a good deal fewer of these than is generally supposed. The number of originators of large volume mail is actually small, consisting principally of Government, insurance companies and mail order houses. One is drawn, therefore, to the conclusion that initial sales will be of peripherals to existing microcomputer users with only a relatively small number of communications terminals for inter-company use.

Of course, these are not the only means of originating electronic mail. Around 20 percent of all word processors sold in the U.S. are supplied with a communications capability. The population of communicating word processors is put at 75,000 in the States — not a very large number.

The Post Office is presently experimenting with a system based on the Rascal ESL-1044 Communications Controller. It will run file management software for the telepost system. So far about 150 ATS Vitel terminals have been installed in large companies for a trial period.

Meanwhile, ITT has announced new software which will enable customers to integrate their systems with networks operating on the recently-established X-25 specifications. They are part of an attempt to standardise the world of public database systems, and the British Telecom packet-switching system will be compatible with them.

However, my own conclusion is that the sales of acoustic couplers and software apart, microcomputer dealers should not be looking to make profits out of electronic mailing systems in the immediate future. That 1981 will be another bumper year for the industry is not in doubt.

The European scene

From the States-side vantage-point, Rodnay Zaks analyses the European micromarket.

THE European market is an apparent mosaic of contradictions. The market in the U.S. is dominated by Radio Shack with the TRS-80 — about 50 percent of the market seems to be dominated by the Pet, followed by both the Apple and the the market seesm to be dominated by the PET, followed by both the Apple and the TRS-80, with a visible penetration by Japanese manufacturers which are non-existent in the U.S.

Sales of microcomputers in Europe are difficult to evaluate, because most manufacturers will not release sales data and because there are very few European-wide distribution systems able to supply the data. It can be estimated that the European market probably represents only 10 to 20 percent of the U.S. market.

Two important factors must be considered when evaluating sales: the first microcomputer to be established strongly on the maket tends to retain a dominant position, and the market is growing very rapidly. Local politics often play a significant role in the limited markets that exist, because of poor consumer education, and short-sighted government intervention.

The U.K. reputed to be in a depression and having a low average per capita income, achieves a high level of microcomputer sales in Europe. That is probably owing to good consumer information — because there is no language barrier — as well as to the immediate usability of U.S. programs written in English. Some economists might also claim that a country in a recession probably has a greater need for microcomputers and automation than a country with a healthy, expanding economy.

West Germany, the most powerful industrial country in Europe, and the largest purchaser of microprocessor components in Europe — perhaps 50 percent in European sales — has been a poor market for microcomputers. A number of the few microcomputer shops open several years ago have now closed, and even fewer new ones have replaced them.

Everyone predicts that the market is about to start growing, but this has yet to occur. Why that has not occurred in a country like West Germany is still something of a mystery, and several possible explanations may be suggested; one might be a possible cultural resistance to a different system.

Because most sales in Europe are made to businessmen and other professionals, those buyers look for the immediate availability of the complete software facilities that they require. In particular, accounting systems used in other countries, such as West Germany, do not adapt easily to the U.S. pattern. That may be a significant item for resistance.

Another possible explanation may lie in the traditional conservatism of the electronics publishing establishment in West Germany, which has remained outside the mainstream of microcomputer developments for many years. To a large extent, the public may simply be uninformed.

In the Netherlands — one of the countries most open to business innovations — microcomputers and microcomputer education have been an instant success. Microcomputer courses have even been featured on a repeated series of courses on television — the Teleac series.

Also, English is understood and spoken throughout the Netherlands, which makes the programs, as well as the manufacturers' brochures and documentation, readily usable.

Scandinavia has recorded limited success with microcomputer products. It has long had a reputation for accepting high technology, but this has also been the case with West Germany. Microcomputers are not used in industry as much as they are used by individuals. Therefore, they have to fit within a cultural and a professional pattern. Apparently, they have not yet fitted well in Scandinavia.

Large quantities

In France, microcomputers are now sold in large quantities, much to the surprise of observers, since a majority of French nationals do not speak English. Most of the purchasers, however, are university-trained, and are able to understand English. Additionally, microcomputers may have become a fashion trend or status item in much the same way that they have in the U.S. In Italy and Spain, sales are lower than elsewhere in Europe.

The situation in Switzerland is hard to assess because many microcomputers might, in fact, be purchased in West Germany or even in France. It appears, however, that microcomputers are sold in small numbers and are used mainly for educational purposes or by engineers.

In summary, the European market is now a mosaic incorporating miscellaneous facets of the evolution of the U.S. market, but is still several years behind the U.S. Some of the products sold in the U.S. will not sell in Europe and some of the products already established in Europe will probably sell there for a very long time.

Many U.S. manufacturers have no understanding of the relative importance of the various European markets and direct their efforts at the wrong country.

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They should be aware that the market is now unstable, and is likely to shift quickly over the next year, as additional segments of the population become aware of the capabilities of microcomputers, and as the various psychological or technical barriers are overcome. At least until West Germany awakes, France may be the largest potential short-term market.

The TRS-80 system from Tandy is marketed in the U.S. exclusively by more than 1,000 Radio Shack outlets. That is a captive network which has achieved spectacular results. Radio Shack is developing a similar network in Europe, but it does not yet compare in size to the one in the U.S.

Short of such a captive distribution, the bulk of microcomputers are sold by the more than 1,000 specialised computer stores. Many other distribution channels are being tested. In particular, a number of department stores are introducing a microcomputer line. Radio and TV stores are also modestly introducing microcomputers.

Marked preference

However, at least in the U.S., buyers seem to have a marked preference for a specialised computer store which gives service after the sale, brings them new products, and makes required changes or updates.

Unless such specialised personnel can be available at the retail outlet, it is unlikely that a complete system can be sold. Department stores are not likely outlets for general-purpose microcomputers, but they carry games-orientated products.

The situation in Europe is altogether different. Microcomputers are sold in a variety of ways. There are relatively few active computer stores. Depending on the country, they may be sold through established radio or electronics stores, directly through magazines, or by agencies set-up by the manufacturers or their distributors.

By and large, most European users are not as aware of the status of microcomputer products as users are in the U.S., so they tend to attach more importance to traditional safeguards. That might be a possible explanation for the marked preference by many customers for established, older, and more traditional stores.

Computer stores are also severely handicapped by their lack of capital, by the delays in securing products, and by the fact that they can seldom offer a comprehensive assortment of equipment. All of those handicaps lead to serious user frustration.

Although national microcomputers have been built in most European countries, only a few have experienced European-wide sales; most have been sold only nationally. It is not easy for those companies to bring information on the existence of microcomputer products to the attention of purchasers in other countries.

Most European companies are not accustomed to the direct style of public relations used by U.S. companies, and will often fail to react to simple requests for information. Cajoling and begging may be necessary to obtain the required information.

A number of those companies are perhaps convinced that they have access to some protected share of the market, either because of a large parent company, or because of their specific competence. Often, however, they may not have the flexibility required to service the general public market at large.

It can be hoped that this will be corrected within the not-too-distant future and that several of the systems will become widely accessible throughout Europe.

Several factors must be examined to evaluate the prospect of existing companies. First, the microcomputer board itself will, with time, continue to diminish in size as LSI circuitry progresses. Again, the dominant cost of the system will be with the peripherals: the CRT display, the printer and the disc required for reasonably quick storage.

Manufacturers capable of mass-producing all or most of the peripherals will reap the highest benefits, and, thereby, be in the best position to sell products on a competitive basis. Once an adequate customer education is achieved, the companies with the best capabilities for integrated mass production will be in the best position to compete on a price basis.

Second, one can expect that the usual devices of protectionism will be invoked in many European countries as soon as governments realise the commercial and industrial impact of microcomputers. Such measures will relate to radio frequency norms, shielding, electrical protection, in addition to various other norms — most of them different or incompatible from one European country to another, e.g., colour standards for televisions, etc.

As long as the market does not become overly restricted by such devices, U.S. companies have an excellent potential for capturing first rank in the markets in most European countries. They are also likely to retain this position once they have obtained it.

A number of European companies have emerged, however, that are taking advantage of various governmental devices for protectionism and financial aids, and that have established viable operations. If additional devices for protectionism are invoked, they could have an impact on a significant share of the national market. In such an instance, the long-term result of such a policy might be to isolate that particular country from the world-wide benefits of microcomputerisation.

The essential usefulness of microcomputers today is to perform practical services. That requires the availability of software and it is just not practical to adapt software from one microcomputer to another. Any national microcomputer, if it is to have long-term value and benefits, should, therefore, be a copy of a leading U.S. microcomputer.

European government intervention might lead to short-term benefits for selected national companies at the expense of potential users, who will be penalised by the unavailability of usable software, while other neighbouring countries will have access to it.

Only specialised segments of the European population will be reached by the microcomputer industry in the near future. The short-term market is likely to be much more fragmented in Europe than in the U.S. and there will be more focus on specific professional categories within each country. In the long-term market, however, every educated segment of the professional population will eventually be reached.

Assessing the market by speaking to the manufacturers may provide, at best, highly-tentative data as most manufacturers may not even know to what kind of a market they have access nor are they willing to discuss it.

Discussing the market with computer store owners is also, at best, tentative, since many computer store owners are entrepreneurs rather than technicians and have only a feel for the local market to which they have access.

Public events

Probably the best way to assess the market is to attend large-scale public events such as congresses and shows focused on microcomputers — provided they are attended by qualified participants.

Qualified participants does not mean that the visitors attend just to gawk at the equipment, and to ask endless questions with no intention of buying a microcomputer.

Participating in such events or talking to companies which have exhibited at such events provides a much more accurate idea of the new segments of the market in microcomputers.

The dice are still rolling. While the market has somewhat stabilised in the U.S., it is still fluctuating in Europe, and several years may pass before a stable pattern becomes visible. The share of the total market that any single company can dominate in Europe might seem small by U.S. standards.

For example, if a company were to capture the equivalent of 10 percent of the U.S. market, that might seem small, except that a leadership position in many European countries is hard to dislodge, and insures that the company will keep the major share of the available market.

In other words, a well-managed company with good European marketing could achieve sales in Europe which might represent only seven percent or eight percent of the total sales in the U.S., but that might represent 50 percent or 80 percent of that particular company's U.S. sales. The race is still open.

Evaluating microprocessors for real-time service

SOME physical experiments require high, real-time data-processing rates to sift desired information from extraneous clutter and noise. In many cases, commercial signal-processing instruments are available to perform the task but there are situations which call for the development of a special-purpose data processor.

If the processing rate is lower than 10^3-10^4 bytes s^{-1} the first law of microcomputers, *EDN,* 1977, will usually apply: Over a wide range of applications, any CPU board will do.

However, when data rates exceeding 10^4 bytes s^{-1} require to be processed in real time the choice of microprocessor types become critical. That was the case in a signal processor being developed for a radar meteor detection system. The real-time data enters the processor at a fixed rate of one byte every 33 microseconds, which severely limits the scope of operations attainable with available microprocessor types.

Speed comparison

Accordingly, a comparison of the effective processing speeds of various microprocessors was undertaken. The starting point is the manufacturer's recommended clock cycle time T_c, which lies between 100ns and one microsecond for all microprocessor types considered.

Anywhere from one to 20 clock cycles are required for a machine cycle in which the microprocessor completes an externally meaningful change of state, e.g., fetching a byte from memory and placing it in the low order byte of the program counter.

Let this number be N_m, so the machine cycle time T_m will be

$$T_m = N_m T_c.$$

In some cases, N_m varies, so it is better in such cases to set $N_m = 1$ and absorb the variation in the factor N_i, which is then the average number of clock cycles per instruction. Otherwise N_i is the average number of machine cycles per instruction.

by C S L Keay

N_i is the first factor which can vary according to the task being performed, but the variation would be within a factor of two for all but the most unusual or specialised programs. The minimum possible value of N_i is included in the comparative figures in table 1 to indicate the lower limit for this factor.

Attempts to utilise only those instructions requiring the fewest machine cycles will generally produce programs containing more instructions, which is self-defeating.

The average time per instruction is therefore

$$T_i = N_i T_m = N_i N_m T_c$$

In signal processing and other compact data-manipulation programs, a very reasonable benchmark routine is the one devised by Osborne, *et al.*, 1977, and applied by them to a wide range of microprocessors. For realism, the loop in the program is counted 10 times to give less weight to the initialising instructions.

The resulting program run times T_p are listed in table 1 with the factor N_p which is the number of instructions per benchmark program. Thus, we may write

$$T_p = N_p N_i N_m T_c$$

The values of T_c, T_m, T_i and T_p are shown diagrammatically in the chart, figure 1, which reveals more clearly how given microprocessors compare in terms of speed. The chart emphasises the importance of evaluating microprocessors by the use of benchmark assessments rather than naive comparisons based on clock or machine-cycle speeds or even instruction timing.

The results in table 1 are concordant with other published benchmark results, such as the 12 test results from three sources collated by Boisvert, 1977, and the Basic compiler benchmarks published by Rugg and Feldman, 1977.

The bi-polar 8 × 300 microcontroller, as its manufacturer prefers to call it, is the fastest performer by almost an order of magnitude. However it is expensive, a power-hog and difficult to use because it is 16-bit instructions, 8-bit data words are in separate memory areas and self-modifying code is not possible.

Even so, we have used it very successfully for high-speed digital image-slicing applications where its sheer speed is essential.

Slower versions

The next two 8-bit microprocessors in terms of run-time, T_p, are the 6502A and the Z-80A running almost neck and neck. The slower versions of those two processors are among the next in order and it is no accident that they are by far the most widely-used in modern microcomputer systems — Apple II, Pet, Sorcerer and TRS-80 are well-known examples.

In distinguishing between the Z-80A and the 6502A, their individual strengths and weaknesses had to be considered carefully. The great strength of the Z-80 architecture lies in its ability to transfer data at very high rates provided the data does not require to be processed or modified on the way. For data communication, input/output control, file manipulation and database management the Z-80 is much better than the 6502.

However, the 6502 in a signal-processing role offers the advantage of an elegant instruction set with more flexible addressing modes and excellent zero-page capability which, in effect, provides 256 registers with almost the power of the 20 on-chip registers in the Z-80, of which only two permit indexed addressing.

When taking into account the full-memory reference capability of the 6502

Table 1.

PROCESSOR	f MHz	T_c ns	N_m	T_m ns	N_i	N_i MIN.	T_i	N_p	T_p
PACE[a]	1.33	750	4	3000	5.1	4	15.3	65	995
SC/MPII (8060)	4	250	4	1000	15.9	5	15.9	50	795
F8	2	500	4	2000	2.4	1	4.8	69	332
6100 [PDP-8]	4	250	20[b]	5000	1.2	1	6.0	50	300
2650	1.25	800	3	2400	3.7	2	8.9	33	294
6800	1	1000	1	1000	4.9	2	4.9	56	274
8080A	2	500	1[c]	500	7.7	4	3.9	65	254
COSMAC (1802)	6.45	155	8	1250	2.1	2	2.6	74	192
2650A-1	2	500	3	1500	3.7	2	5.5	33	184
9900[a]	3	333	1[c]	333	16.0	8	5.3	32	171
8085	3.10	320	1[c]	320	7.7	4	2.5	65	162
CP1600[a]	5	200	2	400	8.0	4	3.2	45	144
6800B	2	500	1	500	4.9	2	2.45	56	137
6502	1	1000	1	1000	3.0	2	3.0	45	135
LS1-11[a]	10	100	4	400	14.0	13	5.5	24	130
Z-80	2.5	400	1[c]	400	19.5	4	7.8	15	117
Z-80A	4	250	1[c]	250	19.5	4	4.88	15	73
6502A	2	500	1	500	3.0	2	1.5	45	68
9440[a]	10	100	2	200	6.9	5	1.4	47	67
8x300[d]	8	125	2	250	1.0	1	0.25	34	8.5

a. 16-bit processor
b. Fetch and execute cycle
c. Varies; so refer T_m to T_c directly
d. 16-bit instruction; 8-bit data.

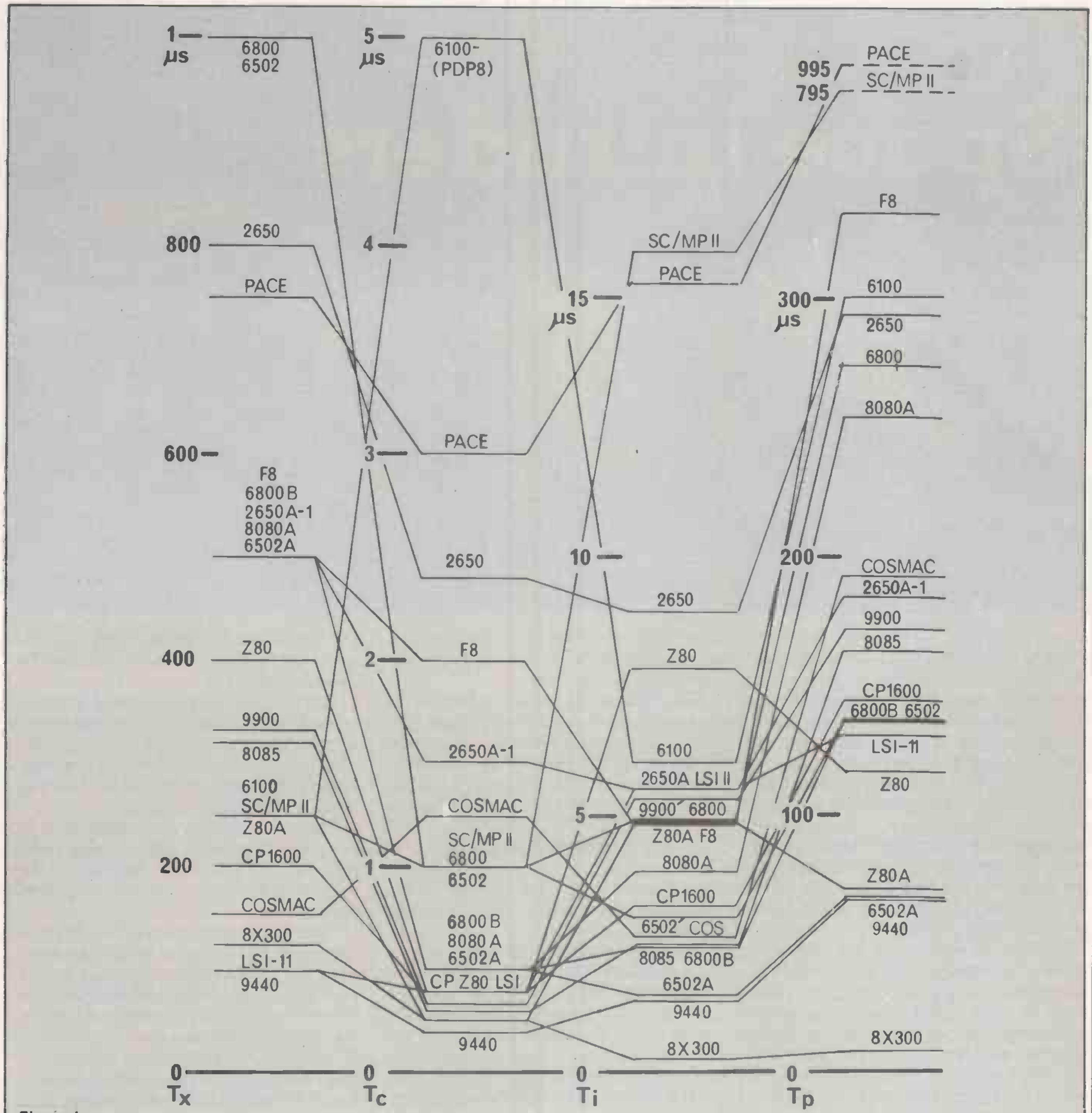


Figure 1.

arithmetic, logical and shift commands compared to the Z-80 ability to memory reference only the load and store commands, the 6502 has superior properties for real-time signal processing.

Power consumption

It also possesses other worthy advantages such as lower power consumption, excellent peripheral interface devices compatible with those of the 6800 family and these and the processor are all available at low cost from a variety of sources.

The merits of 16-bit processors are not very relevant to systems with small memory space where the data is principally manipulated in 8-bit byte form. The economic penalties of greater memory requirements and costlier devices, together with less ready availability of the fastest type, removed 16-bit processors from the final choice.

Some sections of the meteor signal processor have now been built and are presently under test. The completed processor will employ 10 microcomputer units with the first five in a daisy-chain configuration, each performing a specific function such as signal averaging.

The 10 microcomputers are each on identical printed circuit boards. The only differences are in their programs stored in EPROMs and their interconnections and handshaking methods which are greatly facilitated by the versatility of the peripheral interface adaptor chips compatible with the 6502A.

The cost of each microcomputer board is slightly less than £50 for components, which makes the multi-microcomputer solution a very cost-effective one for the real-time, data-processing task.

References

System Design Project, EDN Journal, 22, 21, pp144-150, November 20, 1977.

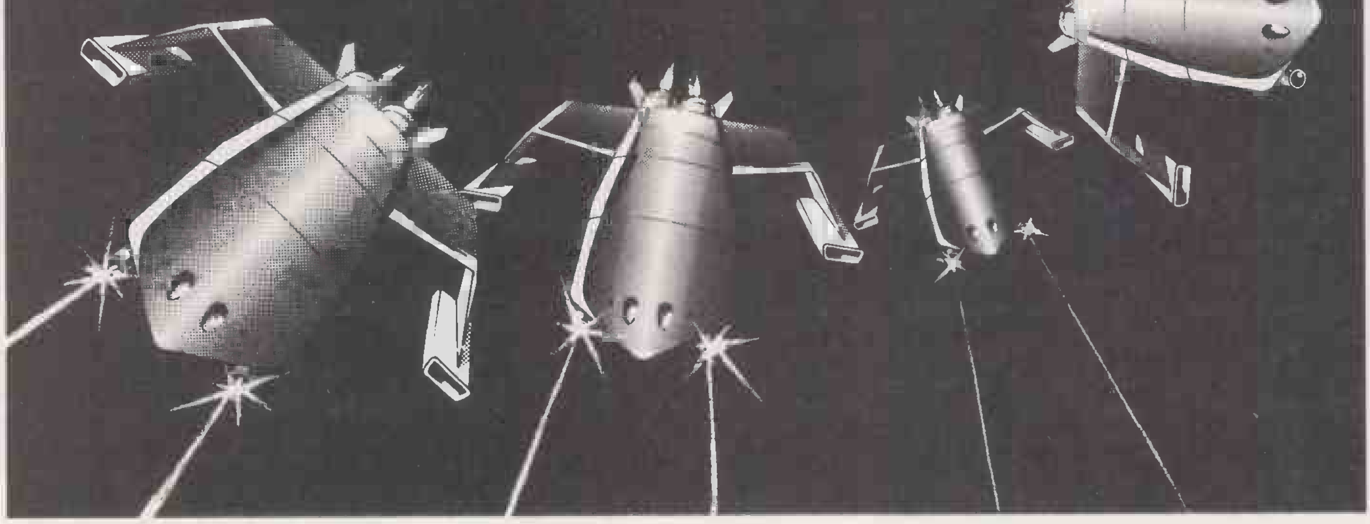
Osborne, A, Jacobson, S and Kane, J, An introduction to Microcomputers, Volume 2, Some real products, Osborne and Associates, Berkeley, June 1977.

Boisvert, C, EDN Journal, 22, 21, P19, November 20, 1977.

Rugg, T and Feldman, P, Kilobaud, 1, 10, pp20-25, October 1977.

Practical Computing **presents a Basic program of the famous invasion pub game, which is fast enough to offer a challenge to most players.**

Space Intruders



by Simon Goodwin

SPACE intruders is perhaps the first effective attempt at using a Basic language — and hence transportable — program to simulate the zap-the-greenies game which has contributed to a national small-change shortage in Japan and seems to have taken over every pub in the U.K.

For those who have already spent £10s on the game, I have included extensive notes on conversion of the game to machines other than the Apple II for which it is written, and I have outlined a few variations you might like to try when you have the version of the game listed up-and-running satisfactorily.

Two main techniques are used to optimise the speed of the game, which is potentially the greatest problem when trying to write such a program in Basic. Firstly, the flow of the game has been adjusted very carefully so that only the essential operations occur in the main loop of the program but that the chrome, e.g., the appearance of the command ship across the top of the screen, still operates at regular intervals to keep the game interesting.

Second technique

The second technique used is rather more machine-dependent. Up to a limit of about 100 characters on a line, multiple-statement lines are used to speed program execution. They involve one special Apple integer Basic feature I often find useful — most interpreters will ignore all statements on the same line after a THEN if the IF condition is not satisfied, whereas the Apple language ignores the statement only immediately following the THEN.

To convert that feature to a different brand of Basic, either use a new line after each THEN or follow each conditionally-executed statement with an ELSE if you have the facility to do so.

Most interpreters run subroutines at the start of program RAM faster than ones later in memory, so the order of sections of the listing has been set out to reflect this. Likewise, if you define the variables to be used most often by the program as early as possible in it, in order of utility, your machine's access to them should be accelerated.

Use integer variables if possible, as they can be handled far more quickly than floating-point ones, and if your language does not use a semi-compiled format — does it check for syntax errors after the entry of each line? — try to avoid using numeric constants as opposed to variables as each time the computer executes them, it may have to convert them to its own number-format for processing, which takes time.

The listing of the game uses quite a few CALLs to a machine-code sound-effect routine, and they can be deleted if not compatible with your computer, to speed things. Fast graphics access of the Set, Reset, point variety, as on TRS-80, Nascom 2, etc., is required on a 40 by 40 co-ordinate grid, but a keen memory-mapped VDU user could probably produce a working version on 16 lines of 32 characters at a pinch.

Most will, I suspect, be quite familiar with the various arcade versions of the game. On the screen are displayed, at first four rows of five multi-coloured enemy spacecraft. You control a laser cannon which can move under your control across the bottom of the display firing upwards at the spaceships when instructed to do so from the keyboard.

Between you and the enemy at intermittent intervals are piles of shields which protect you from bombs dropped continuously and at random by the invaders. Those shields also tend to be in your way if you try to shoot through them.

You aim to destroy the spaceships at as fast a rate as possible without being hit by their bombs. Your score is based on the number of spaceships you hit before they destroy you.

The game is made more difficult by the fact that the columns of spaceships move back and forth across the screen as you do your best to hit them, and whenever the edge of a row disappears from the end of the screen or when you have destroyed all 20 attackers — extra points for that — they return moments later, reinforced and lower on the display, giving you less and less time to avoid their bombs.

Command ship

When all that grows boring, every so often the green alien command ship dashes across the top of the screen, giving you 300 points if you plug it with your laser before it vanishes.

In the program listed, I have used a repetitive system with the array R to store ones and zeros to tell me whether a given spacecraft in the formation is destroyed. Two-dimension arays would offer a much better system and I feel the technique used is not the best for the job, if a re-write is intended. The system is used to prevent reincarnations of spacecraft as they move.

The key to the operation of a fast Basic game is that only what absolutely has to be done at a given time is implemented. The main part of the program, sections four, five and six, are run in a tight loop to keep the bombs falling and the laser moving or firing as fast as possible.

At every third move, the slower routine one is called to move the aliens around, check that the screen is not empty, print the score, and catch-up generally on less immediate business.

For nine out of every 80 turns, the machine displays the moving command ship, doing a special branch to an add-on routine which moves the alien commander's ship, and keeping speed up by dispensing with the move-invaders routine one for a few turns.

The listing of the game is in Apple integer Basic, which will need conversion for other machines. In addition to the point mentioned earlier about the IF . . . THEN construct, there are a few other special machine commands in the listing. Peeks Pokes and Calls are used to generate sound effects, scan the keyboard and clear the screen. All should be deleted, and any loops containing those instructions can also be removed.

Line 580 is used to initialise the variables: use DEFINT on other machines or just set the values to zero in the order given — remember the earlier a variable is encountered by Basic, the quicker it will be found in the variable-table when later accessed.

Graphics modes

The GOSUB 740 initialises the tone subroutine and is now redundant. The GR and TEXT commands set graphics and text modes respectively, and should be replaced by the equivalent commands, if needed, for your machine.

Lines 260-290 scan the keyboard of the Apple. If you do not have a keyboard-scan Get instruction which does not halt processing, try 260 INKEY or GET M/ 270 IF M ≠ 2 . . . / 280 IF M ≠ 4 . . . 290 IF M ≠ 9 . . . For a Tandy Model 1 use 260

Variables

R%(%) = Aliens hit matrix.
V (%) = Vertical Bomb position.
H (%) = Horizontal Bomb position.
X = Laser fire X co-ordinate.
Y = Laser Fire Y co-ordinate.
L, M, N, General-purpose fast-access variables.
G = Laser Gun position.
S = Player's score.
T = Number of turns passed.
V = Vertical Intruder position.
H = Horizontal Intruder position.

M = PEEK(—14340) 270 IF M ≠ 128 . . . 280 IF M ≠ 4 . . . 290 IF M ≠ 1 . . . and press keys W or R to move and P to fire.

The Apple has a 24-line screen and only the bottom four lines are available for test while the graphics display is in use. Hence, the VTAB and TAB instructions are used to set the absolute print positions of messages. The MOD function returns the remainder of two numbers after division, i.e., 26 MOD 10 = 6.

For other Basics, X MOD Y should evaluate as X-INT(X/Y)*Y for positive numbers. Put in INTs as needed if you decide to throw caution to the wind and use floating-point variables. Delete the REMs to speed things up if necessary.

When describing the graphics, I will assume that you have a black-and-white TV displaying graphics in a manner similar to TRS-80, e.g., SET (X,Y) turns on a dot, RE-SET (X,Y) turns it off, and POINT (X,Y) returns 0 if there is nothing at a position and a positive number if that position is SET.

Apple graphics uses a 40 by 40 screen area, with the origin (0,0) at the top-left of the display. The manual says that this feature is a specially useful one, but does not say why. A PLOT command corresponds to either SET or RESET depending on the most recent COLOR = statement. If colour is zero it is RESET, otherwise use SET. Now, you can delete all the COLOUR statements.

The SCRN feature on Apple is the equivalent of POINT elsewhere. The really impressive features are HLIN and VLIN, which have equivalents in TRS-80 level four Basic. Those plot lines, e.g., HLIN X,Y AT Z does a series of SETs — or RESETs if the last colour used was zero — along a horizontal line at height Z from positions X to Y inclusive. VLIN X,Y AT Z draws a vertical line at position Z from X to Y, inclusive.

I hope you do not feel, having read through the list of alterations for other Basics, that you are confronted by a really massive task, because if you follow the instructions carefully, you should quite quickly have with a game a cut above the average which is already rapidly wearing-out the keys of a few computers and running successfully — you may also have learnt something about dialects of Basic into the bargain.

You should by then also be able to change parts of the program to suit your own tastes, doing anything from changing the keys used — on the day when two, four, and nine disappear into the case of your machine as things grow somewhat hectic — through to building-in various extra features of your own design. I have tried several variations.

Alternative game

'Armed Intruders' is a game for masochists which replaces the line randomly choosing the position of the next bomb to fall, with one setting the position to G + RND(3)-1, where G is the gun position and RND(X) returns a truly random integer between 0 and X-1, in this case 0, 1 or 2.

It could be arranged to choose either a random or a determined bomb position alternately by using IF T MOD 2 = 0

If checks are incorporated to ensure that no bombs go off the screen, they can be made to move diagonally or zigzag, which gives the extra possibility of collisions between them.

The fire of the laser could be set to travel at the same speed as the bombs or to zigzag also. That is why two different variables are used for X and G.

```
>LIST

  99 REM *********** JUMP TO INITIALISE **********
 100 GOTO 580
 109 REM *********** CLEAR HIT ARRAYS **********
 110 FOR M=1 TO 5:R1(M)=1:R2(M)=1:R3(M)=1:R4(M)=1: NEXT M: RETURN

 119 REM *********** COMAND SHIP ROUTINE **********
 120 R1=((T MOD 80)-70)*4: COLOR=0: HLIN R1-4,R1-3 AT 2: POKE 0,
     40: POKE 1,3: CALL 2
 130 COLOR=9: HLIN R1,R1+1 AT 2: IF R1<34 THEN 250: COLOR=0: HLIN
     R1,R1+1 AT 2: GOTO 250
 139 REM *********** MOVE ATTACKERS **********
 140 COLOR=0: FOR L=0 TO 12 STEP 4: HLIN 1,38 AT V-L: NEXT L
 150 M= RND (3): IF M=1 THEN M=0:H=H-M+1: IF H<12 AND H>0 THEN 170

 160 R1=0:V=V+2: IF V>32 THEN 770:H=3: GOSUB 110
 170 FOR L=1 TO 5:M=H+L*6-6
 180 IF R1(L)=0 THEN 190: COLOR=(V MOD 14)+1: HLIN M,M+2 AT V
 190 IF R2(L)=0 THEN 200: COLOR=((V+2) MOD 14)+2: HLIN M,M+2 AT
     V-4
 200 IF R3(L)=0 THEN 210: COLOR=((V+3) MOD 14)+2: HLIN M,M+2 AT
     V-8
 210 IF R4(L)=0 THEN 220: COLOR=((V+5) MOD 14)+2: HLIN M,M+2 AT
     V-12
 220 NEXT L: VTAB 22: PRINT S;: TAB 1: GOTO 250
 229 REM *********** MAIN LOOP START ***********
 230 T=T+1: IF T MOD 80>70 THEN 120: IF T MOD 3#0 THEN 250
 240 GOTO 140
 249 REM *********** DRAW GUN/NEXT COMMAND **********
 250 COLOR=0: HLIN G-1,G+1 AT 37: PLOT G,36: PLOT X,Y
 260 M= PEEK (-16384): POKE -16368,0
 270 IF M#178 THEN 280:G=G-2: IF G<2 THEN G=2
 280 IF M#180 THEN 290:G=G+3: IF G>37 THEN G=37
 290 IF M#185 THEN 310
 300 POKE 0,50: POKE 1,15:X=G:Y=36
 310 COLOR=3: HLIN G-1,G+1 AT 37: PLOT G,36
 319 REM *********** MOVE YOUR FIRE **********
 320 IF Y<4 THEN 490
 330 COLOR=0: PLOT X,Y:Y=Y-2: COLOR=4: PLOT X,Y:M= SCRN(X,Y-1)+ SCRN(
     X,Y-2): IF Y>3 AND M=0 THEN 330
 340 IF R1=0 OR Y>4 THEN 370: IF G>35 OR X>R1+1 OR X<R1 THEN 370
     : COLOR=6: PLOT R1-1,2: PLOT R1+2,2
 350 FOR L=-5 TO 8: POKE 0,100- ABS (L)*10: POKE 1,6: CALL 2
 360 NEXT L: COLOR=0: HLIN R1-1,R1+2 AT 2:T=T+9:S=S+300:R1=0
 370 FOR N=1 TO 4: IF X#H(N) THEN 380: COLOR=0: PLOT H(N),V(N):V(
     N)=39
 379 REM *********** CHECK FOR EXPLOSION **********
 380 NEXT N: IF M=0 THEN 490: COLOR=13: HLIN X-1,X+1 AT Y: PLOT
     X,Y-1: PLOT X,Y+1
 390 COLOR=11: HLIN X-1,X+1 AT Y: PLOT X,Y+1: PLOT X,Y-1: FOR N=
     0 TO 5: POKE 0,-N*7+120: POKE 1,3: CALL 2
 400 NEXT N: COLOR=0: HLIN X-1,X+1 AT Y: PLOT X,Y+1: PLOT X,Y-1:
     M=X-H
 410 IF M<0 OR (M MOD 6)>2 OR Y>30 OR M>29 THEN 490:M=M/6+1
 419 REM *********** DESTROY BOTTOM ENEMY UNIT **********
 420 IF R1(M)=0 THEN 430:R1(M)=0: GOTO 480
 430 IF R2(M)=0 THEN 440:R2(M)=0: GOTO 480
 440 IF R3(M)=0 THEN 450:R3(M)=0: GOTO 480
 450 IF R4(M)=0 THEN 490:R4(M)=0: GOTO 460
 460 IF R4(1)+R4(2)+R4(3)+R4(4)+R4(5)#0 THEN 480: FOR L=0 TO 4: FOR
     M=-2 TO 5: POKE 0,100-L*10- ABS (M*6): POKE 1,4: CALL 2
 470 NEXT M,L:H=100:S=S+100: VTAB 23: GOTO 140
 480 S=S+(40-Y)*((Y>24)+1):Y=2
 489 REM *********** CHECK FOR NEW MISSILE **********
 490 FOR N=1 TO 2+R4(1)+R4(5): COLOR=0: PLOT H(N),V(N): IF V(N)<
     37 THEN 520:V(N)=V+1
 500 L= RND (5): IF R4(L+1)=0 THEN 570:H(N)=H+L*6+1: POKE 0,25: POKE
     1,5: CALL 2
 510 POKE 0,50: POKE 1,5: CALL 2
```

(continued on next page)

(continued from previous page)

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519 REM ********** MOVE MISSILE & CHECK FOR HIT **********
520 V(N)=V(N)+2: COLOR=1: PLOT H(N),V(N):M= SCRN(H(N),V(N)+2)+ SCRN(
    H(N),V(N)+1)
530 IF M=0 THEN 570: COLOR=4: VLIN V(N),V(N)+2 AT H(N): FOR L=0
     TO 5: POKE 0,-L*6+90: POKE 1,3: CALL 2
540 NEXT L: COLOR=9: VLIN V(N),V(N)+2 AT H(N)
550 COLOR=0: VLIN V(N),V(N)+2 AT H(N): IF H(N)<G-1 OR H(N)>G+1 OR
    V(N)<34 THEN 560: GOTO 770
560 V(N)=39
570 NEXT N: GOTO 230
579 REM ********** INITIALISE EVERYTHING **********
580 L=M=N=X=Y=G=S=T: GOSUB 740
590 DIM V(4),H(4),R1(5),R2(5),R3(5),R4(5)
600 GOSUB 110
610 FOR L=1 TO 4:V(L)=36:H(L)=0: NEXT L
620 TEXT : CALL -936
630 PRINT "*** SPACE INTRUDERS 42 INTEGER BASIC ***"
640 PRINT "  WRITTEN BY SIMON GOODWIN,  (C) 1980.  "
650 PRINT " PRESS 2 TO MOVE LEFT, 4 TO MOVE RIGHT  "
660 PRINT " AND 9 TO FIRE YOUR LASER."
670 FOR L=0 TO 2000: NEXT L
680 GR : VTAB 22: PRINT "       : CURRENT SCOREBOARD."
689 REM ********** SET POSNS. & SET UP SCREEN **********
690 T=0:S=0:V=15:G=19: COLOR=6: HLIN 0,39 AT 38: COLOR=2
700 FOR L=0 TO 3: FOR M=1 TO 3
710 HLIN 5+L*8,8+L*8 AT 27+M*2: NEXT M: NEXT L
720 COLOR=12: HLIN 0,39 AT 0:H=7:Y=1: VLIN 1,38 AT 0: VLIN 1,38
     AT 39
730 GOTO 140
739 REM ********** APPLE SOUND ROUTINES **********
740 POKE 2,173: POKE 3,48: POKE 4,192: POKE 5,136: POKE 6,208: POKE
    7,4: POKE 8,198: POKE 9,1: POKE 10,240
750 POKE 11,8: POKE 12,202: POKE 13,208: POKE 14,246: POKE 15,166
    : POKE 16,0: POKE 17,76: POKE 18,2: POKE 19,0: POKE 20,96
760 RETURN
769 REM ********** INTRUDERS HIT THE DECK **********
770 IF V>32 THEN PRINT "¡¡¡¡¡¡¡¡¡¡ THE INVADERS LAND ! ¡¡¡¡¡¡¡¡¡¡ "

780 IF V<33 THEN 790: FOR L=0 TO 39 STEP 2: COLOR=(L MOD 14)+1:
     VLIN 33+ RND (7),39 AT L: NEXT L: FOR L=0 TO 2000: NEXT L
789 REM ********** INTRUDERS DELETE YOU **********
790 PRINT "THE INVADERS DESTROY YOUR LASER CANNON !"
800 FOR L=1 TO 150: POKE 0,100- ABS (100-L)/2: POKE 1,5: CALL 2

810 NEXT L: PRINT "ΣΣΣ YOU ARE CAPTURED AND DISSECTED. ΣΣΣ"
820 FOR L=1 TO 26: COLOR=L: PLOT G-1,37: PLOT G,36: PLOT G+1,37
    : PLOT G,37: POKE 0,50-L: POKE 1,6: CALL 2
830 NEXT L
840 FOR M=0 TO 3: FOR L=1 TO 10: POKE 0,118-L*10: POKE 1,4: CALL
    2
850 NEXT L,M: TEXT
860 PRINT : PRINT "FINAL SCORE WAS ";S
869 REM ********** CLEAR SCREEN & SCAN KEYS **********
870 FOR L=1 TO 17: PRINT : NEXT L: PRINT "TYPE 'A' TO RUN AGAIN
       : "
880 IF PEEK (-16384)<128 THEN 880
890 M= PEEK (-16384): POKE -16368,0
900 IF M>175 AND M<186 THEN 880: IF M=193 THEN 600
910 END
```

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Multiple-choice tests with the micro as question master

IN THE classroom, lessons can be improved by good questioning techniques which help to consolidate the information imparted to the student. The computerised lesson can, to some extent, improve on the ordinary lesson by individual questioning rather than the group method employed in the general classroom.

That type of questioning is limited to the scope of the immediate subject matter of the lesson, whether in the class or computer room. To check the progress of each student over a period of time, examinations and class tests are a useful teaching tool, providing not only a check of progress, but also revision and consolidation of the subject as a whole.

There are three types of question paper in general use for examinations and tests. The written-answer paper is perhaps the easiest to set, but the most difficult to mark, particularly if the teacher attempts to allocate the task to the computer. The short-answer paper needs carefully-worded questions if ease of marking is to be achieved, particularly if marking is to be passed to the computer, where the program can look for key words within a short answer — but which otherwise could be gibberish. The easiest type of question paper for the computer to handle is the multiple-choice test.

Plausible answers

The multiple-choice question consists of a well-defined question, short and to the point, together with four plausible answers, only one of which is the correct answer, the other three are known as distractors. The student has to choose the correct answer simply as A, B, C or D. Some versions of the test have more distractors, or sometimes more than one correct answer to be chosen; those versions are off-shoots of the pure form of the multiple choice ideal.

As the student has only to select the answer, there is less examination strain imposed, yet a wide range of the subject can be covered by many questions, which can be answered in a short examination time as no writing is involved. Answering is usually on a special answer sheet with

by Rex Tingey

crosses marked in appropriate squares; marking is carried out using a masking sheet where only the correct crosses can be seen through the mask.

In the computer, each question, together with its answers, can be presented on the screen, found from multiple-banked data for ease of extraction by the program. So that the program can be suitable for both examination and revision purposes, the displayed question must be answered correctly before proceeding to the next question; marking is, therefore, rather different from the paper examination.

The multiple-choice test was developed by the education branch of the RAF as the only practical way of testing the progress of the vast numbers of recruits under training during the Second World War, and afterwards, during National Service. The research, methods and conclusions have been accepted by modern education authority.

In particular, the test is more useful than other examination methods since each result can be subjected to detailed analysis, and the analyses as a whole used to determine many factors, even to finding the success and level of teaching methods prevailing.

The major use of the analysis is to determine the success of the set of questions, and to allocate, or re-allocate, a difficulty factor to each question in the set. A set of questions should have a range of difficulty factors which approximate a Gaussian standard-deviation curve in distribution. Thus, whenever a set is used, the results should be analysed to re-allocate the positioning. Then, ideally, questions should be selected from a store of questions which cover the whole range of factors.

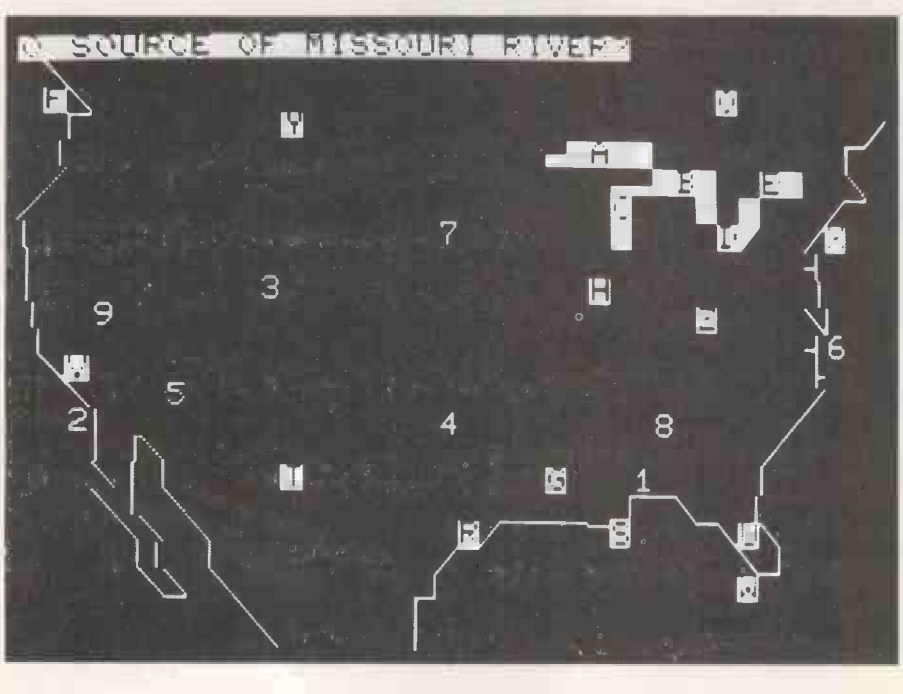
Difficulty factor

If a question shows a particularly high difficulty factor — many students answer it incorrectly — it should be reviewed for ambiguity after checking that it is in the syllabus being taught. No question in a multiple-choice test should be ambiguous. Questions must be kept short, with only one possible answer and answers should be brief, with the distractors relevant or apparently relevant.

That is, of course, where the limitation of this type of test starts, with the requirements of a complex subject needing complex questions with a multitude of answers. However, it can be interesting and surprising to find how a seemingly complex question can be broken-down to several useful multiple-choice questions, each with a short answer.

The programs given are sets of 50 questions, each covering three types of geography papers; regional U.S., regional U.K. and physical geography. Each of the three will fit into less than 8K when run, and provide a running score and a final result. The two regional programs provide a map of the country on which the questions are based, and the map appears on the screen with a question at the top. Whenever a question based on the map is being asked, any key pressed brings the question plus the four answers on to the screen. Further immediate consultations of the map can be obtained by pressing any key but A, B, C or D; pressing one presumes an answer.

While all the questions and answers, as listed, are in upper-case, they should be re-written in upper- and lower-case for a



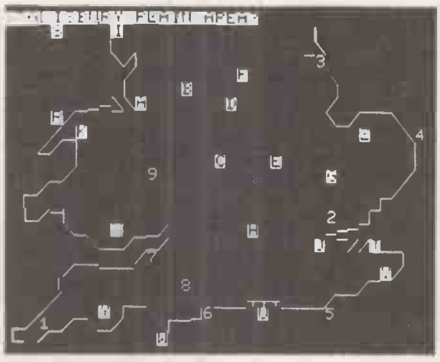
better display, with the appropriate Poke 59468, 14 for lower-case and 12 for upper-case whenever the map is to be displayed. Quotes must be used around that kind of data. The 50 questions emerge with no fixed sequence, in random order, and each question appears only once during a run.

That feature is carried out, first, by a shuffle of the numbers Ø to 5Ø, to become D string, the numbers then being retrieved in the new order by subroutine 7ØØØ, and that particular numbered question found from data, restored each time on 5ØØ before the search. In that way, the same set of questions could be used for revision several times without the student being able to learn an order of answers, or a sequence of letters.

Code letters

The questions and answers are held in data using two different forms of multiple data banking. The question simply has the code letter for the correct answer on the right data end as A, B, C or D, which is extracted and held as Y string whenever a question is displayed. Answers are held in a more complex form as quadruple banking, extracted as B string and then divided into four parts to become the answers printed together with left-hand additions of identity as O, P, Q and R strings.

To achieve the simplicity of extraction, the four answers must be brought to the same length, physically, during programming, by the addition of Øs or spaces, together with a number giving the number of spaces or Øs (+1), so that the manipulations of 5Ø4Ø to 5Ø7Ø may succeed. Not only are the answers more easily entered



when programming, using this method, but extraction is quicker since only two elements of data are read, instead of five.

Furthermore, there is a considerable saving of memory space due to the omission of quotes and commas required for upper- or lower-case data. The extra spaces in the questions shown bring a correct double-line on to the screen without words over-running the line character length.

Because of the essential difference of presentation between ordinary multiple-choice and the computer version, a different method of scoring must be adopted. Ordinarily, marks are allocated only to correct answers, and those marks are totalled and brought to a percentage figure.

Since the computer version insists on an eventual correct answer, so that the test gives a more positive element of revision, the correct answer is allocated five marks, but every incorrect answer deducts two marks from the total score. The system goes further than the ordinary method of scoring by penalising the student who has absolutely no idea of the answer — —1 — over the student who is just a little doubtful — +3. As all the results can be used for comparison they remain fair.

The programs include no method of saving the score, should the student clear or re-run, both of which clear variables from memory. However, if the score is required to be kept and found confidentially, add line:

9Ø1Ø I = I × 4:I = I/1ØØØ:POKE 59459,I

and then to read the percentage score type I = PEEK(59459):?I, and return, and the score will be screened even if the memory has been cleared.

If full and correct multiple-choice techniques and procedures are to be carried out, using analysis of results, adjustment of difficulty factors and construction of new, corrected question papers, the result of each answering attempt needs to be recorded.

Stepped series

As we have the facility of allocating a stepped series of difficulty factors, dependent on the number of tries before the correct answer button is pressed, it is not necessary to know which first-time correct answers have been given — only incorrect inputs need to be known.

To keep in memory a record of the number of wrong answers, a hidden string can be constructed from the numbers of the incorrectly-answered questions, on line 522Ø, first dimensioning the string to the maximum possible incorrect responses (150) right at the start of the program.

Providing that the program has not been cleared of re-run, the string can be screened, printed-out, or added to data on a floppy disc, using a FOR-NEXT loop.

PHYSICAL GEOGRAPHY MULTI-CHOICE

```
100 CLR:Y=1:O=-1:GOSUB8000:PRINTTAB(8)"ANSWER: A, B, C OR D
120 PRINTTAB(6)"COPYRIGHT (C) REX L TINGEY"
200 C$="0102030405060708091011121314151617181920212223242526272829303132333435
220 C$=C$+"363738394041424344454647484950
300 R=2*INT(LEN(C$)*RND(1)/2+1)-1:H$=MID$(C$,R,2)
330 IFR>1THENT$=LEFT$(C$,R-1):GOTO350
340 T$=""
350 C$=T$+MID$(C$,R+2):D$=D$+(N$):IFLEN(C$)>=1THEN300
490 GOSUB7000:GOSUB8000
500 RESTORE:FORK1=1TO50:READA$,B$:IFK1=AGOTO5000
510 NEXT
730 DATA"COVERAGE OF THE WORLD BY SALT WATER IS  APPROX.A
732 DATA"=70%=60%=50%=40%
734 DATA"FRACTURED AND DISPLACED FOLD STRUCTURE  ISA
736 DATA"0004=NAPPE=RECUMBENT=ANTICLINE1=SYNCLINE
738 DATA"PH OF A NEUTRAL SOIL ISD
740 DATA"=PH3=PH6=PH5=PH7
742 DATA"CONTINENTS TEND TO HAVE CLIMATES WHICH  AREC
744 DATA"1=EQUABLE=MARITIME1=EXTREME=MODERATE
746 DATA"RAINCLOUDE FORMED OVER MOUNTAINS AREC
748 DATA"003=FRONTAL003=LEEWARD=OROGRAPHIC02=WINDWARD
750 DATA"BELTS OF HIGH PRESSURE ARE FOUND ATA
752 DATA"=30DEG N & S=60DEG N & S=40DEG N & S=50DEG N & S
754 DATA"SUBTROPICAL GRASSLAND WITH A SCATTERING OF TREES ISB
756 DATA"1=PAMPAS=SAVANNA=PRAIRIE003=VELD
758 DATA"MAP VERT.SCALE=1CM:100M & HORIZ.SCALE= 1CM:500M.VERT.EXAGGERATION=A
760 DATA"1=X5=X10=X50=X.2
762 DATA"A SOLAR YEAR CONSISTS OFA
764 DATA"=365 1/4 DAYS0004=365 DAYS=364 1/4 DAYS0004=366 DAYS
766 DATA"CLAY IS A SEDIMENTARY ROCK CLASSIFIED ASA
768 DATA"0004=CLASTIC003=CHEMICAL0004=ORGANIC=BIOCHEMICAL
770 DATA"AT THE POLES THE CENTRES OF PRESSURE AREC
772 DATA"003=POLAR=SEASONAL0004=HIGH00005=LOW
774 DATA"FERMANENTLY FROZEN SUB-SOIL OF HIGH LATI-TUDE APEAS ISD
776 DATA"00005=TAIGA0004=MAQUIS0004=TUNDRA=PERMAFROST
778 DATA"30DEG IN LONGITUDE REPRESENTS A TIME    DIFFERENCE OFD
780 DATA"1=1 HOUR=3 HOURS=4 HOURS=2 HOURS
782 DATA"A TEMPORARY SALT-LAKE BASIN ISD
784 DATA"=BAHADA1=LOESS02=WADI1=PLAYA
786 DATA"OCEAN CURRENTS MOVING TOWARDS THE POLES AREC
788 DATA"02=COOL=DRIFTS02=WARM02=DEEP
790 DATA"ONE INSTRUMENT CONTAINED IN A STEVENSON SCREEN ISA
792 DATA"=THERMOMETER1=RAIN GAUGE1=ANEMOMETER02=WIND VANE
794 DATA"TROPICAL CONTINENTAL CLIMATE IS ALSO    CALLEDC
796 DATA"=DESERT1=ASIAN1=SUDAN1=CHILE
798 DATA"TYPE OF REEF SEPARATED FROM MAINLAND BY DEEP,WIDE CHANNEL ISB
830 DATA"0004=ATOLL02=BARRIER=HORSESHOE1=FRINGING
832 DATA"TOGETHER, WET AND DRY BULB THERMOMETERS MEASUREB
834 DATA"003=DEW POINT=REL.HUMIDITY02=SATURATION1=EVAPORATION
836 DATA"THE TABULAR ZEUGEN IS FORMED BYC
838 DATA"1=DEFLATION1=ATTRITION02=ABRASION=DEPOSITION
840 DATA"GOOD EXAMPLE OF THE BIRD'S-FOOT DELTA ISA
842 DATA"=MISSISSIPPI0000007=NILE000006=VOLGA000006=RHONE
844 DATA"GLACIAL-FORMED WINDING RIDGE OF SAND ANDGRAVEL ISC
846 DATA"02=LOESS=DRUMLIN02=ESKER003=TILL
848 DATA"REDDISH SOILS OF THE HUMID TROPICS ARE  KNOWN ASD
850 DATA"=CHERNOZEM1=RENDZINA003=PODSOL=LATERITIC
852 DATA"IN ATMOSPHERE, AVERAGE LAPSE-RATE PER   1000M RISE ISB
854 DATA"=7.5DEG C=6.5DEG C=4.5DEG C=5.5DEG C
856 DATA"DATE WHEN SOUTH. HEMISPHERE HAS LONGEST NIGHT & SHORTEST DAY ISB
858 DATA"=SUMMER SOLSTICE=WINTER SOLSTICE02=MARCH EQUINOX02=SEPT. EQUINOX
860 DATA"DISINTEGRATION & DECOMPOSITION OF ROCKS IN SITU (ONLY) IS BYB
862 DATA"0004=EROSION1=WEATHERING02=HYDRATION=CARBONATION
864 DATA"HEIGHT OF A SEA WAVE IS DEPENDENT ON ITSC
866 DATA"=LENGTH1=SWASH1=FETCH1=CREST
868 DATA"SUBMERGED GLACIATED COAST FORMS AD
870 DATA"=ESTUARY0004=RIA003=SPIT02=FJORD
872 DATA"SALINITY OF THE OCEANS ISD
874 DATA"02=SAME ALL OVER=MORE AT EQUATOR=LESS AT TROPICS02=LESS AT POLES
876 DATA"ONE TYPE OF MEDIUM-HIGH CLOUD IS THEB
878 DATA"000006=CIRRUS=ALTO-STRATUS00005=CUMULUS00005=STRATUS
880 DATA"LOCAL WIND OF EGYPT ISA
882 DATA"02=KHAMSIN=HARMATTAN02=CHINOOK02=SIROCCO
884 DATA"NUMBER OF MILLIBARS AT WHICH ISOBARS AREDRAWN ISC
886 DATA"1=51=61=4=10
888 DATA"INTERNATIONAL DATE LINE IS THE MERIDIAN ATD
890 DATA"=100DEG=360DEG=200DEG=180DEG
892 DATA"BARE ROCK DESERTS ARE TERMEDA
894 DATA"=HAMMADA0004=REG003=KOUM0004=ERG
896 DATA"A SERIES OF CONCENTRIC CLOSED ISOBARS   INDICATES AD
898 DATA"0004=TROUGH0004=SECTOR00005=FRONT=DEPRESSION
930 DATA"WHICH OF THESE IS NOT A MEDITERRANEAN   CLIMATE SHRUBB
932 DATA"003=MAQUIS0004=TAIGA1=GARRIGUE=CHAPPARAL
934 DATA"LINE ON MAP JOINING PLACES OF EQUAL     RAINFALL ISD
936 DATA"=WATERBAR1=BORABAR1=PLEURET1=ISOHYET
938 DATA"EXAMPLE OF MAJOR DELTA SETTLEMENT ISB
940 DATA"02=CALAIS003=CAIRO02=VIENNA=TOULOUSE
942 DATA"FISH WHICH LIVE NEAR THE SURFACE ARED
944 DATA"=DEMERSAL=PLANKTON02=DORSAL1=PELAGIC
946 DATA"BEAUFORT NUMBER OF STRONG BREEZE 28-32KTISB
948 DATA"=4=6=8=9
950 DATA"RIDGE OF HIGH PRESSURE, PRESSURE HIGHESTATA
952 DATA"=CENTRE1=SIDES1=POINT=TROUGH
954 DATA"ANGULAR DISTANCE N OR S OF EQUATOR. FROMCENTRE OF EARTH ISB
956 DATA"003=GLOBAL1=LATITUDE=LONGITUDE1=MERIDIAN
958 DATA"DIFFERENTIAL RATES OF GLACIER MOVEMENT  CAUSE AC
960 DATA"00005=CWM02=CORRIE=CREVASSE02=CIRQUE
962 DATA"EARTH'S AXIS TILTS FROM PERPENDICULAR   AT ANGLE OFC
964 DATA"0004=23DEG0004=24DEG=23 1/2DEG=24 1/2DEG
966 DATA"ORIGINAL FORM OF THE METAMORPHIC ROCK:  QUARTZITE WASD
968 DATA"0004=SHALE=LIMESTONE02=GRANITE=SANDSTONE
970 DATA"PORT SPECIALIZING IN REDISTRIBUTION OF  CARGO ISC
972 DATA"02=GLASGOW0004=DOVER=ROTTERDAM1=MONTREAL
974 DATA"TERM FOR INHABITED AREAS OF THE EARTH'S SURFACE ISC
976 DATA"1=TERTIARY=SECONDARY02=ECUMENE02=PRIMARY
978 DATA"MESAS OR BUTTES ARE FORMED BYA
980 DATA"003=WINDS003=WATER=GLACIERS02=FAULTS
982 DATA"CLIMATE FOUND ON A CONTINENTS EASTERN   SIDE IS CALLEDA
984 DATA"1=CHINA1=ASIAN=EASTER1=CUBAN
986 DATA"  &   ARE WEATHER MAP SYMBOLS FORC
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(continued on next page)

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```
968 DATA"1=SNOW1=WIND=CLOUD1=HAIL
5000 L=LEN(A$):PRINTLEFT$(A$,L-1):Y$=RIGHT$(A$,1)
5020 M=LEN(B$) M=M/2:M$=RIGHT$(B$,M):N$=LEFT$(B$,M)
5030 N=M/2 O$=RIGHT$(M$,N) P$=LEFT$(M$,N) Q$=RIGHT$(N$,N):R$=LEFT$(N$,N)
5040 C=VAL(O$) B=LEN(O$):O$=RIGHT$(O$,B-C)
5050 C=VAL(P$) B=LEN(P$):P$=RIGHT$(P$,B-C)
5060 C=VAL(Q$):B=LEN(Q$):Q$=RIGHT$(Q$,B-C)
5070 C=VAL(R$) B=LEN(R$):R$=RIGHT$(R$,B-C)
5080 PRINT,"A"R$:PRINT,"B"O$:PRINT,"C"P$:PRINT,"D"Q$
5100 PRINT"",,H"
5200 GETZ$:IFZ$=""GOTO5200
5210 IFZ$=Y$GOTO6000
5220 PRINT"INCORRECT" I=I-2:GOTO5200
6000 I=I+5:J=J+1 PRINT"CORRECT"SPC(1)Y$SPC(15)J"SCORE"I
6010 TI$="000000"
6015 IFTI$<"000002"GOTO6015
6020 GOTO490
7000 O=O+2:O$=MID$(D$,O,2):A=VAL(O$) IFO>100GOTO9000
7010 RETURN
8000 PRINT" PHYSICAL GEOGRAPHY MULTIPLE CHOICE ":RETURN
9000 GOSUB8000:PRINT"SCORE"I" OUT OF 250"
READY.
```

REGIONAL GEOGRAPHY U.K. MULTI-CHOICE

```
100 Y=1:O=-1:GOSUB8000:PRINTTAB(7)"ANSWER: A, B, C OR D
120 PRINTTAB(6)"COPYRIGHT (C) REX L TINGEY"
200 C$="0102030405060708091011121314151617181920212223242526272829303132333435
220 C$=C$+"36373839404142434445464748495 0
300 R=2*INT(LEN(C$)*RND(1)/2+1)-1:N$=MID$(C$,R,2)
330 IFR>1THENT$=LEFT$(C$,R-1):GOTO350
340 T$=""
350 C$=T$+MID$(C$,R+2):D$=D$+(N$):IFLEN(C$)>=1THEN300
490 GOSUB7000
500 RESTORE:FORK1=1TO50:READA$,B$:IFK1=AGOTO4500
510 NEXT
730 DATA"MANCHESTER IS ATB","='F'= B'='D'='A'","BIRMINGHAM IS ATB
734 DATA"='D'='C'='F'='E'","LIVERPOOL IS ATD","='3'='X'='I'='A'
742 DATA"OXFORD AND CAMBRIDGE ARE ATC","='C'&'E'='E'&'G'='H'&'G'='H'&'C'
746 DATA"ISLE OF SHEPPEY IS ATD","='R'='S'='U'='T'
750 DATA"2 CENTRES OF COAL MINING ATB","='C'&'F'='X'&'F'='C'&'X'='E'&'X
754 DATA"CENTRE OF STEEL INDUSTRY ATB","='F'='E'='B'='C'
758 DATA"LARGE AREA OF LOWLAND ATC","='8'='U'='Z'='I'
762 DATA"2 AREAS OF NATIONAL PARKLAND ATC","='F'& K'='E'&'K'='K'&'Y'='Y'&'E'
766 DATA"FIRST NUCLEAR POWER STATION ATA","='1'='3'='6'='U'","DOVER IS ATD
772 DATA"='5'='4'= U'='V'","ESSEX IS COUNTY AROUNDB","='G'='2'='J'= H'
778 DATA"2 MAJOR FISHING PORTS ATA","='3'&'4 ='3'&'5'='3'& 6'='4'&'6'
782 DATA"BRISTOL IS ATC","='X'='Y'='7'='1'","DARTMOOR IS ATB
788 DATA"='8'='Y'='7'='1'","RHONDDA AREA ATD","='7'= K'='9 ='X
800 DATA"RIVER AT '3' ISD","=MERSEY02=TEES02=TYNE=HUMBER
810 DATA"POINT CLOSEST TO CONTINENT ATB","='4'= V'='5 ='W
820 DATA"BEACHY HEAD ATB","='4'='5 ='V'= 6 ","PORTLAND BILL ATC
830 DATA"='V'='6 ='W'='5'","MAJOR PORT FOR IRELAND ATC","='3'= I'='R'='7'
836 DATA"AREA OF TIN MINING ATA","='1'='X'='C'= 8 ","SHEFFIELD IS ATB
842 DATA"='E'='D'='3'='C'","MENAI STRAIGHT IS ATD","='U'= W ='V = R
848 DATA"SHROPSHIRE COUNTY AROUNDA","='9'='8'= C ='D
852 DATA"SALISBURY PLAIN AREAD","='9'='H'='Y'= 8
856 DATA"MAJOR RIVER THRO' VALE OF EVESHAMB","02=DART02=AVON=THAMES02=WEAR
860 DATA"MOST UPLAND AREAS ARE INA","1=WEST1=EAST=SOUTH=NORTH
864 DATA"GENERALLY, BRITAIN'S CLIMATE ISB
866 DATA"=CONTINENTAL003=MARITIME003=TROPICAL000006=POLAR
868 DATA"TYPICAL SCOTTISH SUBMERGED GLACIATED      SEA-LOCH ISD
870 DATA"=ESTUARY0004=RIA003=SPIT02=FJORD
872 DATA"IMPORTANT SCOTTISH DAIRYING AREA ISC
874 DATA"00000008=DUNBAR=AYRSHIRE PLAIN=GALLOWAY PLAIN003=UPPER CLYDE
876 DATA"MAJOR SCOTTISH COALFIELD INA
878 DATA"=CENTRAL LOWLANDS1=SOUTH'N UPLANDS0000007=HIGHLANDS0000007=GRAMPIANS
880 DATA"MAJOR FENLAND RIVERSD
882 DATA"1=NENE&YARE1=OUSE&YARE=OUSE&STOUR1=NENE&OUSE
884 DATA"FANS OF LOOSE STONES IN LAKE DISTRICT    AREB
886 DATA"=SHALE=SCREE1=SLAG1=SILT
888 DATA"LARGEST CITY IN SW PENINSULARC","02=EXETER1=BRISTOL=PLYMOUTH1=TAUNTON
892 DATA"HIGHEST MOUNTAIN IN BRITISH ISLESA
894 DATA"=BEN NEVIS02=SNOWDON02=SCAFELL1=SNAEFELL
896 DATA"MAJOR RIVER THRO' BELFAST ISB","02=BANN1=LAGAN=LIFFEY1=BOYNE
930 DATA"EXAMPLE OF INDUSTRIAL TOWN ISC
932 DATA"003=LINCOLN=SHREWSBURY1=SHEFFIELD003=BRISTOL
934 DATA"EXAMPLE OF COMMERCIAL PORT ISD","02=DOVER=CHATHAM003=HULL=GLASGOW
938 DATA"IMPORTANT PRODUCT MINED IN CHESHIREC
940 DATA"=IRON ORE0004=COAL0004=SALT02=KAOLIN
942 DATA"MOST IMPORTANT OIL PORT ATB
944 DATA"0000007=LONDON=MILFORD HAVEN00000008=DOVER00005=PLYMOUTH
946 DATA"MINOR DEPOSITS OF GOLD MINES IND
948 DATA"1=ENGLAND1=IRELAND=SCOTLAND003=WALES
950 DATA"OF IRON ORE NEEDED BY BRITAIN,AMOUNT    MINED IN BRITAIN APPROXB
952 DATA"=35%=45%=55%=60%
954 DATA"BODMIN MOOR & CAIRNGORM MTNS EXAMPLES OFC
956 DATA"0004=EXTRUSIONS1=METAMORPHOSES0004=BATHYLITHS=BEDDING PLANES
958 DATA"GREENWICH MERIDIAN USED AS STANDARD FORB
960 DATA"0004=EQUINOXES0004=LONGITUDE=INT.DATE LINE00005=LATITUDE
962 DATA"CLEVELAND DYKE IS INA","1=YORKSHIRE=LANCASHIRE003=CUMBRIA0004=DURHAM
966 DATA"BARE ROCK PROJECTIONS ON DARTMOOR ARED","=CLINTS1=SILLS=GRYKES02=TORS
970 DATA"ANTRIM PLATEAU IN N.IRELAND EXAMPLE OFC
972 DATA"003=REVERSE FAULT0004=NORMAL FAULT=FISSURE ERUPTION1=CRATER ERUPTION
974 DATA"PORT SPECIALIZING IN CONTAINERS & GRAIN CARRIERSD
976 DATA"003=PORTSMOUTH0000007=REDCAR=MILFORD HAVEN000006=TILBURY
978 DATA"LONDON AIRPORT (HEATHROW) ISC
980 DATA"=SOUTH OF LONDON=NORTH OF LONDON1=WEST OF LONDON1=EAST OF LONDON
4500 IFA<27GOTO10000
5000 GOSUB8000
5010 L=LEN(A$):PRINTLEFT$(A$,L-1):Y$=RIGHT$(A$,1)
5020 M=LEN(B$):M=M/2 M$=RIGHT$(B$,M):N$=LEFT$(B$,M)
5030 N=M/2:O$=RIGHT$(M$,N):P$=LEFT$(M$,N):Q$=RIGHT$(N$,N) R$=LEFT$(N$,N)
5040 C=VAL(O$):B=LEN(O$):O$=RIGHT$(O$,B-C)
5050 C=VAL(P$):B=LEN(P$):P$=RIGHT$(P$,B-C)
5060 C=VAL(Q$):B=LEN(Q$):Q$=RIGHT$(Q$,B-C)
5070 C=VAL(R$):B=LEN(R$):R$=RIGHT$(R$,B-C)
5080 PRINT,"A"R$:PRINT,"B"O$ PRINT,"C"P$ PRINT,"D"Q$
5200 GETZ$:IFZ$=""GOTO5200
5210 IFZ$=Y$GOTO6000
5212 IFZ$>"D"GOTO10000
5220 PRINT"INCORRECT" I=I-2:GOTO5200
6000 I=I+5:J=J+1 PRINT"CORRECT"SPC(1)Y$SPC(15)J"SCORE"I
6010 TI$="000000"
6015 IFTI$<"000002"GOTO6015
6020 GOTO490
7000 O=O+2:O$=MID$(D$,O,2):A=VAL(O$):IFO>100GOTO9000
7010 RETURN
8000 PRINT" GEOGRAPHY UK MULTIPLE CHOICE ":RETURN
9000 GOSUB8000:PRINT"SCORE"I" OUT OF 250":END
10000 IFA>26GOTO5000
10001 L=LEN(A$):PRINT" "LEFT$(A$,L-1)""
10002 PRINT"
10004 PRINT"
10006 PRINT"
10010 PRINT"
10020 PRINT"
10030 PRINT"
10040 PRINT"
10070 PRINT"                                    4
10080 PRINT"
10090 PRINT"
10100 PRINT"          9
10120 PRINT"
10140 PRINT"   r
10160 PRINT"   L                                2
10170 PRINT"
10180 PRINT"
10190 PRINT"
10200 PRINT"
10210 PRINT"               8
10220 PRINT"
10230 PRINT"                      6              5
10240 PRINT"   1
10250 PRINT"   L
10300 GETQ$ IFQ$=""GOTO10300
10310 GOTO5000
READY.
```

REGIONAL GEOGRAPHY USA MULTI-CHOICE

```
100 Y=1 O=-I GOSUB8000:PRINTTAB(8)"ANSWER  A, B, C OR D
120 PRINTTAB(6)"COPYRIGHT (C) REX L TINGEY"
200 C$="0102030405060708091011121314151617181920212223242526272829303132333435
220 C$=C$+"36373839404142434445464748495 0
300 R=2*INT(LEN(C$)*RND(1)/2+1)-1 N$=MID$(C$,R,2)
330 IFR>1THENT$=LEFT$(C$,R-1):GOTO350
340 T$=""
350 C$=T$+MID$(C$,R+2) D$=D$+(N$) IFLEN(C$)>=1THEN300
490 GOSUB7000
500 RESTORE:FORK1=1TO50:READA$,B$ IFK1=AGOTO4500
510 NEXT
700 DATA"NEW ORLEANS IS ATC","='V'='G'='S'='U'
730 DATA"KEY WEST IS ATB","='6 = W'='S'='2'","EL PASO IS ATA","='T'='3'='4'='5'
734 DATA"NIAGARA FALLS BETWEEND","='A'&'B'='B'&'C'='B'&'D'='D'&'E'
742 DATA"MAJOR TIMBER PRODUCING AREA AROUNDA","='8'='4'='9'='T'
746 DATA"2 MAJOR COALFIELDS AREC","='Y'&'Z'= 7'&'Z'='H'&'Z'='Y'&'H'
750 DATA"LOS ANGELES  IS ATD","='F'='5'= V'='2'","LAS VEGAS IS ATB
754 DATA"='V'='5'='9'='3'","SALT LAKE CITY IS ATC","='Y'='7'='3'='4'
758 DATA"NATURAL GAS-FIELDS BELT BETWEENA","='Y'&'G'='Y'&'5'='5'&'T'='3'&'T'
762 DATA"AREAS OF NATIONAL PARK AROUNDC","='7'='3'='9'='V'
764 DATA"EVERGLADES IS AREA BELOWA","='U'='8'='T'='G'
766 DATA"SOURCE OF MISSOURI RIVERD","='7'='3'='9'='Y'
772 DATA"DELTA OF MISSISSIPPI ATB","='2'= S'='R'='6'
778 DATA"MAJOR OIL FIELD AROUNDD","='9'='5'='Z'='G
782 DATA"DUSTBOWL AREA AROUNDB","='T'='4'='3'='8'
788 DATA"CITY AT SOUTH END OF'C'C","=BUFFALO1=DAYTON=CHICAGO=DETROIT
792 DATA"LARGEST DENSITY OF TRUCK-FARMING ATA","='X'='V'= R'='G'
796 DATA"AREA RICHEST IN HYDRO-ELECTRIC POWERC","='7'= H'='Q'='Z'
800 DATA"VANCOUVER ISLAND IS ATA","='F'='2'='X'='6
816 DATA"CHESAPEAKE RIVER ATC","='S'='R'='6'='2'
820 DATA"FRUIT FARMING AREAS ATA","='V'&'1'='Y'&'4'='U &'4'='T'&'1'
830 DATA"CITY BETWEEN LAKES'B'&'D'A","=DETROIT1=DAYTON=BUFFALO=CHICAGO
836 DATA"PHOSPHATE IS MINED ATA","='U'= 8'='R'='H'","LONG ISLAND ATD
842 DATA"='6'='S'='W'='X'","LAKE SUPERIOR ISA","='A'='B'='D'='E
848 DATA"LAKE ERIE ISC","='A'= C'='D'='E'","HUDSON RIVER ATB
852 DATA"='6'='X'='1'='2'","HOUSTON IS ATD","='1 ='4 ='G'='R
856 DATA"FINANCIAL HUB OF USD","=WASHINGTON0004=BOSTON003=HOUSTON1=MANHATTAN
860 DATA"MOST MOUNTAINOUS AREAS ARE INA","1=WEST1=EAST=SOUTH=NORTH
864 DATA"CAPITAL OF USB","0004=NEW YORK02=WASHINGTON00005=CHICAGO=PHILADELPHIA
866 DATA"CITY WITH'GOLDEN GATE'ISC
868 DATA"02=LOS ANGELES00005=NEW YORK=SAN FRANCISCO02=NEW ORLEANS
870 DATA"RIVER OUTLET FOR THE GREAT LAKES ISB
872 DATA"00005=HUDSON=ST LAWRENCE003=COLORADO0004=ONTARIO
874 DATA"MOUNTAIN RANGE IN CALIFORNIAC
876 DATA"02=SIERRA MADRE1=CASCADE RANGE1=SIERRA NEVADA=SACREMENTO MTS
878 DATA"MAIN CLIMATE OF CALIFORNIA ISD
880 DATA"02=CONTINENTAL00005=TROPICAL00005=MARITIME=MEDITERRANEAN
882 DATA"TEMPERATURES IN FLORIDA INFLUENCES BYC
884 DATA"02=MOUNTAINS003=ATLANTIC=GULF STREAM00005=STORMS
886 DATA"INDUSTRIAL HUB OF NEW ENGLAND ISD
888 DATA"1=NEWPORT=PORTLAND=HARTFORD02=BOSTON
892 DATA"US STATE NEAREST TO VANCOUVER ISB
894 DATA"003=MONTANA=WASHINGTON1=MINNESOTA000006=UTAH
896 DATA"RIVER THRO'GRAND CANYON ISD
930 DATA"=RIO GRANDE00005=SNAKE02=COLUMBIA02=COLORADO
932 DATA"RED RIVER FLOWS INTO THEA
934 DATA"=MISSISSIPPI003=MISSOURI003=COLUMBIA003=COLORADO
938 DATA"GROWING SEASON FOR COTTON ISC
940 DATA"=5MONTHS=6MONTHS=7MONTHS=8MONTHS
942 DATA"GROWING SEASON FOR MAIZE ISA
944 DATA"=4MONTHS=5MONTHS=6MONTHS=7MONTHS
946 DATA"MOST CRUCIAL RESOURCE IN UTAH ISB
948 DATA"003=SUN1=WATER02=LAND=COPPER
950 DATA"STATE WITH SEVERE SOIL EROSION PROBLEMD
952 DATA"=WISCONSIN02=FLORIDA=LOUISIANA=TENNESSEE
954 DATA"WARM DRY WIND AFFECTING ALBERTA ISA
956 DATA"=CHINOOK003=BORA=MISTRAL=SIROCCO
958 DATA"AREA OF TEMPERATE INTERIOR CLIMATE ISC
960 DATA"0004=GULF PLAIN=ATLANTIC PLAIN00006=PRAIRIES003=COAST RANGE
962 DATA"DISASTROUS EARTHQUAKE IN 1964 OCURRED INB
966 DATA"=CALIFORNIA0004=ALASKA00005=TEXAS=NEW MEXICO
970 DATA"COLUMBIA PLATEAU EXAMPLE OFC
972 DATA"003=REVERSE FAULT0004=NORMAL FAULT=FISSURE ERUPTION1=CRATER ERUPTION
974 DATA"AREA BETWEEN SIERRA NEVADA & WASATCH    RANGE EXAMPLE OFC
976 DATA"000000010=HORST0004=FAULT SCARP=BLOCK MOUNTAINS0004=RIFT VALLEY
4500 IFA<30GOTO10000
5000 GOSUB8000
5010 L=LEN(A$):PRINTLEFT$(A$,L-1) Y$=RIGHT$(A$,1)
5020 M=LEN(B$):M=M/2 M$=RIGHT$(B$,M) N$=LEFT$(B$,M)
5030 N=M/2:O$=RIGHT$(M$,N) P$=LEFT$(M$,N) Q$=RIGHT$(N$,N) R$=LEFT$(N$,N)
5040 C=VAL(O$):B=LEN(O$):O$=RIGHT$(O$,B-C)
5050 C=VAL(P$):B=LEN(P$):P$=RIGHT$(P$,B-C)
5060 C=VAL(Q$):B=LEN(Q$):Q$=RIGHT$(Q$,B-C)
5070 C=VAL(R$):B=LEN(R$):R$=RIGHT$(R$,B-C)
5080 PRINT,"A"R$:PRINT,"B"O$ PRINT,"C"P$ PRINT,"D"Q$
5200 GETZ$ IFZ$=""GOTO5200
5210 IFZ$=Y$GOTO6000
5212 IFZ$>"D"GOTO10000
5220 PRINT"INCORRECT" I=I-2 GOTO5200
6000 I=I+5 J=J+1 PRINT"CORRECT"SPC(1)Y$SPC(15)J"SCORE"I
6010 TI$="000000"
6015 IFTI$<"000002"GOTO6015
6020 GOTO490
7000 O=O+2 O$=MID$(D$,O,2) A=VAL(O$) IFO>100GOTO9000
7010 RETURN
8000 PRINT" GEOGRAPHY USA MULTI-CHOICE " RETURN
9000 GOSUB8000 PRINT"SCORE"I" OUT OF 250" END
10000 IFA>29GOTO5000
10010 L=LEN(A$) PRINT" "LEFT$(A$,L-1)""
20000 PRINT"
20010 PRINT"
20020 PRINT"  r
20030 PRINT"                          A
20040 PRINT"                            B      E
20050 PRINT"
20060 PRINT"             7
20070 PRINT"                                   4
20080 PRINT"         3
20090 PRINT"   9
20110 PRINT"                                   46
20120 PRINT"
20130 PRINT"    5
20140 PRINT"  2          4       8
20150 PRINT"
20160 PRINT"                          1
20170 PRINT"
20190 PRINT"
20200 PRINT"
20210 PRINT"
20220 PRINT"
20230 PRINT"
50000 GETQ$ IFQ$=""GOTO50000
50010 GOTO5000
READY.
```

Software experts tackle last stage of Tuscan's development

Mike Hughes, in his final comments, opens and closes the last part of our series on the development of the Transam Tuscan written this month by the software designer, Brendan Owen.

TO TEST the prototype Tuscan, we took a section of the proven Triton monitor, written in 8080 code, and patched in the relatively few modifications to allow it to work within the hardware configuration of our new embryonic machine.

As the Triton monitor was available in assembly language source code, it was a very simple matter to change its address location and the designated ports for the I/O interfaces — VDU and keyboard — before re-assembling the program to sit at the top end of memory.

It was also possible to use the new program on Triton to simulate the way it would work on Tuscan, thus we were assured that if Tuscan had refused to operate in the first instance, the problem would be in the hardware and not the software. Fortunately for me, that philosophy proved useful and I was able to diagnose the hardware design problems with the minimum of time lost.

Once the hardware design had been proven, I was able to turn my mind to the rather more mundane aspects of power-supply design, cabinet style and lay-out, preparation of drawings and to start work on the detailed documentation. The Transam software specialists now had to be fully briefed on the final hardware architecture so that they could start to consolidate their ideas for the monitor program proper and at the same time configure TCL Basic to run both as a resident interpreter and, as an option, from discs under the command of the CP/M disc operating system.

They also had to produce the all-important BIOS — Basic I/O System — firmware to link CP/M to the Tuscan hardware configuration. That was no small task — especially as our deadline date for the launch was not many months away. The responsibility for the broad and the all-embracing assembly language work rested primarily with Brendan Owen and Keith Frewin of Transam. Now Brendan Owen takes up the story.

IN THE computer design series, Mike Hughes has led us through the stages of designing a computer system from the hardware point of view. To consider the complete Tuscan system, we must also look at the system software used.

From the outset, Tuscan has been designed as a complete system and the hardware and software have gone hand in hand, co-ordinated by frequent meetings between Mike Hughes and myself. It was at those meetings that we realised how various software requirements would influence the hardware design of Tuscan.

A prime example of that is the lay-out of the memory map and the need to provide some power-on jump circuitry. That was required because we wanted to use the CP/M operating sytem which expects to find RAM at address zero whereas the Z-80 expects to find ROM there. Identifying potential problems like that was made easy by the current design process.

Another example of how the software has to some extent corrected the hardware design is in the decision to provide 8K bytes of EPROM space on the Tuscan board.

Bus expansion

Before I could decide what software was required for Tuscan, I had to look at what kind of people would be using Tuscan. Although Tuscan is a single-board computer, it also has an on-board bus expansion which allows memory, disc controllers and other peripherals to be added very easily.

That versatility means that Tuscan is suitable for virtually any application for small computers and so the users fall into four main groups: hobbyists, schools and colleges, industrial and small-business users.

The requirements of such a broad user base is obviously varied and a wide range of software products is required to meet them. Our users would probably want to program in assembly language or some high-level language such as Pascal or Basic and we would need to cater for some of those requirements using just the on-board memory.

On-board memory

The on-board memory consists of 8K of EPROM and 8K of RAM. At this stage, the amount of RAM available need not concern us because it cannot be used for storing the system software. The EPROM consists of four 2516s which each provide 2Kbytes of storage. Those parameters limited the size of the software which was to be availble, e.g., it would not be sensible to write a 2.25K monitor.

We decided that, based on those clear facts, it would be reasonable to provide two software packages for use with the single-board computer. They were a 2K monitor and an 8K Basic interpreter. We were now left to consider how best to cater for the users who want to expand their systems beyond adding extra RAM.

The obvious expansion is the addition of a disc controller and operating system. There is a wide variety of disc operating systems available for the Z-80 and we had to choose one of these. The choice was between the widely-used CP/M operating system and the more powerful multi-tasking systems such as OMNIX or MP/M.

The decision finally fell in favour of CP/M because of the wide range of software which is available to run with it, giving users greater flexibility in choice of programs. The decisions reached so far had been policy decisions involving the entire design team. It was now my task to produce the software to fit those general requirements.

Mike Hughes, in earlier articles, has emphasised the range of input and output ports on Tuscan. For these to be useful, the software must be designed to allow the user to switch easily from one port to another either while a program is running or on a semi-permanent basis when he changes his main system console.

In the early stages of the Tuscan design, it was envisaged that it would be used either with a memory-mapped VDU or with an RS232C terminal. The software could then be left to decide which peripheral was present and produce its prompt on that one by default. That involved a simple test of the VDU memory to check whether it existed.

Added complications

A problem occurs, however, if someone uses the terminal for main output and the memory-mapped VDU as some specialised output device. To add to the complications, we decided to add a VDU to the Tuscan board which also communicated via an output port like the terminal. There were now two console screen devices which would not be tested

for their presence automatically.

The solution to the problem was to add an extra input port to the Tuscan with a DIL switch on it. The switch could be used to set up the default console at switch-on. In fact, we used a four-bit switch and used two bits to determine the console and two bits to determine what port to use for a printer.

I/O flexibility

Having found a way to make good use of the Tuscan input/output flexibility, my attention now turned to the memory map for Tuscan. The main board provides 8K of RAM between addresses 0-1FFF Hex and 8K of EPROM between addresses E000-FFFF Hex. The remaining space is available for any form of memory expansion. A minimum system would contain 1K of RAM and the monitor or Basic ROMs.

That RAM would have to be located at address 0 so that the S-100 vectored interrupts would work — they cause a RST1-7 instruction to the executed. The area used by the interrupts corresponds to quarter-page of memory — one page = 256 bytes.

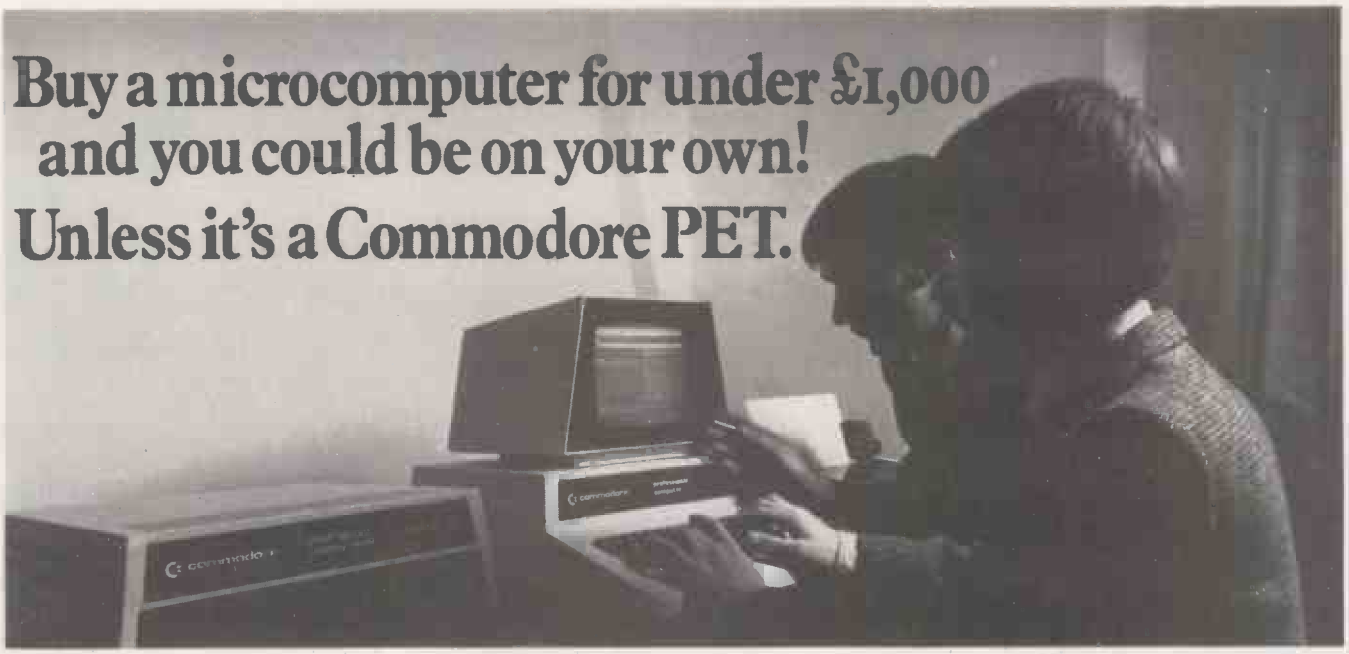
It seemed reasonable to assign the system scratch-pad RAM to be contiguous with it. The amount of RAM required varies with the different software packages and it is used for such purposes as input buffers, pointers, temporary storage stack and disc buffers. Now that an overall plan had been formulated, the individual packages could be designed and developed.

Anyone who has developed an assembly language program using just a monitor and a Hex code cad will know how tedious a process it can be — especially if the monitor functions or the user interface have not been carefully planned. Many of my programs are written in assembly language and so I know exactly what was needed to make a good monitor. The trouble is that my ideas would have generated four or five kilobytes of code and we wanted a 2K monitor.

List of features

At that point, I had included features such as disassembly, trace and single step with mnemonies being displayed. However, those features would fit into a

(continued on page 85)



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(continued from page 83)

complete assembly language development package more realistically and so could be dropped from the monitor specification.

I now had to think carefully about the cuts which I could make to my original list of required monitor functions without restricting severely its usefulness. Essentially, the monitor functions could be split into four groups. They would provide facilities for program entry, program display, program storage and program debugging. Having arrived at those four categories, each could be considered separately to produce the final specification.

Firstly, we will deal with program entry. Normally, there are two distinct forms of data required by a program. These are Hex bytes which form the program instructions and ASCII strings which are use for prompts and other messages sent to the user.

To intput the program, all that is needed is to prompt the user with an address and the current data from that location and then allow the user to modify that data optionally. There must be a means of stepping back to the previous location in case a mistake was made while data was being entered.

Most of the prompts used in a program tend to be just one line long and so an easy and convenient means of entering a line of text is required. Once again, it is necessary to provide some means of correcting typing errors.

It is good programming practice to put all data together at the end of the program and so it would be useful to print-out the address of the memory location which immediately follows the string. That saves having to count the bytes in the string to discover where the next string should start.

Data blocks

Another function is one to move a block of data around in memory — very useful when you have omitted one byte in a program during entry and notice the fact 30 or 40 bytes later. It may also be necessary to delete a byte of data. Clearly, the move function needs to be able to move data up or down memory without corrupting it — even if the data is going to be moved on top of itself.

To do that means that the starting address for the move operation must be chosen to be one end or the other of the block and the data moved up or down as necessary. That choice introduces a good chance of operator errors which could destroy the data integrity. Since we have a computer, we may as well let it make the decision and incorporate the necessary logic into the monitor.

The last function connected with the data entry enables an area of memory to be filled with a single byte value. That is useful to pre-set data areas and to see where a program is putting data if it runs away.

We can now move on to the facilities which are needed to display programs and data. It may be necessary to look at single bytes in memory or at large areas at a time. In addition, it may be more convenient to have the ASCII characters displayed rather than the Hex codes.

Those display formats can be accommodated easily in two functions. The first one is the same as that used for entering data into memory. As it displays each address, the contents are also displayed. Subsequent or previous locations can also be displayed reasonably easily. In addition, the data can be modified readily if required.

Tabular format

Large amounts of data cannot be presented in that way and some form of tabular format is needed. To fulfil these requirements, I decided to display both the Hex codes and ASCII characters simultaneously. The monitor displays half a screen of data at a time by default but can be made to give a continuous dump between two addresses.

To make it easier to view contiguous 128 byte blocks of memory, the monitor keeps track of where it stopped the last dump and can be made to resume from that point without re-entering the address.

The next facilities required after being able to enter and check program provide the means to store and load programs on to cassette tape. For convenience, the programs need to be stored as files with names so that several can be stored on one tape and the correct one re-loaded at a future date.

Additional information is also required so that the program can be re-loaded to the correct place in memory. That leads to a file format with two distinct parts; a leader, containing some synchronising marker, the file name and the address limits of the data and the data itself.

Having decided how the tape is to be formatted the details of the monitor commands can be fixed. When a file is written, it is necessary to specify the file name and the address limits. During writing, the file the keyboard needs to be checked to decide whether the operation is to be aborted.

Similarly, the complementary load function needs to check for an abort command from the keyboard. While the load is in progress, the UART status word needs to be checked after each byte is ready to ensure that it was received without error.

If an error does occur, the user needs to be informed by printing some error indicator on the console. Due to the self-locating tape format, there is no need to specify an address for re-loading.

The final group of commands allow programs to be run and de-bugged. Two fundamental facilities for developing programs are the insertion of breakpoints into the program and executing single instructions at a time — single-stepping. To keep track on the execution of the program, one must be able to examine the registers within the Z-80 CPU.

To do that, they must be dumped into RAM when the monitor is entered and re-loaded before the program under test is resumed. The break-points could be implemented in a number of ways. I chose to implement eight break-points which would be transparent in use.

That means that the monitor would remove the break-points from the program whenever it regained control and re-set them when control was handed to the test program. Facilities would be needed to set, re-set and list the break-points and that is all achieved with a single function.

The single-step function would need to execute one or more instructions from a program as required. When the monitor regains control either after each single step or after a break-point, it must display the contents of the Z-80 registers. Of course, we need to be able to modify the registers from where they are saved in RAM having modified the program counter if necessary.

Monitor specifications

I now had a specification for the monitor and could start writing the code to fit the specification. All of the commands were to require a single-line entry consisting of a function letter followed by up to three parameters as required, e.g., the move command might be M1ØØ, 2ØØ, 5ØØØ.

The numeric parameters could take one of three forms as a Hex number, decimal number or as an ASCII character, e.g., 41 Hex could be entered as 41 or # 65, decimal, or A ASCII. Finally, the command line must be capable of being edited before it is executed.

Before I wrote any code, I drew flowcharts of the monitor as a whole and of each separate function. By doing that, I was able to identify routines which occurred more than once so that they could be coded as subroutines, I started by writing the I/O routines for the various console and list devices.

At a single-character level, they were trivial and they could be tested easily with a short routine to echo characters. The I/O core would be used by all of the Tuscan firmware. The next stage was to write the buffered input routine which could deal with the input — and deletion — of any characters including tabs.

Once again, it was tested with a short routine on Tuscan. The rest of the software could be tested using CP/M and a Triton. The use of a disc system made debugging much faster and easier. The main control loop, initialisation and

(continued on next page)

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parameter-parsing routines were now developed ready to be used by each monitor function.

Having obtained a working monitor which could do nothing but input commands, I was now ready to start writing the various monitor functions. Each function was written and tested as a separate subroutine and was entered into the monitor jump table when it was completed.

While producing the code, I realised that a Hex-conversion routine could be implemented for an overhead of three bytes. It would accept a number in any valid form, i.e., decimal or ASCII, and print-out the Hex value. As we progressed, the 2K of memory rapidly became full and I still had three or four functions to provide, single step being one of them.

Realising that I would need about 500 bytes for these functions, I looked again at my specification and decided not to implement single step. However, I would provide a vector into the next ROM so that it could be part of an expansion package. After some code compaction during which I had to sacrifice part of the structured lay-out of the monitor, enough space was found for the other functions.

After about six weeks' work, the monitor was finished. All that remained was to give it a name and after some consideration, we arrived at Mitsi, an acronym for Monitor In Tuscan System 1.

Basic interpreter

The second software packge for Tuscan was an 8K Basic interpreter. It was to be a stand-alone package which would be entered when the machine was turned-on. For that, I inherited the poorly-documented source code for the Triton L7.2 Basic. The task seemed easy: add the Mitsi I/O package and partially optimise the 8080 code so that the whole package would fit in 8K — it took, however, about six man weeks. What went wrong?

The development work involved Keith Frewin — also from TCL software — and myself. We wanted to have a disc Basic which would run on a 16K CP/M system and it seemed sensible to develop it in parallel with the Tuscan Basic. The first two weeks were spent in tidying and annotating the original source code — if only programmers were as fluent with comments as with instructions.

Having prepared the source code into an understandable form, we took separate paths although it was useful to be able to compare the code when a bug appeared in one version or other. My first task was to translate all of the mnemonics into Z-80 code using a program we had in our library and then to convert as many absolute jumps to relative jumps as possible.

That pruning operation and the removal of some unused keywords reduced the Basic to about 8K, give or take 24 bytes. The time arrived to start testing the various Basic statements to see what would happen.

The interpreter was run in RAM on a Tuscan using CP/M. As I tested more and more statements, my confidence grew until I arrived at string handling. To test for type compatibility of the arguments, the Basic made use of the Z-80 parity flags. Unfortunately, the Z-80 uses the flag as an overflow flag on some operations and it was not being set the same as for an 8080.

After changing some code, all was well. Obviously, not all 8080 code will run directly on the Z-80. After everything was checked and a few more economies made so that the program fitted into 8K, I re-assembled it at the correct address and burned it into ROM.

One of the design requirements was for the Basic to be able to load and run Triton programs. I had made provision for the program to be re-located and since it was the same Basic everything should have worked, so I plugged in a tape recorder and loaded a program. When I listed it, all was not well, when a line like:

```
100 IF A > B GOTO 30
```

became

```
100 LIST A > B FOR 30
```

By removing the extra unused keywords, the values of others had changed and hence some strange listings were produced. I had to put entries back into the keyboard tables and remove the trace option, which was not very useful, to make space.

Cronologically, the Tuscan firmware was now complete but we will now look at the development of the Tuscan CP/M system. All of the routines I needed had already been written. It was just a case of putting the together in the proper places.

CP/M requires a set of I/O routines to run. They can be divided into two groups — those for the printer and console and those to control the disc. The first group were lifted straight from the Mitsi monitor and the second group from the Triton Bios. Since there was plenty of space in the 2K ROM on Tuscan, I decided that there was little point in optimising the code for the Z-80. After a few days' work in modifying the system generation program, Tuscan sprang into life with two 8in. disc drives. Producing the software to drive the 5¼in. drives was almost as easy.

Disc drives

I just had to combine the Triton disc routines with the Tuscan I/O core. We had decided to use TEAC disc drives on Tuscan instead of Shugart because they had the advantage of providing 40 tracks rather than 35 and they are capable of moving the head faster. That is where the extra work was hidden. In addition to patching those parameters into CP/M, the programs to copy and format discs needed re-writing.

I have said that provision had also been made for an editor and some other packages such as Pascal compiler or an assembler. It would be possible to produce a complete assembly-language development package for Tuscan to reside in the 8K of on-board ROM. Other possible expansions would include software to drive a colour VDU and a graphics display.

In addition, we could provide CP/M packages for various business applications and for a Prestel terminal or viewdata system.

Perhaps it was luck — we thought it was good planning — everything suddenly began to happen at once. Brendan Owen and Keith Frewin had their respective firmware packages ready, the final — tidied-up — printed circuit arrived in all its glory with solder mask and silk screening. The specially-wound transformers landed with a thud on the Transam doorstep as did the prototype cabinet.

Transam, no doubt with a sigh of relief, took delivery of the outstanding bulk component orders — the only things remaining were, if I recall correctly, the power-supply capacitor mounting clips but that was soon put right.

Drawings were back from the artist and the manuals well advanced through the final stages of typing. Advertising managers were requiring confirmation that the reserved pages were to be taken. Everyone associated with the project now started to operate in a quiet sort of frenzy — nothing could be stopped or slowed at this stage and the complete Tuscan system was launched in June 1980.

Tuscan has been on the market for six months and we are now able to see how our initial thoughts are being transformed into reality. Designed initially to try to provide all things to all people, Tuscan certainly seems to have fulfilled its role — I have seen it operating as a £300 domestic system at one end of the scale and at the other supporting twin 8in. discs, Centronics printer and remote terminal in a business environment, the whole system must have cost around £4,000.

It is being used in schools, polytechnics, Government departments, research laboratories, photographic studios, offices, and doctors' surgeries to name but a few applications.

The future looks even more rosy. Already there is talk of interfacing to 10megabyte disc systems, and via currently-available S-100 cards, Tuscan can operate as an intelligent Prestel terminal.

Without doubt none of this would have been possible without the S-100 standard busbar and the simple versatility of CP/M with its massive software repertoire.

Recursion is highly wasteful and seldom truly needed

IT IS becoming part of the folk-lore of computing that programming languages which allow something called recursion are in some way far more advanced than languages which do not possess such features.

At its most naive, the lack of recursion in Basic means that Pascal is far superior. Recursion and recursiveness seem to be applied loosely to many ideas and items without any attempt at precision.

Epimenides was a Cretan who said: All Cretans are liars. By saying that, he produced the liar paradox so beloved of logicians. The statement is recursive in that it refers indirectly to itself. To see how the statement refers to itself, let S be the set of all statements made by Cretans, so "All Cretans are liars' becomes: If Si is an element of set S, Si will be untrue. However, the statement just described was a statement made by a Cretan — call it Si.

If Si is true, Si is not true; if Si is not true, it is not true that Si is not true; if it is true that Si is not true, it is not true that it is not true that Si is not true.

Self-reference is not without its problems, but the Greek philosophers who invented the liar paradox saw that at least one form of recursiveness was quite safe: for a statement to refer to its own structure, rather than its own meaning was acceptable — for then the statement was right or wrong.

Important distinction

To say: This sentence has 94 letters in its entirety, is either correct or incorrect, and raises no philosophical problems. That shows the importance of the distinction between syntax/structure and semantics/meaning.

See what you can make of the proposition/sentence/statement, G, where G: It is impossible to prove the sentence which results from completing the sentence G.

The G in the sentence is replaced by the words which constitute G. G says, in effect, that it is impossible to prove whether G is itself true: if G is true, it is unprovable. Therefore, we do not know if G is true; if we do not know if G is true — we cannot prove it — G is correct.

The point is that a recursive statement can be unsolvable by recursive methods. That lessens the weight of the claim that, as a certain recursive function cannot be analysed by non-recursive means, recursive procedures are inherently superior. A favoured justification of the importance of recursiveness comes from artificial intelligence, e.g., how can one disentangle the sense of: "The audience who heard, "The person who cited, 'The King who said, "My kingdom for a horse," is dead,' as an example, is a psychologist," is very patient.' Miller, 1970:113.

It contains a series of embedded clauses. Higman, 1977:21-22, uses the example, but he does not realise that, though "The audience . . . patient" is embedded, it is not recursive in the same sense as: "It is impossible to prove the sentence which results from completing

by Boris Allan

the sentence 'It is impossible to prove the sentence which results from completing the sentence "It is impossible —" ' "

G is truly recursive, it is embedded and self-referencing. G is also unprovable by recursive or non-recursive means. When Higman, 1977:21, claims:

It may be worth mentioning that there are certain functions which are easily defined recursively but which cannot be defined in terms of ordinary algebraic expressions.

He refers to Ackerman's function in support of his claim. Interestingly Ackerman's function is an extension of the same ideas — due to Kurt Gödel — which gave rise to G. Embedding of clauses, and statements, is a necessary condition for recursion, but not sufficient condition.

When discussing recursion, monographs and articles usually begin with either the addition function or the factorial function; for the factorial of N = N*(N-1)* . . . *2*1

	1	N = 0
FACT(N)	FACT(N-1)*N	N > 0
	Undefined (=0?)	N < 0

In Algol 68, we could write the factorial as either a recursive procedure, a recursive function, or a recursive monadic operator. To show the beauty of Algol 68, we will define a monadic operator "↑ " which goes in front of our variable to give the factorial, i.e., " ↑ N" means; factorial of N.

```
op↑  = (int N)int: (N=0|1|  ↑(N- 1)*N);
```

Translated, that means that this is to be a monadic operator " ↑ ", which acts on an integer value "N" to produce an integer result. The result if "N=0" is 1 else " ↑ (N-1)" times N. It would be very simple to put in a check for N ⩾ 0

```
op ↑ = (int N)int: (N=0 |1| :N > 0|↑
(N-1)*N  | 0);
```

Algol 68 is the most sophisticated and advanced programming languge, and Basic one of the simplest. A Basic subroutine for factorials is:

```
2000 IF N >  =0 THEN 2030
2010 F=0
2020 RETURN
2030 IF N=0 THEN 2090
2040 N=N—1
2050 GOSUB 2000
2060 N=N+1
2070 F=F*N
2080 RETURN
2090 F=1
2100 RETURN
```

In the main program, we call the number, of which we need the factorial, "N". The value of the factorial is returned in "F", after the statement GOSUB 2000. The size of the stack for subroutines will affect the maximum value of N, but as the factorial of 9 is 362880, that need not bother as unduly. The factorial of 8 will not fit within bounds for most integer Basics.

The subroutine could be shortened by the omission of the check in lines 2000 to 2020, and the call would then be GOSUB 2030 in the main program, and in line 2050, but after all a loop would be simpler. Finally, a Pascal function:

```
FUNCTION FACT(N:INTEGER):INTEGER;
BEGIN
  IF N=0 THEN FACT=1
    ELSE IF N 0 THEN FACT=0
      ELSE FACT = FACT(N-1)*N;
END;
```

The Pascal function seems hardly more transparent than the Basic subroutine.

We are told repeatedly that the factorial function is a trivial example, but that the technique is very powerful for more complex tasks. In Pascal, with its one-pass compiler, life is not so simple. Despite claims that recursion makes Pascal a better language, things can become messy if two procedures are mutually recursive.

Fact function

Let there be a function/procedure "A" which, within its body, calls function/procedure "B" — the Fact function calls itself within its body. If in addition function/procedure "B" calls function/procedure "A" itself, we have a sequence of calls A B A B.

In Pascal, we have to make the compiler aware of "B" before we can define "A". In the definition of "B", we need, however, already to know "A". to stop that regression, in Pascal, we give a dummy definition of "B" before we define "A", and then later give a full definition of "B". Bowles 1977:163.

When one reads discussion of recursions, one of the most popular examples is Ackerman's function, but the most popular example is the Towers of

Hanoi game. For a non-computing explanation read Northrop, 1961:33-34. The Towers of Hanoi are three pegs; on one peg, peg zero, there are discs arranged so that the largest disc is at the bottom of the pile, with discs in decreasing order of size to the smallest at the top.

The problem is to move the discs, one at a time, so that a larger disc is never placed on a smaller disc, ending with all the discs on a different peg — discs can reside on any of the three pegs.

For example, with three discs: move one — disc one to peg one; move two — disc two to peg two; move three — disc one to peg two; move four — disc three to peg one; move five — disc one to peg zero; move six — disc two to peg one; and move seven — disc one to peg one.

The Towers of Hanoi problem is classical in computer science. It can be solved in a recursive program no longer than about 40 lines, without doubling up statements on a line — Bowles, 1977:297.

So long as ultimately you reach a simple situation which can be handled, the initial complexity of the problem does not matter. This idea translated into programming terms, is called recursion — Gardner, 1979:84.

A formula for the number of moves (2^N —1) is not hard to find, but a Basic program not using recursion is rather difficult to write and is rather difficult to follow — Stout, 1980:8.

I have chosen the three comments because the first makes an interesting statement about program length, and the other two quotes seem to be not only incorrect but to be repetitions of vaguely-understood folk-lore.

Towers problem

One of the best discussions of the Towers problem from a recursive standpoint is in Maurer and Williams, 1972:118-120, and their scheme goes as follows for N discs:

1. If N = 1, move the disc from peg zero to peg one, and stop.
2. Otherwise, move the topmost N-1 discs from peg zero to peg two.
3. Move the remaining disc from peg zero to peg one.
4. Move the N-1 discs on peg two to peg one.

The recursive nature of the algorithm is clear from the moves at stages 2 and 4. We start with having to move N discs, and then having to move N-1 discs, and then having to move N-2 discs. We go through the four stages with N-1 substituted for N in the descriptions, and the peg numbers altered correspondingly.

Every ordinary algebraic function, e.g., the factorial, can be re-cast in a recursive form, and I suspect that most recursive functions can be put into an ordinary algebraic form. That suspicion makes me believe that the Towers problem has a simple non-recursive form, if only it can be found.

If the pegs are re-arranged into the points of a triangle, instead of in a line, a simple pattern appears — as an application of modulo arithmetic rather than arithmetic defined on the field of integers. A pattern should appear, one guesses, because of the formula for the number moves needed, 2n-1 — figure 1.

Figure 1 shows that disc one goes from peg zero to peg one to peg two to peg zero to peg one. Disc two goes from peg zero to peg two to peg one; and disc three goes from peg zero to peg one. A pleasant cycling of the triangle in opposing directions. We have discovered that disc one always cycles clockwise, disc two cycles anticlockwise, disc three cycles clockwise, disc four cycles anticlockwise. We have yet to discover when each disc moves.

Disc one moves every other turn, disc two moves every four turns, disc three moves every eight turns, and disc four moves every 16 turns. That beautiful regularity is encapsulated in table 1. If we convert the move number into its binary form, the rightmost 1 in the number indicates which disc to move.

A Basic program to solve the Towers problem can now be written easily without a trace of recursive statement. Ignoring prints, inputs, remarks and dimensions, and not having the subroutine from 1000 to 2100 as a subroutine, the program is 23 lines long.

The total program without remarks, but with everything else, is 46 lines long. The language used was integer Basic for the Apple II. I suspect that it would work equally well on the Sinclair ZX-80. Integer Basic was used to reinforce my strong belief that many high-level, structured languages lead many to laziness in programming — recursion is highly wasteful and seldom, if ever, truly needed if we think constructively enough.

In the program, "B" is a vector which holds the binary equivalent of the move number "M", the maximum being "EN"; "C" is a vector which holds "1" or "2" alternately in each element, a "1" for a clockwise rotation, and a "2" for a anticlockwise rotation; and "T" is a vector which holds the peg number of the corresponding disc.

The program is easy to understand as long as it is remembered that it is written in any integer Basic. Apple II integer Basic has a MOD function, but I did not use it, and those without an integer Basic need to use only the INT function, e.g., in line 230 : C(I) = 1 + I — INT(I/2)*2).

I have shown that non-recursive

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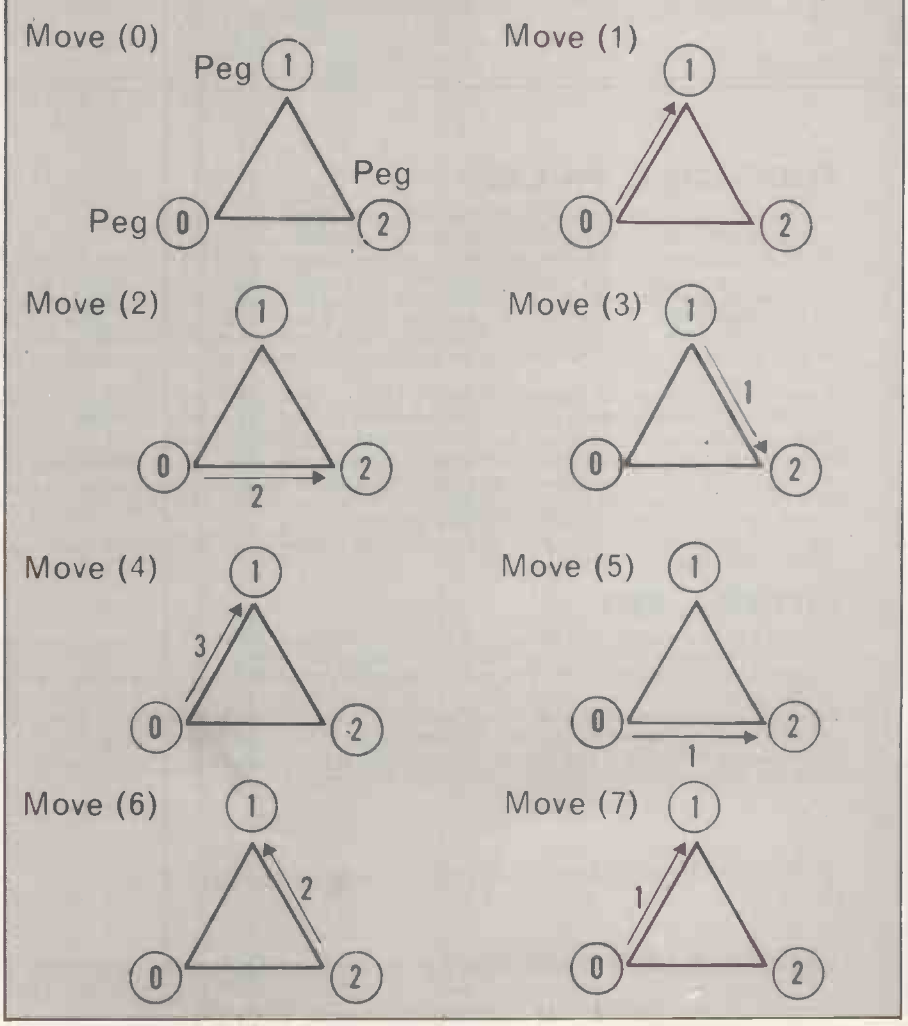
The movements of 3 discs on the pegs (Cyclic Analysis)



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procedures are conceptually superior to recursive procedures for the Towers of Hanoi problem, and I challenge any person to find a practical application in which recursion is greatly superior to a non-recursive approach.

```
 11 REM
 12 REM   TOWERS OF HANOI
 13 REM
 14 REM   BY
 15 REM
 16 REM   G J BORIS ALLAN
 17 REM
 18 REM
 19 REM
 20 REM   A SHORT INTEGER BASIC
          PROGRAM
 21 REM   USING THE SIMPLEST OF
          OPERATIONS
 22 REM
 23 REM
 24 REM
 25 REM
 30 GOSUB 3000
 35 GOSUB 3000
 40 PRINT "TOWERS OF HANOI"
 41 PRINT
 42 PRINT "AN INTEGER BASIC
    PROGRAM"
 43 PRINT "WITHOUT RECURSION"
 45 GOSUB 3000
 50 PRINT "AUTHOR IS G J BORIS
    ALLAN"
 51 GOSUB 3000
 99 REM   MAIN PROGRAM FROM
          HERE
100 PRINT "HOW MANY DISKS"
110 INPUT ND
115 PRINT
116 PRINT
120 DIM B(ND),T(ND),C(ND)
190 EN=1
200 FOR I=1 TO ND
210 B(I)=0
220 T(I)=0
230 C(I)=1+I—(I/2)*2
240 EN=EN*2
250 NEXT I
260 EN=EN—1
300 FOR M=1 TO EN
310 GOSUB 1000
320 NEXT M
350 GOSUB 3000
351 GOSUB 3000
400 END
999 REM   MAIN SUBROUTINE FROM
          HERE
1000 K=0
1010 CA=1
1020 FOR I=1 TO ND
1030 CB=(B(I)+CA)/2
1040 B(I)=B(I)+CA-CB*2
1045 CA=CB
1050 IF K>0 THEN 1090
1060 IF B(I)=0 THEN 1090
1070 K=I
1090 NEXT I
2000 T(K)=T(K)+C(K)
2010 T(K)=T(K)-(T(K)/3)*3
2020 PRINT "MOVE ";M;" : DISK ";K;"
     TO PEG ";T(K)
2100 RETURN
2999 REM   THIS PRINTS BLANK LINES
3000 FOR IT=1 TO 5
3010 PRINT
3020 NEXT IT
3030 RETURN
RUN
TOWERS OF HANOI
AN INTEGER BASIC PROGRAM
WITHOUT RECURSION

AUTHOR IS G J BORIS ALLAN

HOW MANY DISKS
?5

MOVE 1 : DISK 1 TO PEG 2
MOVE 2 : DISK 2 TO PEG 1
MOVE 3 : DISK 1 TO PEG 1
MOVE 4 : DISK 3 TO PEG 2
MOVE 5 : DISK 1 TO PEG 0
MOVE 6 : DISK 2 TO PEG 2
MOVE 7 : DISK 1 TO PEG 2
MOVE 8 : DISK 4 TO PEG 1
MOVE 9 : DISK 1 TO PEG 1
MOVE 10 : DISK 2 TO PEG 0
MOVE 11 : DISK 1 TO PEG 0
MOVE 12 : DISK 3 TO PEG 1
MOVE 13 : DISK 1 TO PEG 2
MOVE 14 : DISK 2 TO PEG 1
MOVE 15 : DISK 1 TO PEG 1
MOVE 16 : DISK 5 TO PEG 2
MOVE 17 : DISK 1 TO PEG 0
MOVE 18 : DISK 2 TO PEG 2
MOVE 19 : DISK 1 TO PEG 2
MOVE 20 : DISK 3 TO PEG 0
MOVE 21 : DISK 1 TO PEG 1
MOVE 22 : DISK 2 TO PEG 0
MOVE 23 : DISK 1 TO PEG 0
MOVE 24 : DISK 4 TO PEG 2
MOVE 25 : DISK 1 TO PEG 2
MOVE 26 : DISK 2 TO PEG 1
MOVE 27 : DISK 1 TO PEG 1
MOVE 28 : DISK 3 TO PEG 2
MOVE 29 : DISK 1 TO PEG 0
MOVE 30 : DISK 2 TO PEG 2
MOVE 31 : DISK 1 TO PEG 2
```

References

Bowles K L 1977 Microcomputer problem solving using Pascal. New York: Springer-Verlag.

Gardner M 1979 The thinking computer's language. Practical Computing, *October.*

Higman B. 1977 A comparative analysis of programming languages. Second edition. London: Macdonald and Jane's.

Maurer G A and Williams M R 1972 A collection of programming problems and techniques Englewood Cliffs, NJ: Prentice-Hall.

Miller G A 1970 The psychology of communication. Harmondsworth: Penguin Books.

Northrop E P 1961 Riddles in mathematics. Harmondsworth: Penguin Books.

Stout J 1980 Pets' Corner. Liverpool Software Gazette, 3:6-14.

Fast Fourier transforms

YOU PROBABLY FALL into one of three categories:

- You know all about fast Fourier transforms, FFTs.
- You have heard about FFTs, but do not know what they are, or you have been told that they are far too complicated for mere mortals to understand.
- You have not heard about FFTs before, but the subject appeals.

If you are in the first group, and have managed for years to confuse people by using terms like Nyquist limit, aliasing, butterflies, complex multiplication or skew-Hermitian functions, beware — we intend to reveal all.

You will be able to write FFT programs quickly and easily and use them for fun — you can obtain some very pretty patterns — or for education — have you ever wanted to know how beat frequencies occur, or what sidebands are, or what a white noise spectrum is?

You can even use FFT programs for serious, real-world applications in engineering, biology or business. What is more, you can do that faster and more elegantly using FFTs than you can with other techniques of frequency analysis.

What is the FFT and what does it do? It is a black-box program which you can use on your computer. You push in a sequence of numbers — the input signal — and obtain a different set of numbers — the output signal, or frequency spectrum. For example, if you enter a sine wave, you obtain a spike, as shown in figure 1. The spike tells you that the sine wave has a

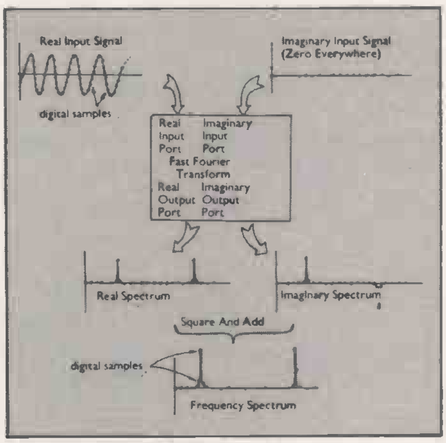

Figure 1. The FFT black box.

frequency of say 500 Hz, a musical tone, or perhaps 500,000 Hz, a radio wave frequency.

The FFT is designed for use on computers, so you cannot push an oscillating electrical signal into your computer and expect to receive a numerical answer. What you will probably obtain is a bright blue flash and a very large repair bill. You must provide digital samples of the signal, store those samples in your computer memory and then operate on them instead.

If you have money to spare, or an analogue-to-digital converter, you can collect

by Ben Rogers

your samples directly from your signal source after some adjustments.

Otherwise, you must type in the numbers which you want to look at, or else write a line or two of program to

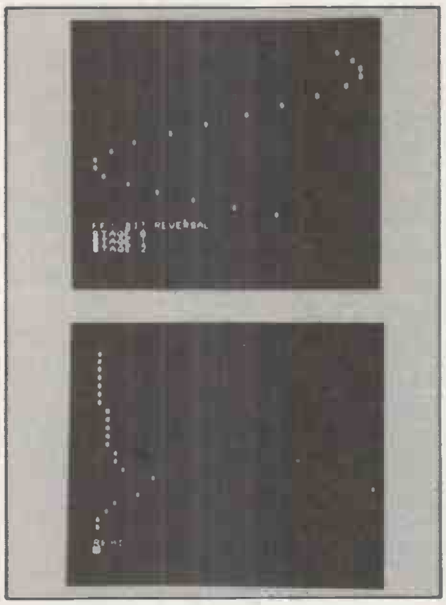

Figure 2. Part of the input and output.

generate the numbers — something like:

```
DIM T(255) : FOR X = 0 TO 255: T(X) =
SIN(3.14159*X/10) : NEXT
```

would generate 256 samples of a sine wave for you to analyse.

You can write an FFT program in less than 20 lines of Basic. It is true that they are packed lines; I have an old Pet which runs faster when you do not use a new line number for every instruction. You should be able to run a useful FFT program, based on the following recipe, in any machine which has Basic and more than 4K of memory, although 8K would be better and 16K puts you in good stead.

Although you can write an FFT program in 20 lines or so, it will not give you a very elegant output display. The extra memory is needed, partly for storing more input data to give you more accurate results but mostly so that you can have better display routines.

The first line, 100, asks for a power of two to be typed. That is because FFT programs only work with 2,4 - 256,512,1024 input data values. It is possible to write FFT programs which can cope with any number of input samples, but it is not really worth it in general. So you might type 7, for 128 data points, or 8 for 256 points.

The larger the number the better the results you obtain, but it takes longer to compute the answers and you need more memory, of course. With 4K of memory you can analyse 128 points. Thanks to a software quirk on my old-style Pet, I am limited to a maximum dimension of 256 for arrays. That is a convenient number with which to work, and you can fit some very useful display routines for 256 data points into 8K of memory.

So in response to line 100, type 8. Line 200 then generates five arrays, each with 256 elements, 0 to 255. The next line, 300, fills two of those arrays, CO and SI, with values of a cosine and sine function respectively. CO and SI will be used by the FFT as look-up tables which need computing only once for each run of the program. Line 300 also fills another array, IM, with zeros. The DIM statement should do that, but it is better to be careful.

Line 1000 represents the input data to be analysed. In the example, it is the simple sine wave quoted, but adjusted slightly to allow for different lengths of input data. The input data are stored in the temporary array T. Line 2000 displays the input data, using the TAB function. You should see the sine wave scrolling up the screen when this line is working.

The FFT proper has been written as two short subroutines. The first one, lines 6000 and 6010, performs the operation of bit reversal on the order of the input data. It then stores them in the correct order in the array RE. For example, if you are using 256 input samples, data element T(1) is put into RE(128), element T(2) is

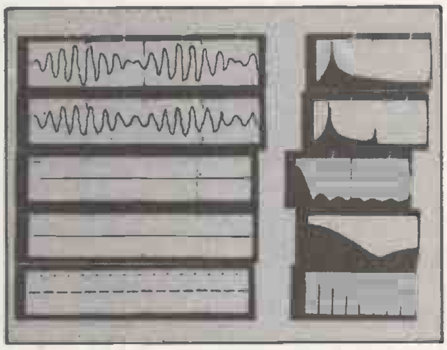

Figure 3a-3e. Beats, pulses and pulse trains.

put into RE(64) and so on. That is because the binary label (0000 0001) of T(1) becomes (1000 0000), which is 128 in decimal.

Similarly, 2 (= 0000 0010) becomes 64 (= 0100 0000) and so on up to 255 (= 1111 1111) which becomes itself. Do not try to economise on storage space by just re-arranging the elements of T or you will overwrite half of the data.

The FFT subroutine occupies only a few lines of program. Exactly what it does

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need not concern us in detail; suffice it to say that it takes two input arrays RE and IM — which stand for real and imaginary — and processes them through several stages of jiggery-pokery before coughing out the answer, still in the arrays RE and IM but with different contents.

The calculation involves complex multiplication and addition of suitably-chosen pairs of numbers — a diagram showing which pairs to choose bears a fanciful resemblance to a butterfly — hence the buzzword butterfly.

Two arrays

The number of stages involved is printed-out by the program as computation proceeds — "STAGE 1", "STAGE 2", and so on. That lets you monitor the work for large amounts of input.

All that remains is to display the output data in some way. The answers are held in the two arrays RE and IM. They contain real numbers, which might be anywhere between, say, -10^{40} and $+10^{40}$, depending on what function you pushed into line 1000. Lines 4000 and 4010 represent the simplest form of display, which squares and adds matching elements of RE and IM, then uses the TAB function to print the integer part only of the square root of the answer in the proper part of the screen. Figure 2 shows part of what you would find on your screen as the input and output data are scrolled up your screen.

The program listing is about the simplest one possible; a variety of alternatives can be used, limited only by the capabilities of your computer and by your ingenuity. Those refinements have nothing to do with the FFT, though — they just give you prettier pictures.

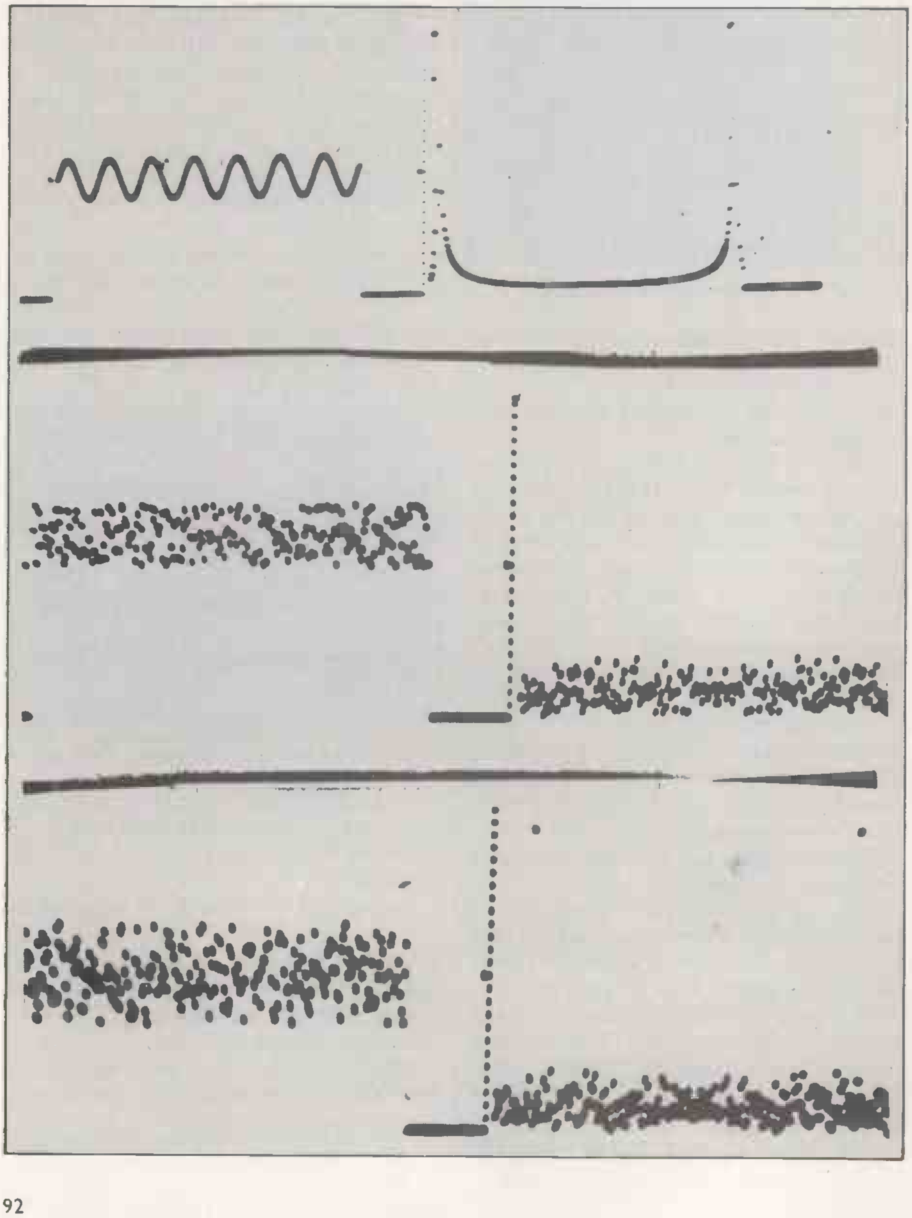
For example, if you have a line printer, you can produce hard-copy graphs of the input and output — some kind of scale factor will probably be required to have the graphs to match the width of the paper. If you have no printer and do not want a strained neck from looking at graphs rolling sideways up your screen, you can patch in a graphical display routine to show the data in large chunks.

Figure 3 shows the kind of thing which you can obtain from a Pet with a little care. Alternatively, if you have an oscilloscope and a D/A converter, you can generate real-time, high-resolution displays like those shown in figure 4.

Always remember, the FFT itself consists of only a few lines of program — most of your program space will be taken up with display routines and data storage.

If you use the program listing, you will find that it takes about 20 seconds to compute the look-up table values for 256 points, about 10 seconds for the input sine function, about one minute to bit-reverse the data and about two minutes to compute the FFT. You might say that it sounds more like a slow Fourier transform. It all depends to what you compare it.

Figure 4a-4c. Sine wave signal, white noise and signal-plus-noise.



Data points

In the past, those who wanted to compute frequency spectra used a different kind of Fourier transform. If you had N data points to analyse, you had to perform approximately 4.N.N multiplication and addition operations to obtain your answer.

Now, using Basic with a modern micro, it takes perhaps three milliseconds to multiply and one millisecond to add two numbers, plus about two milliseconds for a for-next loop. So, with N = 256 it took the old method about 4.256.256.(3 + 2 + 1) /1,000 seconds, which is about 30 minutes. By clever arrangement of the sums, the FFT manages with about 4.N.logN multiply-add steps — log to the base two, by the way. So the FFT takes only 4.256.8.6/ 1,000 = 50 seconds to do the same sums.

That is how the FFT earns its name, and why you find old-style frequency analysis programs which hobble along analysing perhaps 40 or 50 points at best. The present program takes more than 50 seconds because it has to do some additional data shuffling and computation but the principle is the same.

If you want to go to more than 256 points, even the FFT can become somewhat boring if you use just Basic. With 1,024 points, it would take more than 10 minutes to do the sums. It is possible to write machine-code programs which do everything much faster — a 256-point machine code FFT program runs in about two seconds on the Pet. You can also buy special-purpose FFT hardware from various manufacturers which will do 1,024-point FFTs in a few milliseconds, but they are not really intended for use at home.

The photographs in figure 3 show the kind of thing which you can obtain from a Pet display with a little care. Similar or better results can be obtained with an Apple or Exidy Sorcerer or other computer with higher-resolution plotting ability. With the Pet, it is possible to have 80 by 50 points on a graph by using the whole screen and double-density plotting, but it is more sensible to leave a margin which can be used for labelling the axes.

Black lines on white backgrounds are easier to see than white on black, while the spectrum is best plotted as a histogram or bar chart display. Figure 3 shows the input and output data chopped into chunks of 64 points and displayed as double-density graphs with 64 by 40 points.

You can take photographs of the screen easily — use an ordinary black-and-white film such as Ilford FP4, which is rated at 125 ASA. Use a time or bulb exposure of one or two seconds at about f/11. It is best to use a tripod and cable release, otherwise use a table top, a pile of books and a good deal of breathholding. Assemble the final prints with a little trimming at the edges, because most displays are distorted at the edge of the screen.

If you insist on analysing large amounts of data, say, 1,024 points or more, chopping the data into chunks is awkward, while a computer printout is the length of a roll of wallpaper. You then have only one sensible option, which is to obtain a digital-to-analogue (D/A) converter — or build one — and beg, borrow, buy or steal an oscilloscope.

Machine-code routine

More or less any scope is good enough to allow you to produce displays for up to 1,024 points, with a little squeezing. Turn your data into bytes — 0 to 255 — set the scope running and push the data out, one byte at a time, to the D/A converter. Have that connected to the Y-input of the scope, which must be set for DC signals.

Things are much better if you use a small machine-code routine to speed things and to provide a trigger signal so that you can obtain a stable, real-time picture. Figure 4 shows some simple examples of what can be obtained at a cost of about £10 in electronic bits and £80 upwards for a second-hand scope.

There are one or two aspects of the FFT which may seem strange when you first use it. The first is that if you put say 256 points into the FFT, you obtain 256 points, but points 128 to 255 are mirror images of points 0 to 127. Figures 1 and 4 show some examples of this.

You may think that the FFT is not giving you value for money, but that is not the case. It occurs because the pictures show the sum of the square of the two arrays RE and IM. If you print-out the numerical values of the two arrays, you see that the upper set of points will usually have the opposite sign to the lower, at least in one array.

That is because we are using a particularly simple form of input, by only feeding data into one of the arrays — the array IM is set to zero at the start. If you are careful and clever, try modifying the program and running it twice, using the output from the first run as the input for the second.

If you do it properly, you obtain almost your original answer, which shows that the FFT does not really throw away half of what you put in. If you are really cunning, you can filter the spectrum by chopping some of the spectral components. Doing a second FFT then gives you a filtered signal — low-pass, high-pass, etc.

```
  90 REM***FFT PROGRAM***
 100 PRINT "WHAT POWER OF 2?":
     INPUT Q:P = Q—1
 200 F = 0.1: R = INT(2↑Q + F)—1:
     DIM T(R) : DIM RE(R) : DIM IM(R) :
     DIM CO(R) : DIM SI(R)
 290 REM***LOOK-UP TABLE
     COMPUTATION***
 300 K = 2*π/(R + 1) : FOR X = 0 TO R:
     CO(X) = COS (K*X) : SI(X) =
     SIN(K*X) : IM(X) = 0 : NEXT
 310 REM***INPUT DATA
     GENERATION***
1000 FOR X = 0 TO R: T(X) = SIN(K*X*
     (P + F)):NEXT
1990 REM***DRAW INPUT GRAPH***
2000 FOR X = 0 TO R: PRINT TAB
     (INT(19*(1 + T(X)) ));"*": NEXT
2010 REM***THIS IS THE FFT***
3000 PRINT "FFT: BIT REVERSAL":
     GOSUB 6000: GOSUB 7000
3110 REM***DRAW OUTPUT GRAPH***
4000 FOR X = 0 TO R: A = INT(SQR(RE
     (X)*RE(X) + IM(X)*IM(X))):IF
     A > 38 THEN A = 38
4100 PRINT TAB(A);"*": NEXT: END
5990 REM***BIT REVERSAL
     SUBROUTINE***
6000 FOR X = 0 TO R: Y = 0: FOR V = 0
     TO P: A = INT (2↑V + F) : B =
     INT(2↑(P—V) + F)
6100 Y = Y + B*(X AND A)/A: NEXT:
     RE(Y) = T(X): NEXT: RETURN
6990 REM***FFT SUBROUTINE***
7000 FOR S = 0 TO P: PRINT"STAGE";
     S: T = INT(2↑S + F): D = INT(2↑
     (P—S) + F):FOR Z = 0 TO T—1
7100 L = INT(D*Z + F): FOR I = 0 TO
     D—1:A = 2*I*T + Z:B = A + T:
     F1 = RE(A): F2 = IM(A)
7200 P1 = CO(L)*RE(B): P2 = SI(L)*IM(B):
     P3 = SI(L)*RE(B): P4 = CO(L)*IM(B)
7300 RE(A) = F1 + P1—P2:IM(A) = F2 + P3
     + P4: RE(B) = F1—P1 + P2:IM(B) =
     F2—P3—P4
7400 NEXT:NEXT:NEXT:RETURN
```

Table 1. The FFT program listing.

The other peculiarity of the FFT is that you apparently obtain different answers, even with a simple sine wave input, depending on the exact frequency of the input. For example, if you enter sine wave which has an exactly integral number of cycles, say, 45 cycles in 256 points, you obtain an output spectrum which is zero everywhere, except for a spike at 45 cycles in 256 points.

Yet, if you enter a sine wave with, say, 45.1 cycles in 256 points, instead of just a spike, you have a spike with wings. Figures 2 and 4 show examples of that behaviour. The difference occurs because the FFT treats the input data as cyclic, i.e., as though the left-hand end joined on to the right-hand end. With a whole number of cycles, the ends join smoothly; but with a non-integral number of cycles, there is a discontinuity. That sharp step generates a range of spurious spectral signals which show as the low-intensity wings. Normally, you need not worry about them particularly if you are using big input arrays.

Figures 3 and 4 give a few examples of FFT applications. For example, if you feed in the sum of two sine waves with slightly different frequences — figure 3 — you have beats in the input, but the spectrum shows that there are only two spectral components present.

Figure 3b shows an input which is apparently very similar, but the spectrum shows that there is an additional, high-frequency sine wave present. Those two spectra are shown with a logarithmic scale on the y-axis to let you see weak signals: that also emphasises the wings.

Figure 3c shows a simple step input — it is really a top hat or isolated square wave pulse. The spectrum shows that the pulse generates frequencies over a wide range. As the pulse narrows so the spectrum broadens, figure 3d — hence the problem that many microcomputers act as good radio transmitters.

Figure 3e shows a train of pulses: compare this spectrum to the one above it. By trying different pulse widths and numbers of pulses, you can rapidly understand how narrow pulses generate energy over a wide range of frequencies.

Figure 4b shows an example of a white-noise input. It was obtained by using the RND function to generate a string of random numbers between +½ and —½. The right-hand side shows that this white noise has a more or less constant energy over a wide range of frequencies. The top of figure 4 shows a simple sine wave input and its spectrum — note the mirror image effect in the spectrum.

Now add the sine wave and the noise together — the sine wave signal disappears almost completely into the noise, figure 4c, but the spectrum still shows the spike corresponding to the single-frequency sine wave.

Another interesting demonstration is to use the FFT to examine frequency-modulated signals. For example, suppose that you fill the temporary array T(X) with T(X) = SIN(K*X + M*SIN(K*X/10)) where K = 2*π*30/256. That represents a low-frequency signal — three cycles in 256 points modulating a higher-frequency carrier — 30 cycles in 256 points. M is the modulation; as M increases, say, from 0.5 through 1.0 to 2.0, so the spectrum shows more and more energy being pushed into the sidebands. A small warning; do not try feeding in functions which oscillate too fast for the FFT to analyse or you will obtain false results — aliasing.

For example, with 128 input points, do not feed in a sine wave whose frequency is greater than 64 cycles in 128 points. Put another way, you must have at least two points for each period of you input sine waves. That is called the Nyquist limit.

Remember, the FFT is complicated to use — most of your programming effort will go into designing pretty displays. The best thing to do is to write a short program, such as that listed, and try it with different inputs and different lengths of input.

How to write machine-code programs in Basic

by E R Parr

AN APPRECIATION of machine-code programming is essential to understanding how a computer operates, but, unfortunately, the languages of micros are too complex and subtle to assimilate quickly. As a result, machine-code programming tends to be skimmed over in any short computer course.

The program described was developed for a two-day introductory course on computers. The students were first-line maintenance personnel who would shortly be responsible for several control microcomputers; they were all without computing experience. The course would be followed by specialist courses on the specific machines, and hence it was essential to lay good foundations.

It was decided that the best way to tackle the training was to deal initially with a very simple hypothetical computer known as Marvin. That would allow computer architecture and programming to be explained without involving the complexities of a real machine.

To assist with that, a program in Basic was written to simulate Marvin's operation. This allowed pseudo-machine-code programs to be written by students with no knowledge in a surprisingly short time.

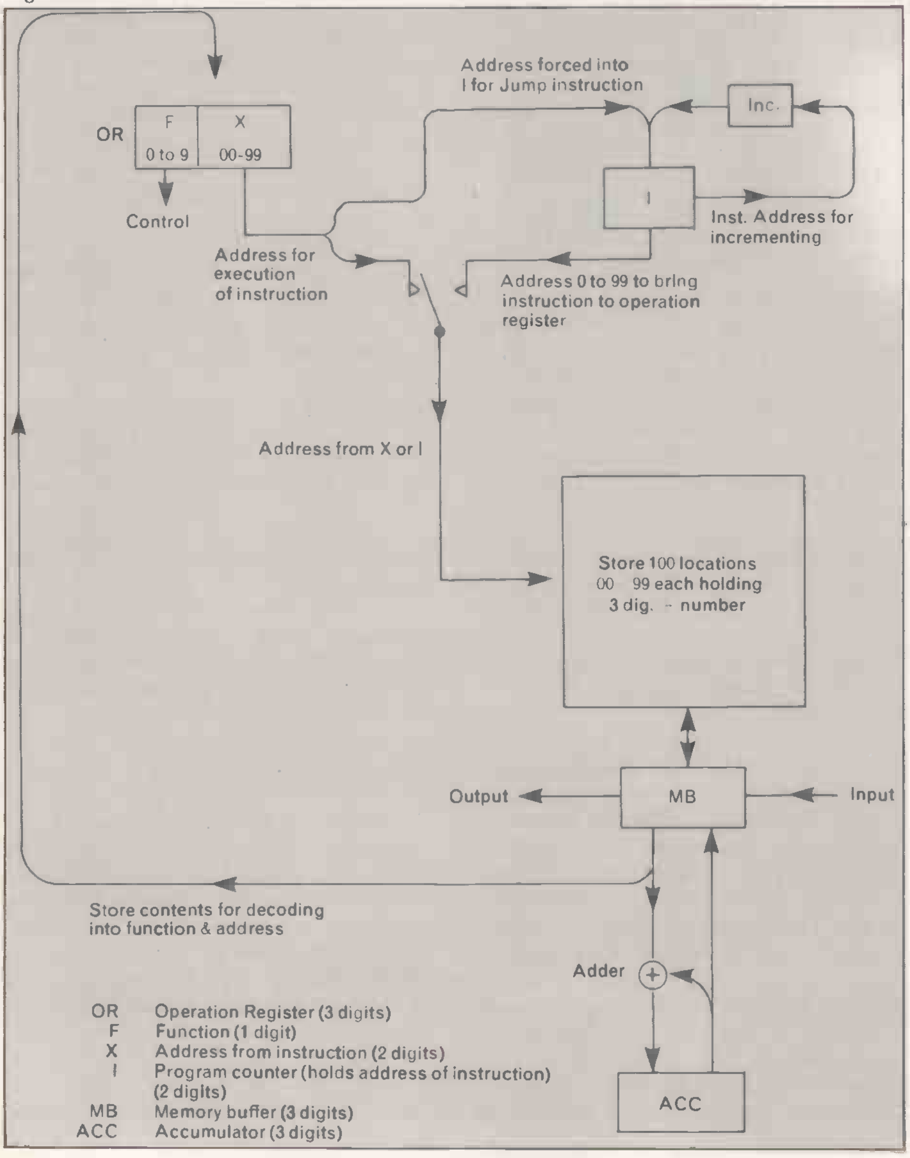
Before examining the Basic program, it is useful to look briefly at the hypothetical machine. Marvin is a simple machine based on a three-digit decimal word. Each store location can, therefore, store a number in the range 000 to 999. Marvin has 100 store locations, with addresses from 00 to 99. It follows that direct addressing is used with the most significant decade denoting the instruction, and the least significant two decades the address — figure 1.

Marvin has the block diagram of figure 2, with ACC being the single accumulator. Although very restrictive, a single accumulator was chosen to keep the machine as simple as possible. With figure 2, the operation of the 10 instructions can be followed easily:

Variables

I	program counter
R	accumulator contents
S	array store locations 0 to 99
A$	input strings
B$	truncated input string
D	input data
N	input locations
S	single-step marker
SK	marker if monitor required
F	function part of instruction
X	address part of instruction

Figure 2.



Instruction	Function
0 (N)	Input to store location N
1 (N)	Output from store location N
2 (N)	Add the contents of store location N to the accumulator
3 (N)	Subtract the contents of store location N from the accumulator
4 (N)	Fetch the contents of store location N to the accumulator
5 (N)	Store the contents of the accumulator in store location N
6 (N)	Jump to the instruction at store location N
7 (N)	Jump if the accumulator is negative
8 (N)	Jump if the accumulator is zero
9 (N)	Stop. The value of N is irrelevant

Despite the simplicity of the instruction set, students can write reasonably involved programs, and are given a good idea of programming without involving in binary or Hex coding. As an example, a program for multiplying two numbers by successive addition is presented here. Marvin, can, in fact, utilise subroutines, but it is left as an exercise for the user to discover how.

Location	Contents	Comments
0	000	Constant zero
1	001	Constant one
2	099	Input first number to 99
3	098	Input second number to 98
4	400	Zero to Acc
5	597	Acc to Result (97)
6	299	Add first number
7	597	Store in 97
8	498	Fetch 98
9	301	Subtract one
10	814	Jump zero
11	598	Store back in 98
12	497	97 to Acc
13	606	Jump

14 197 Print result
15 900 Stop

The program multiplies two non-zero positive numbers stores in location 99 and 98. Store location 97 is used as a running total.

The operation of Marvin is simulated by a surprisingly simple Basic program. The 100 store locations are represented by an array S(0) to S(99). The accumulator is represented by a variable R and the program counter by variable I. These are initialised by lines 10, 20, 30, the array being filled with 999 stop instructions to guard partially against a user leaving his program accidentally.

On entering Marvin, the user is given a menu of options:

a. Load a program. The user gives the start location and types in the data for successive locations, returning to the Menu by typing T as data.
b. Examine a program from a location to check for errors.
c. Modify one location.
d. Single-step a program, one instruction at a time.
e. Run a program. In Single-step and Run a start location is specified.
f. Write a program to cassette tape.
g. Input a program from cassette tape.

When each option is completed, the user is returned to the menu. The menu selection at lines 100 onwards is straightforward, and simply jumps to the selected option.

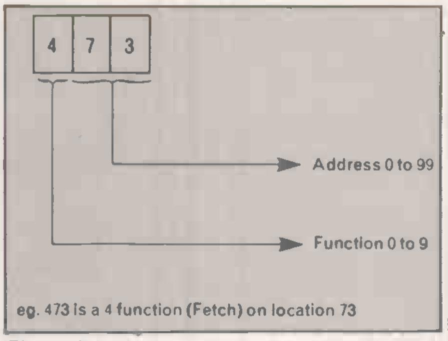


Figure 1.

Options Load line 200, Modify line 400 and Examine line 1000 perform simple operations on the selected array element. The only point of note is the use of a string variable to input numeric data. That is desirable to stop Basic error messages confusing the inexperienced user.

When a program is Run the user is asked for the start location. 'I' is then set to that value. The user is given a monitor option, which prints the value of I. S(I), i.e., the instructions about to be obeyed, and R, the accumulator contents. The monitor print-out is omitted on the value of the variable SK.

The instruction S(I) is decoded at line 812 into an operation F and an address X. At line 820, the requisite operation line number is selected.

Fetch, store, add, subtract and input are simple operations and involve the selected store locations. After execution, line 930 increments I and returns to line 812 for the next instruction.

If a jump is required, either conditionally or unconditionally, the program counter I is set to the address portion of the instruction, held in X, and the program returns to line 812 for the next instruction.

Outputs are dealt with at line 890. If a number is in the range 0 to 899 it is displayed on the VDU. If the number is in the range 900 to 99, an alpha output is generated at line 896 to allow text to be printed. The range of the alpha outputs allows upper-case and lower-case and numbers to be printed.

A Stop instruction simply returns to the Menu — line 825. When Single-step is selected, the market S is set which brings line 980 into the program. That inserts a pause between each instruction. Single-step then operates in the same way as Run.

Because the program is held in an array, it can be saved on cassette in most Basics. If the menu selection is Write, lines 2000 onwards write the entire array to cassette. Similarly, Input reads the array from cassette, when required, at line 3000.

The program can handle both positive and negative numbers, but all numbers are handled as positive numbers when used as instructions. This avoids confusing students, initially, with number representation.

```
1 REM ************* MARVIN ***********
2 REMARKABLY WRITTEN BY E A PARR JULY 1980
4  CLS
10 DIM S(99)
20 FOR I= 9 TO 99:S(I)=999:NEXT I
30 S=0:R=0:I=0
100 REM MENU SELECTION
105 PRINT:PRINT:PRINT
110 PRINT"    CONTROL FUNCTIONS ARE:"
115 PRINT" LOAD, MODIFY, SINGLE STEP,RUN,"
120 PRINT" EXAMINE, TERMINATE"
125 PRINT" YOU CAN ALSO WRITE A PROGRAM TO TAPE"
126 PRINT" OR INPUT A PROGRAM FROM TAPE"
130 INPUT" WHICH DO YOU REQUIRE";A$
140 B$=LEFT$(A$,1)
150 IF B$="L" GOTO200
155 IFB$="M" GOTO400
160 IF B$="S" GOTO600
165 IF B$="R" GOTO800
170 IF B$="E" GOTO1000
180 IF B$="T" GOTO9000
182 IF B$="I" GOTO3000
184 IF B$="W" GOTO2000
185 PRINT " I DO NOT UNDERSTAND ";A$:GOTO100
200 REM ********* LOAD *********
202 CLS
205 PRINT" YOU CAN LOAD A PROGRAM FROM ANY LOCATION"
215 PRINT" TYPE T AS DATA TO RETURN TO MENU"
220 INPUT" START LOCATION";A$:N=VAL(A$)
222 IFN<=99ANDN>=0 GOTO 230
224 PRINT" INVALID LOCATION": GOTO220
230 INPUT" DATA";A$
240 IF LEFT$(A$,1)="T" GOTO100
245 D=VAL(A$)
250 IF D<=999 AND D>=0 GOTO 260
255 PRINT " INVALID DATA": GOTO230
260 S(N)=D
270 N=N+1
275 IF N=100 GOTO 100
280 PRINT " LOCATION";N;"  ";
290 GOTO230
400 REM ******* MODIFY *******
402 CLS
405 PRINT" YOU CAN MODIFY ONE LOCATION, TYPE"
406 PRINT" L AS DATA TO LEAVE UNCHANGED"
410 INPUT" LOCATION";A$:N=VAL(A$)
420 IF N<=99 AND N>=0 GOTO 430
425 PRINT" INVALID LOCATION":GOTO410
430 PRINT" CURRENT DATA";S(N)
440 INPUT" NEW DATA";A$
450 IF LEFT$(A$,1)="L" GOTO100
455 D=VAL(A$)
456 IF D<=999 AND D>=0 GOTO460
458 PRINT" INVALID DATA":GOTO440
460 S(N)=D
470 GOTO100
600 REM ********* SINGLE STEP *********
601CLS:PRINT"               SINGLE STEP"
602 INPUT" EXECUTION TO START AT";A$:I=VAL(A$)
603 IF I<=99 AND I>=0 GOTO610
604 PRINT" INVALID LOCATION":GOTO602
610 S=1:SK=0
611 INPUT" MONITOR REQUIRED";A$: IFA$="YES"THENSK=1
612 GOTO812
800 REM ********* RUN **********
801 CLS: PRINT"          RUN"
802 PRINT" EXECUTION TO START AT";A$:I=VAL(A$)
803 IF I<=99 AND I>=0 GOTO 810
804 PRINT " INVALID LOCATION": GOTO802
810 S=0:SK=0
811 INPUT" MONITOR REQUIRED";A$:IFA$="YES"THENSK=1
812 F=INT((ABS(S(I)))/100):X=ABS(S(I))-100*F
813 IFSK=0GOTO815
814 PRINTI,S(I),R
815 IFS=0GOTO820
```

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```
817 GOSUB980
820 ON F+1GOTO880,890,850,860,830,840,904,870,900
825 GOTO920
830 REM ***** FETCH *****
831 R=S(X)
835 GOTO 930
840 REM *** STORE ***
841 S(X)=R
845 GOTO 930
850 REM **** ADD ****
851 R=R+S(X):IFR>999 OR R<-999GOTO918
855 GOTO930
860 REM **** SUB ****
861 R=R-S(X):IFR>999 OR R<-999 GOTO918
865 GOTO930
870 REM ***** JUMP NEG *****
871 IF R<0 GOTO 904
875 GOTO930
880 REM ***** INPUT *****
881 INPUT" INPUT DATA";A$: S(X)=VAL(A$)
884 IFS(X)>999 OR S(X)<-999 GOTO 918
885 GOTO 930
890 REM ****** OUTPUT *****
891 IF S(X)>=900 GOTO895
892 PRINT" OUTPUT DATA  ";S(X):GOTO930
895 REM ***** ALPHA OUTPUT *****
896 PRINT CHR$(S(X)-869);:GOTO930
900 REM ***** JUMP ZERO ****
901 IF R=0 GOTO 904
902 GOTO 930
904 REM ***** JUMP *****
910 I=X: GOTO 812
918 PRINT" OVERSPILL"
920 PRINT " TERMINATED AT ";I:GOTO 100
930 REM ***** INC PC ****
931 I=I+1
940 IF I=100 THEN PRINT " HALTED AT 100": GOTO 100
945 GOTO 812
980 INPUT " CONTINUE";A$: RETURN
1000 REM ***** EXAMINE *****
1001 CLS
1002 PRINT " YOU CAN EXAMINE THE STORE FROM ANY LOCATION"
1005 PRINT " TYPE T TO RETURN TO MENU OR HIT ENTER TO"
1007 PRINT " CONTINUE WITH NEXT LOCATION"
1020 INPUT " START LOCATION";A$:N=VAL(A$)
1022 IF N<=99AND N>=0 GOTO1030
1025 PRINT " INVALID.LOCATION": GOTO1020
1030 PRINT " LOCATION";N;"  DATA";S(N)
1040 INPUT " NEXT";A$
1050 IF LEFT$(A$,1)="T" GOTO100
1060 N=N+1;IFN=100  GOTO100
1070 GOTO1030
2000 REM ******* RECORD ARRAY *******
2005 CLS:PRINT" SET TAPE RECORDER TO RECORD"
2010 INPUT" HIT ENTER WHEN READY";A$
2015 FOR Z=1 TO 500:NEXT Z
2020 PRINT " *********** RECORDING ***********"
2030 CSAVE*S
2040 PRINT " **********DONE ***********"
2050 PRINT " TURN RECORDER OFF NOW"
2060 GOTO100
3000 REM ****** READ ARRAY *******
3005 CLS:PRINT " ********* INPUT FROM TAPE ******"
3007 PRINT " SET RECORDER TO PLAY"
3010 INPUT " HIT ENTER WHEN RUNNING";A$
3020 PRINT " ********* READING *******"
3030 CLOAD*S
3040 PRINT " ******* DONE *******"
3050 PRINT " TURN RECORDER OFF":GOTO100
9000 REM ********* TERMINATE *******
9010 PRINT " IF YOU TERMINATE YOU WILL RETURN"
9020 PRINT " TO BASIC & LOOSE YOUR PROGRAM IN"
9030 PRINT " MARVIN"
9040 INPUT " DO YOU STILL WISH TO TERMINATE";A$
9050 IF A$="YES" GOTO 9100
9060 GOTO100
9100 PRINT " THANK YOU FOR YOUR PROGRAM"
9110 PRINT " BYE"
9120 STOP
```

Special I/O ports for the outside-world interface

This month, David Peckett covers two approaches to a programmable I/O device.

ANY USEFUL microcomputer has to communicate with the outside world, either via memory-mapped peripherals, or via special I/O ports. To give that capability, the chip builders also supply peripheral chips — programmable, intelligent, devices. Those chips are available in many different forms, but the most widely-used types provide 8-bit parallel ports — usually two ports per chip.

This month, we shall look at two approaches to a programmable input/output, PI/O, device — the 6520 and the Z-80 PI/O. Before we do, however, what facilities should we look for in a PI/O?

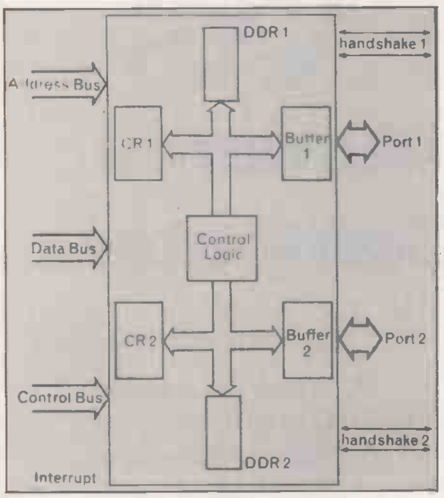


Figure 1. The ideal PI/O.

The most fundamental thing is that the PI/O must provide at least one, and preferably two, or even three, ports; each port will have eight interface lines.

To give the maximum flexibility, each line from a port must be selectable individually as either an input or an output. There has to be, therefore, an 8-bit data direction register, DDR, controlling the lines, associated with each I/O buffer.

We can use each bit of a DDR to control the mode of its associated line. For instance, setting a DDR bit five to 0 might configure I/O line five as an input. That is the usual approach, rather than using a "1" to define an input — why?

We saw last month that handshaking is often used to interface the micro to its peripherals; we must, therefore, also provide a pair of handshake lines for each port. Sometimes, though, we may have to use some of a port's lines to generate handshakes, but that wastes lines.

Since the PI/O must be as flexible as possible, able to communicate in different ways, use different handshake modes, etc., we need some way to select the right operating mode at the right time. A few bits will do the job, and can be part of a control register, CR, for each channel of the PI/O.

Once the appropriate selection has been made in the CR, the internal logic of the PI/O can be left to calculate its detailed working. After all, the idea is to relieve the CPU of as much work as possible.

A second job for the CR is to tell the CPU the status of the port — whether a handshake has occurred, for instance. As well as holding the PI/O control bits, the CR should, therefore, contain at least one status bit which the micro can read.

The CPU will communicate with the PI/O via the normal system busses. The data and control busses must run to it and, if it is memory-mapped, it will also link with the system address bus. The micro needs to be able to access each register of the PIP. Ideally, the device's control logic will give a separate address or port number to each register. The PI/O will need a core of control logic to organise what goes where.

Finally, PI/Os are often used with interrupt-driven systems. Interrupts are a marvellous invention — they allow the CPU to respond very quickly — inside 10μS — to unpredictable outside events, while not losing track of its routine task. They require an interrupt-line from the PI/O to the CPU.

Putting in all those factors, our hypothetical PI/O looks someting like figure 1. How does that compare to the devices to match the 6502 and the Z-80?

The 6520 is a memory-mapped PI/O which can be used with the 6502. Figure 2 is a sketch of it, showing its key features.

It has two channels, called A and B, each with an I/O buffer register called a peripheral data register, PDR. Each port has two control lines associated with it; one is input-only, and the other may be either an input or an ouput. The appropriate channel CR sets-up the control lines as necessary to provide the handshaking that the programmer segments.

One oddity which will strike you straight away is that there are only two address lines to the chip. They are normally the two LSBs of the address bus — AO and A1. There is also a chip-select line, which is enabled by a suitable gating-together of the 14 MSBs of the address bus.

The hardware designer can thus put the 6520 virtually anywhere in memory. Suppose he gates the A2-A15 lines to give a base address of 8000_{16}. Combining the chip-select line with the AO and A1 lines, it is possible to give the PI/O registers four addresses: 8000, 8001, 8002, and 8003.

Here we have a problem. The device has six registers, and only four addresses to allocate to them. What does it do? The DDR and PDR in a given channel share the same address, and we select the one we want to write to via bit two of the appropriate CR. If the bit is "1", we can access the PDR, and if it is "0", that address gives us the DDR. That can force us to use clumsy programming.

The two address lines always select the same registers, and the allocations are shown in table 1. With the addresses I described above, that would make 8001_{16} the address of CRA, and 8002 would be the address of DDRB and PDRB.

The DDR uses the convention I described earlier — a "O" in any bit position configures the relevant line as an input, and vice-versa. The 16 I/O lines can be formed in any pattern of inputs and outputs. The two CRs each have eight bits — figure 3 — which form several functional groups. The six lower bits can be written to, and read, by the CPU, while the two MSBs can only be read.

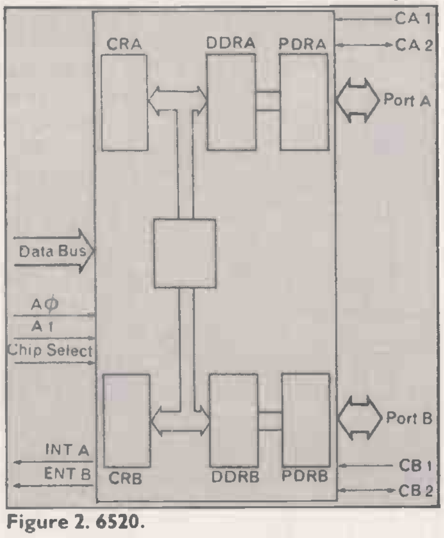


Figure 2. 6520.

The two LSBs control the input-only control line for that channel — CA1 or CB1. It is possible to select whether or not an active transition on that line causes an interrupt to be sent. You can also define whether active means high-to-low or low-to-high. Whether or not an interrupt is actually sent, an active transition always sets bit seven of the CR to "1". That bit is re-set to zero automatically whenever the micro reads the data in the PDR for that channel, no matter whether the PDR is set for input or output.

As we saw, bit two controls access to the DDR or the PDR. A "1" in bit two links the data bus to the PDR. Bits three to five control the two-way control line — CA2 or CB2. You can select the line as an input or an output via bit five. If it is an input, it can be used just like line 1 — it can control interrupts, and active transitions will set bit six. If it is an output, bit six stays at zero, and the line can either be controlled by the micro or automatically.

With either approach, if line two is an output, it can be used for handshaking,

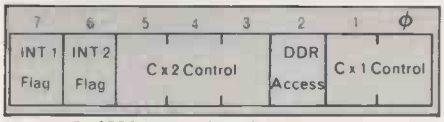


Figure 3. 6520 control register.

but the auto mode is better for the purpose. When it is working automatically, the line is set whenever the PDR is read. The micro does not, therefore, have to worry about the details. When line two is controlled directly, it is normally used simply as a discrete control line, rather than as part of a handshake.

The way of signalling handshakes and status is particularly useful. The status information appears in the control register, and the control lines are also manipulated via the CRs. The two PDRs are thus free to be used only for data.

You can also see that the two control inputs in each channel set the two MSBs of the relevant CR. They are the easiest

A1	A0	REG
0	0	DDRA, PDRA
0	1	CRA
1	0	DDRB, PDRB
1	1	CRB

Table 1. 6520 register selection.

two bits for the micro to test. Even more cunning, the primary input lines — CA1 and CB1 — control the MSBs — i.e., the sign bits — of the CRs. Read a CR, and the N flag shows the status of control line 1 — just like that.

Suppose we want to program a PI/O to control a bi-directional interface, with eight bits of data going each way. Channel A is to be the input, and we set it with an automatic handshake. CA1 will not set an interrupt, but a high-to-low transition will show that data is ready. That will be reflected in bit seven of CRA. CA2 will go low to tell the peripheral that the micro has taken the data.

Channel B will be used to output data. Data read will be shown by the micro setting CB2 low. When the peripheral has read the data, it will set CB1 high, after which the micro can set CB2 low again, and move on to the next phase. Table 2 shows the CR control words that will be needed.

We have two phases to think about in the program — setting-up the PI/O and handling the data. Figure 4 is a flowchart for those activities. To make it simpler, the data is handled via undefined sub-

CR Command	Meaning
xxxx x0xx	DDR Selected
xx10 1100	Control line two output; auto-handshake; auto re-set; PDR selected; no interrupt; line one active transition is high-to-low
xx11 b110	Line two output, and set to value of "b"; PDR selected; no interrupt; line one active transition is low-to-high
	"x": "Don't Care"

Table 2. 6520 control words.

routines, interfacing via A. The flowchart is very simple and the resulting program is in figure 5.

The program is straightforward. We have access to the DDRs by setting the bit twos of the two CRs to zero — since the

(continued on next page)

Figure 4. Flowchart for 6520.

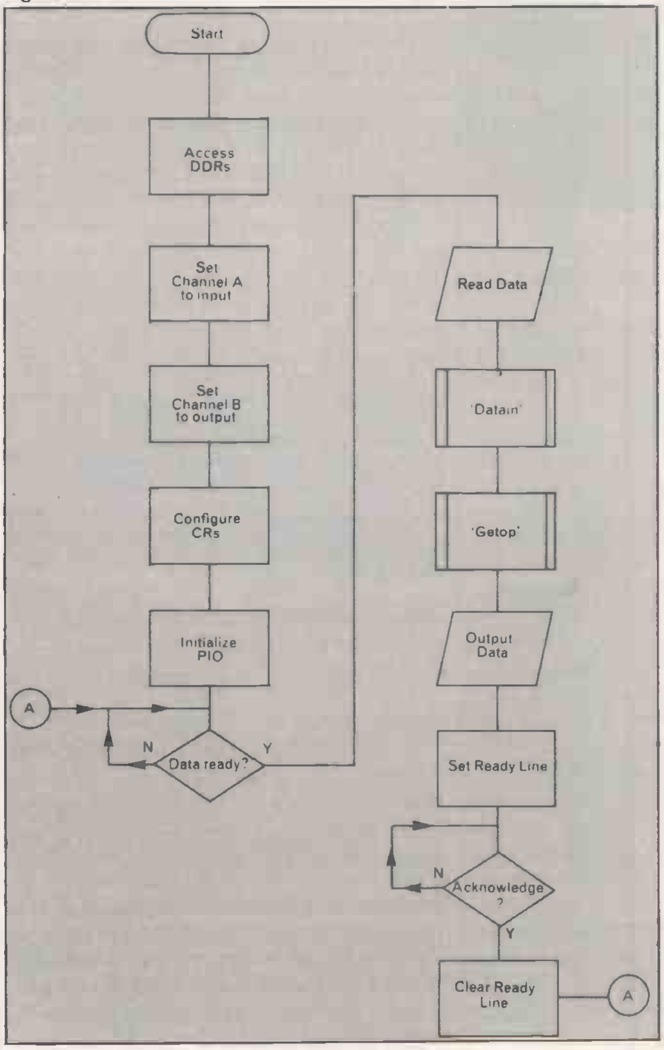
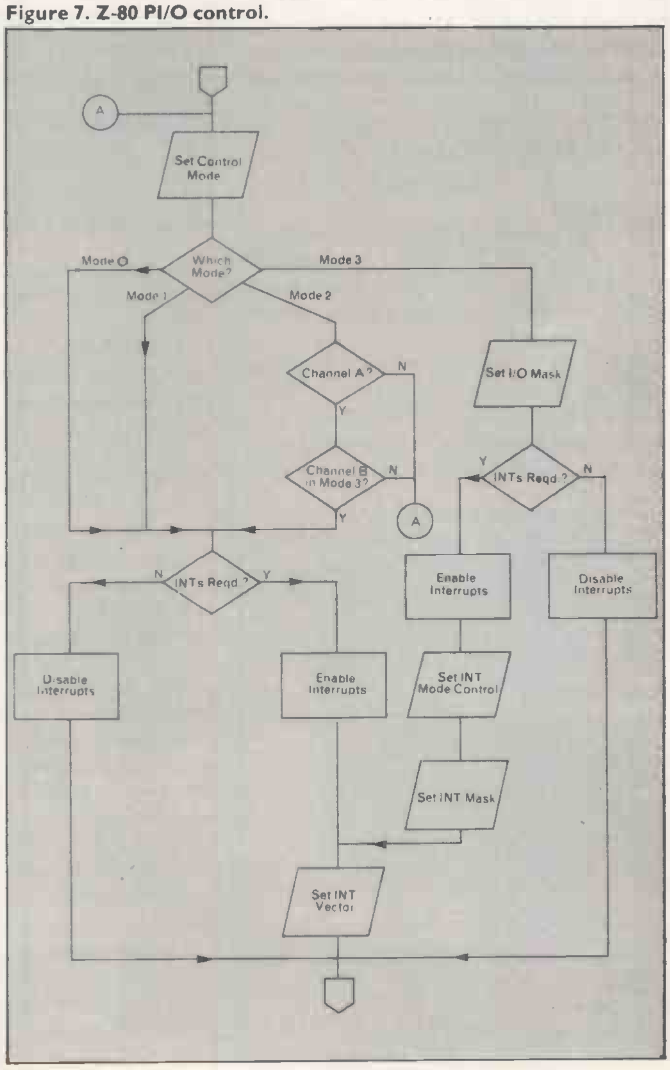


Figure 7. Z-80 PI/O control.



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other bits do not matter at this stage, it is easiest to set the CRs entirely to zero. Channel A is then set as an input by setting all the bits of DDRA to zero, and channel B is established as an output by writing FF_{16} to DDRB. The first part of the program finishes by setting the two CRs to their final command codes, using the values from table 2, and, finally,

```
;CONTROL AND USE OF 6520 PIO
;THE ASSEMBLER SHOULD BE INSTRUCTED TO SET
;     PDRA=DDRA  AND  PDRB=DDRB
;
        LDA   #0
        STA   CRA       ; SET CRS FOR ACCESS
        STA   CRB       ;....TO DDRS
        STA   DDRA      ;SET DDRA FOR INPUT
        LDA   #$FF      ;"OUTPUT" MASK
        STA   DDRB      ;SET DDRB FOR OUTPUT
        LDA   #$2C      ;SET UP CRA MASK
        STA   CRA       ;...AND SET CRA
        LDA   #$2E      ;SET UP CRB MASK AND
        STA   CRB       ;...SET CRB (CB2 IS HI)
        LDA   PDRA      ;CLEAR STATUS
        LDA   PDRB      ;...BITS
;SYSTEM IS NOW CONFIGURED.
;START HANDLING DATA.
LOOP1   LDA   CRA       ;N FLAG SHOWS STATUS
        BPL   LOOP1     ;WAIT IF "0"
        LDA   PDRA      ;READ DATA
        JSR   DATAIN    ;PROCESS IT
        JSR   GETOP     ;GET OUTPUT DATA
        STA   PDRB      ;SET OUTPUT
        LDA   #$26      ;RESET CRB MASK
        STA   CRB       ;SET CB2 LOW
LOOP2   LDA   CRB
        BPL   LOOP2     ;WAIT FOR ACKNOWLEDGE
        LDA   #$2E
        STA   CRB       ;SET CB2 HIGH
        BNE   LOOP1     ;BACK FOR MORE (A≠0)
```

Figure 5.

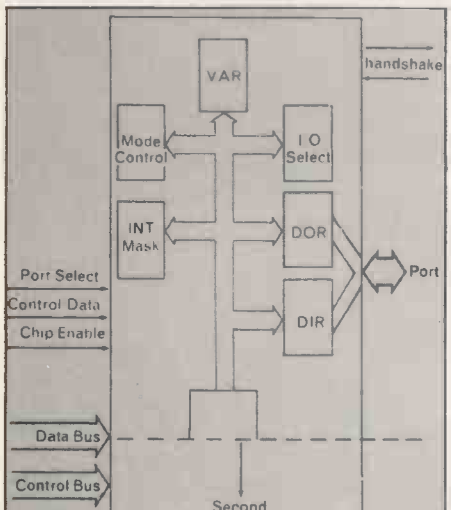
makes dummy reads of the PDRs to ensure that the status bits are clear.

The second part of the program handles the data. We can see how data is entering and leaving the system. Because we are controlling CB2 directly, the program is a little longer than it need be; you should aim to use an automatic handshake whenever you can.

Finally, a trick we have used before in the series; a "BNE" instead of a "JMP" to return to the start. The Z flag is never zero at this point, and a branch is quicker than a jump.

The Z-80 is much more complex than the 6502. It will not be any surprise, then, to discover that the Z-80 PI/O is rather more complicated than that of the 6520. It has the same basic function of providing

Figure 6. One channel of Z-80 PI/O.



Address Bus Bit 1	Address Bus Bit 0	Port No. (Hex)	Function
0	0	74	Channel A data
0	1	75	Channel B data
1	0	76	Channel A control
1	1	77	Channel B control

Table 3. Z-80 PI/O port selection.

two 8-bit ports, but its modes, and the way that they are selected, are very different. Strangely enough, though, it cannot really do much more than the 6520.

Figure 6 shows the structure of one channel — the other is identical. Although it is more complex than the 6520, it is not that much harder to understand. The external connections are much the same — it is connected to the micro by the data bus, various control and selection lines, and an interrupt line. To the outside world, it looks like two 8-bit I/O channels, each with two handshake lines. Unlike the 6520 C×2 lines, all the handshake lines are unidirectional.

To the Z-80, the PI/O looks like four ports. The one used is selected by the data on the lowest eight bits of the address bus when the I/O signal from the micro is active. Normally, the six MSBs of the port address will be gated together to define the base address of the four ports, and used to select the PI/O via the chip-select

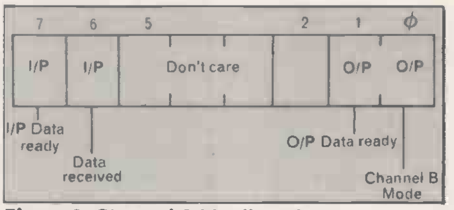


Figure 8. Channel A bit allocations.

line. Which of the four ports is to be used is then selected by the two LSBs of the address.

The addressing technique is very similar to that used with the 6520, and, with a base address of, say, 74_{16}, gives the port allocation shown in table 3.

The Z-80 PI/O has the same limitation as the 6520 of having only one control port per I/O port. In fact, because of the way that the PI/O is designed, that can lead to even more complicated programming than we had with the 6520. Figure 7 is a simplified flowchart of the steps you have to go through to set-up the PI/O — the key word here is simplified.

The first step is to select the channel mode. That is done by writing to the relevant control port — using "OUT" — a mode control word selected from table 4. The two bits "ab" are used to select one of four operating modes. Mode 0 is the output mode; data is written to the appropriate channel data output register, DOR, from where it goes on to the output bus.

Mode 1 makes a given port entirely an input. An "IN" from the port reads data which has been written from an external device into that channel data input register, DIR. In modes 1 and 0, handshaking signals are applied automatically via the two handshake lines.

By selecting mode 2, channel A can be used, virtually simultaneously, as both an input and an output, passing eight bits of data each way. The DIR and DOR are linked to the /O bus under the control of the two pairs of handshake lines. That

```
;Z80 PIO CONTROL ROUTINE
;CHANNEL A IS I/O
;CHANNEL B IS INPUT OR OUTPUT
;
        LD    A,$CF        ;MODE 3 CODE
        OUT   (ACONTR),A   ;CHANNEL A - MODE 3
        LD    A,$C0        ;I/O MASK
        OUT   (ACONTR),A   ;SET I/O MASK
        LD    A,$07        ;NO-INT. MASK
        OUT   (ACONTR),A   ;DISABLE INT FROM A
        OUT   (BCONTR),A   ;DISABLE INT FROM B
        IN    A,(ADATA)    ;INITIALIZE
        IN    A,(BDATA)    ;...PIO
        LD    C,ACONTR     ;SET POINTER
LOOP1   LD    E,$02        ;CHAN B IS I/P
        OUT   (C),E        ;...DATA NOT READY
        LD    A,$4F        ;MODE 1 CODE
        OUT   (BCONTR),A   ;SET B TO I/P
LOOP2   IN    A,(ADATA)    ;READ STATUS
        OR    A            ;SET FLAGS
        JP    P,LOOP2      ;STATUS SET?
;IF BIT 7=1, DATA IS READY (AUTO HANDSHAKE)
        IN    A,(BDATA)    ;READ DATA
        CALL  DATAIN       ;PROCESS IT
        LD    A,$0F        ;MODE 0 CODE
        OUT   (BCONTR),A   ;SET B TO O/P
        SET   0,E          ;A BIT 0=1  B IS O/P
        OUT   (C),E        ;SET MUX
        CALL  GETOP        ;GET DATA
        OUT   (BDATA),A    ;OUTPUT DATA
        RES   1,E          ;A BIT 1=0
        OUT   (C),E        ;SET "O/P READY"
LOOP3   IN    A,(ADATA)    ;WAIT FOR HANDSHAKE
        BIT   6,A          ;DATA ACCEPTED?
        JP    Z,LOOP3      ;WAIT
;PER. HAS ACCEPTED DATA - GO BACK FOR NEXT
        JP    LOOP1
```

Figure 11.

prevents confusion caused by the CPU and the peripheral trying to read or write together. Because that mode needs all four handshake lines, it can be used only with channel A of a PI/O. Furthermore, if channel A is in mode 2, channel B must be in mode 3.

Mode 3 is the control mode used to set up the PIPO, and to control individual I/O lines. Whenever mode 3 command is sent, the next word to that control port must be an 8-bit mask defining the I/O pattern to be set. A "1" in the mask sets

Word	Function
abxx 1111	Mode Control Word
abcd 0111	Interrupt Control Word
---- ---0	Interrupt Vector Control Word
"x": Don't Care	
"-": Set as required	

Table 4. PI/O control words.

the corresponding line as an input. Do not be confused by the 6520, which uses a "1" in the DDR to define an output.

Either or both channels can be set to mode 3, which allows any combination of I/O lines to be set-up. In that mode, however, the handshake lines are not used, and you have to set-up your own.

Whenever a mode 0-2 handshake occurs, the PI/O can automatically send an interrupt to the Z-80. The need for an interrupt is controlled by bit seven of the interrupt control word. If the bit is set to "1", interrupts will be generated. Because mode 3 does not use the handshake lines, it has a different way of generating interrupts. In that mode, the PI/O can gate selected bits in a channel together to generate an interrupt.

The gating is established by sending the interrupt control word with bit four set to "1", followed immediately by a mask which is shunted into the mask register, MR, defining the bit(s) which will control the interrupt. The advantage of that technique is that it lets the Z-80 monitor, via a PI/O, up to 16 peripherals. The micro is able to select which peripherals it is interested in at any time.

Finally, the Z-80, unlike the 6502, can handle vectored interrupts. In those, the interrupting device can tell the micro the address of the routine which handles the interrupt. The PI/O tackles that with the two vector address registers, VARs, which can be set to the right value by the vector control word of table 4.

The Z-80 PI/O lacks one important feature of the 6520. That is the provision of status bits which the micro can read to see if a peripheral is ready. Without them, and if interrupts are not being used, the micro must read a device's status through an I/O channel. That, in turn, reduces the PI/O flexibility, and can lead to even more complicated systems.

Let us implement the same system we set-up with the 6502/6520 combination. That is eight bits of data each way, with an automatic handshake on the input, and a micro-controlled output handshake. We shall not be using interrupts.

Because of the Z-80 PI/O lack of status bits, the implementation is going to be a little more complicated than that for the 6520. We shall have to use one channel as both an input and an output, selecting the proper mode as we go. The other channel will be used for status, system control, etc. We could use channel A in mode 2 for the I/O channel, but let us complicate things by using channel B in modes 0 and 1.

Channel A will, therefore, be set as the control channel — it will operate in a mixed I/O configuration — mode 3. To tell the outside world whether channel B is an input or an output, we shall use channel A bit 0 as an output. It will be linked by external logic to a suitable I/O multiplexer for channel B. When bit zero is "0", channel B will be an output.

We also use bit one as an output, and set it low to show that the CPU has data ready for the peripheral. The handshake will be completed by bit six, an input, which the peripheral will set high when it has accepted data. Finally, bit seven of channel A will also be an input, going high to show that data is ready for the CPU.

Figure 8 shows the configuration of channel A, and the kind of system lay-out is shown in figure 9. The flowchart for the program segment is figure 10, and shows the extra complication caused by using the Z-80 PI/O. Compare it to figure 4.

The program I generated from the flowchart is shown in figure 11. It follows the flowchart closely, but, as usually, it has some interesting points. Initially, channel A is set up; it is forced into mode 3, and then the I/O mask is loaded into the PI/O to set the input and output lines. Only the two LSBs are set as outputs — all the others, including the don't cares, are left as inputs. In a real system, that would be the safest approach to take. Just possibly, other peripherals could be connected to bits two to five. If any of those four lines were outputs, the CPU actions might start the peripherals doing things at the wrong time. At best, that would be embarrassing, but at worst, it could be dangerous.

The interrupts are then disabled in each channel, by writing bit seven of the interrupt control words to "0". When you do that, it does not matter what is in bits four to six, but, once again, I held them at zero. Having set up both channels, we make a dummy "IN" from each. Just as with the 6520, that makes sure that the

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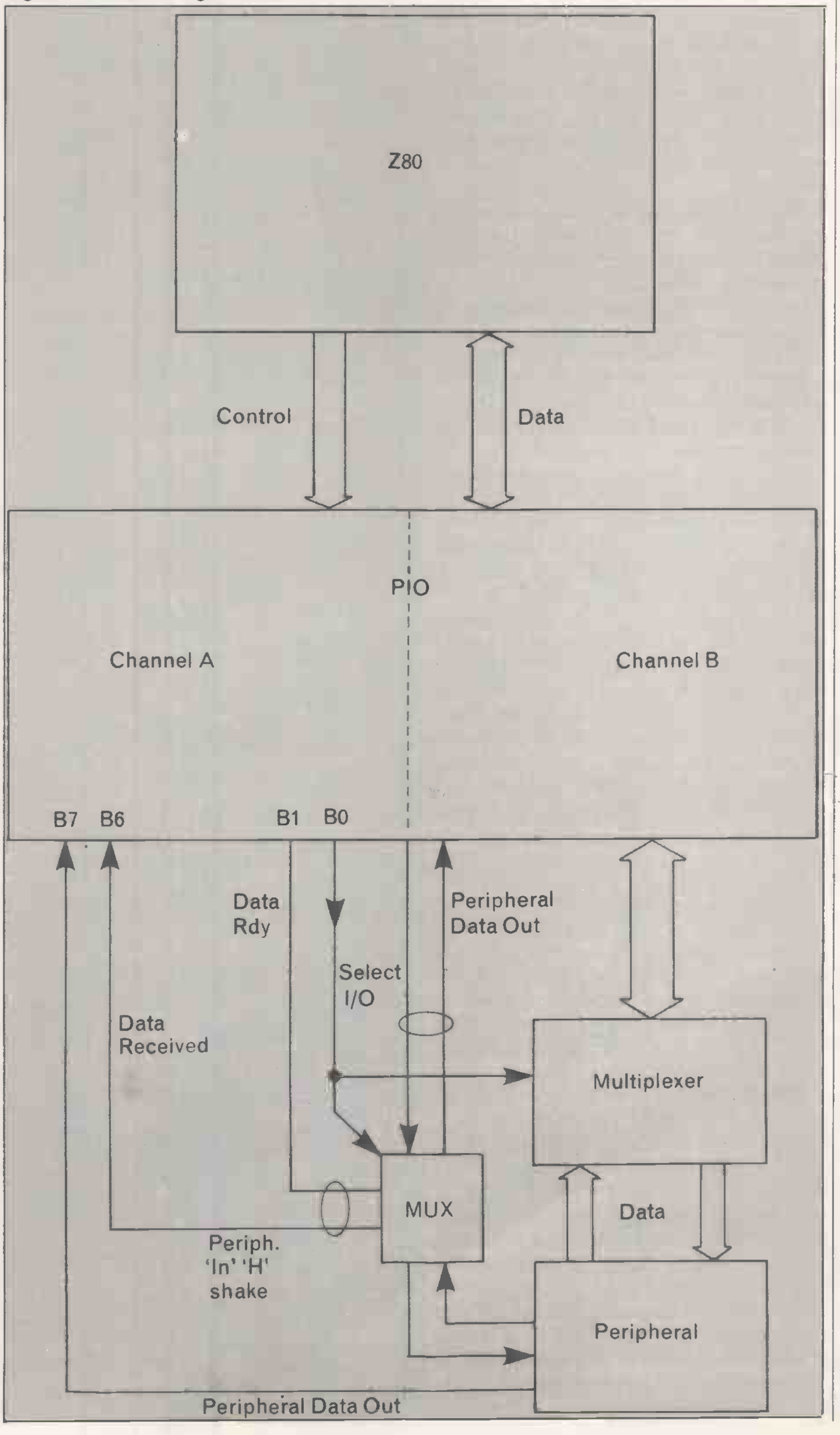
Figure 9. Circuit configurations.



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PI/O is completely initialised. It is not always essential, but it is a good practice.

Throughout the I/O loop, register E is used to control the two output lines from channel A. At the start of the loop, it is set to drive line one high, showing that output data is not ready, and line zero low to indicate that channel B is in the input mode. That control is then set via an "OUT (C),E". We have to use C as a pointer because we cannot output E directly.

At the beginning of the I/O loop, channel B is set to mode 1 input. The system then sits in a loop until the MSB of channel A goes high, showing data ready. The channel B automatic handshaking looks after the peripheral. Data is processed by DATAIN, and the system is reconfigured with channel B as an output — mode 0.

The Z-80 acquires suitable data, sets it on the output bus, and warns the peripheral by setting bit one of channel A low. It waits for the handshake to be complete — the auto handshake is ignored — before going back to the start of the loop.

For the first time, we have investigated a problem where the 6502-based system was more efficient than that using the Z-80. Why was that? There were two main reasons. In the first instance, the Z-80 PI/O is rather clumsier to set up than the 6520. In the worst case, you might have to write to a channel control port six times before that channel was fully configured. You never have to write to a 6520 CR more than twice to set it up fully.

The second reason for the Z-80 clumsiness was the way that we chose to implement the system. Because we were not using interrupts, we had to create a set of status bits, and control a handshake. That occupied one channel of the PI/O, so the other had to be constantly switched between input and output. The result was a lengthy bit of programming. In a way, we were using the Z-80 PI/O to simulate a 6520.

If we had used an interrupt-based approach, or a second PI/O, the second reason above would have largely disappeared. However, the 6520 would still have been simpler to use. Why, then, do we use the Z-80 device? In the first place, we virtually have to if we are using a Z-80 CPU which, as we have seen, is a particularly wonderful wonder-chip.

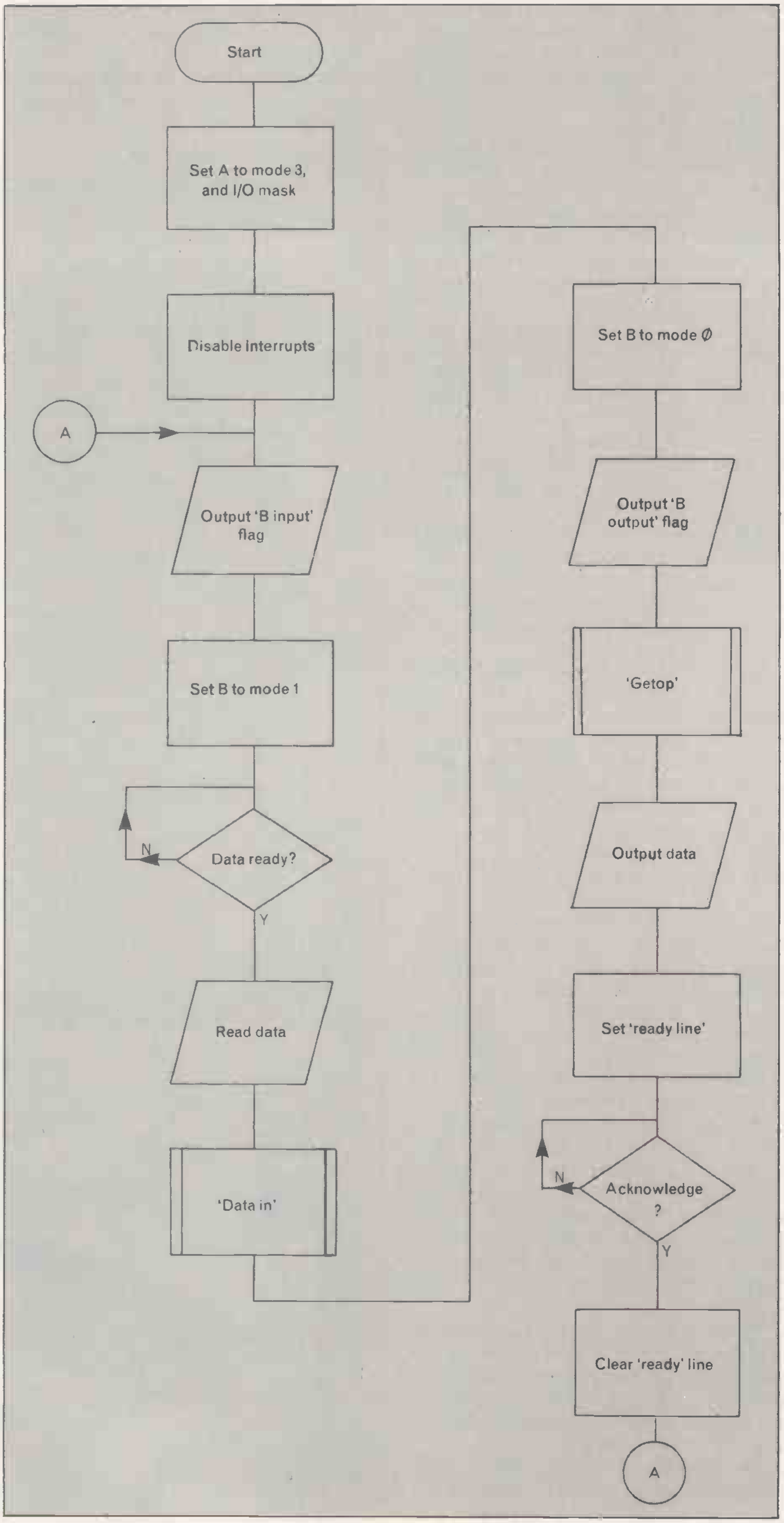
Another point is that the Z-80 PI/O can gate together, under program control, several lines to generate an interrupt. If we have to monitor several peripherals, e.g., to control a chemical process, that can be very useful. The micro can select which peripherals it must respond to at any time.

In the end, though, it is Hobson's Choice. If you use a Z-80, you use a PI/O and put up with it; if your micro is a 6502, you have the easily-used 6520 to compensate you for your CPU limitations.

Other types of typical peripheral chips, e.g., serial outputs, are available, but they are almost always controlled by separate control and data words.

I hope it is clear that they are complex animals, and not necessarily easy to use effectively. Because of that complexity, I have not been able to give full details of either the 6520 or the Z-80 PI/O. I have shown the basics, which should at least be enough to give you a head start when you study the data sheets.

Figure 10. Flowchart for Z-80 PI/O.



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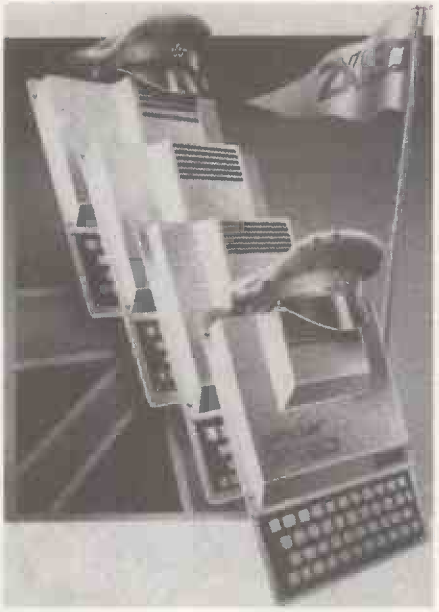


Maths tutor

THE MATHS Tutor is designed for young children and is written by M D Stuart of Baldock, Hertfordshire. Repeated wrong numbers result in the question being simplified while the type of problem cannot be predicted.

```
                ZX80 MATHS TUTOR.
                ================

COPYRIGHT M.D.STUART  29.08.80

1 LET W$="WHAT IS "
2 LET P$=" + "
3 LET M$=" - "
4 LFT T$=" X "
5 LET N$=" NO"
6 LFT G$=" GOOD"
7 LFT CYC=0
8 LFT BAD=0
11 LET S$=" = "
12 LET O$=" / "
13 PRINT "     THIS IS YOUR MATHS TUTOR"
14 PRINT "     ======================="
15 PRINT
16 PRINT "MY NAME IS ZEDEX ATEE."
17 PRINT
20 PRINT "WHAT IS YOUR NAME?"
30 INPUT Z$
40 CLS
50 PRINT "I HOPE YOU HAVE FUN ";Z$
60 PRINT
61 PRINT "PLEASF REMEMBFR / IS DIVIDE"
62 PRINT ,,"X IS TIMES"
63 PRINT ,,"+ IS ADD"
64 PRINT ," AND    - IS SUBTRACT"
65 PRINT ,"-------------------------------"
66 PRINT
70 LET D = RND(5)
80 IF D = 3 THEN GO TO 290
90 LET A = RND(20)
100 LET B = RND(20)
101 IF (B > A OR B = A) AND D > 3 THEN GO TO 90
110 LFT L = PEEK(16421)
111 IF L < 10 THEN CLS
112 PRINT W$;A;
120 IF D = 1 THEN PRINT P$;B;
130 IF D = 2 THEN PRINT M$;B;
140 IF D = 3 THEN PRINT T$;B;
141 IF D > 3 THFN PRINT O$;B;
150 INPUT C
160 IF D = 1 AND C = A + B THEN GO TO 320
170 IF D = 2 AND C = A - B THEN GO TO 320
180 IF D = 3 AND C = A * B THEN GO TO 320
110 IF D > 3 AND C = A / B THEN GO TO 320
200 LET BAD = BAD + 1
201 PRINT S$;C;N$
210 IF BAD < 3 THEN GO TO 110
220 LET A = A - 1
230 LET BAD = 0
240 IF A > 0 THEN GO TO 110
250 LET B = B - 1
260 IF B = 0 THEN LET B = RND(5)
270 LET A = RND(12)
280 GO TO 110
290 LET A = RND(12)
300 LFT B = RND(12)
310 GO TO 110
321 PRINT S$;C;G$
330 LFT BAD = 0
331 IF D = 5 THEN GO TO 380
340 LET CYC = CYC + 1
350 IF CYC < 50 THEN GO TO 70
360 PRINT "THANKYOU "Z$,,"FOR YOUR HARD WORK"
361 PRINT "DO YOU WANT SOME MORE PROBLEMS?"
362 INPUT V$
363 IF V$ = "YES" THEN GO TO 60
364 PRINT "PROGRAM TERMINATED"
370 STOP
380 CLS
390 PRINT  A;O$;B;" IS ";C;,,,,,,,,"
    HOW MANY ARE LEFT?"
400 INPUT R
410 IF (B*C) + R = A THEN GO TO 430
411 PRINT R,"THINK AGAIN"
412 GO TO 390
430 PRINT R
431 PRINT "WELL DONE ";Z$
440 GO TO 340
```

Keyboard circuitry

HERE ARE some notes which describe the video and keyboard circuitry as I understand it from studying the circuit diagram of a friend's ZX-80 writes P Sawyer of Richmond, Surrey.

From a study of the circuit diagram and the manual, I deduce that the video display and the keyboard operate as follows: the display file consists of the line-by-line text, each line terminated by 76X. Each line must be scanned eight times, corresponding to the eight rows of the eight × eight character matrix. The monitor initiates a scan by jumping to the first byte of the line, with A15 of the program counter set, and with interrupt enabled.

Setting A15 causes the open collector outputs of IC14 and 15 to go low, such that the ZX-80 sees zeros on the data bus, i.e., a Z-80 no-op instruction. Thus, the ZX-80 keeps fetching each byte on the line and executing a no-op until the 76X at the end of the line is encountered. 76X has D6 set — all the characters of the text have D6 not set, which causes the open collecter outputs to go high, and the ZX-80 sees the 76X and halts because 76X is the Z-80 halt instruction.

Just before beginning the line scan, the monitor loads the refresh counter such that A6 goes low on a refresh cycle after 32 or so refresh cycles. A6 is connected to the ZX-80 interrupt line, and thus the ZX-80 is interrupted by the expiring refresh counter, terminating the halt at the proper time for a video synchronic pulse.

The code entered via the interrupt issues an I/O command to cause a synchronic pulse to be generated, and then loops to the next scan, either to process the next line of characters matrix or to begin a new line. The byte taken from the line of text is presented via IC7 to the character generator section of the ROM.

The relevant ROM address is formed as follows: the contents of the I-register form — A15-A8, the higher order bits are ignored by the ROM — D0-D5 of the character form A3-A7, and the low order three bits of the address — which represent the eight rows of the character matrix —are formed by the three high-order parts of the counter IC21, which is stepped at the end of each line slice. Each dot is two video lines deep. Rows of the character matrix are transferred from the ROM to the shift-register IC9, from whence the eight bits of the row are shifted to become the video dots.

The rate at which dots must be generated determines the system clock frequency of 6.5 MHz. When divided by two, that becomes the clock frequency of the ZX-80, four cycles of which form an M1 cycle, the time needed to execute a no-op, and thus to enable another character from the line to be presented to the character generator.

The address of the character generator section of the ROM is 3584; the character generator uses the last 512 bytes of the ROM. Inverse video is selected by D7 of the character, which is exclusive-or-ed with the shift register output — see the circuitry involving ICs 11, 12, 20.

The monitor drives the keyboard by each of the eight half-rows of the keyboard are mapped on to one of the address lines A8-A15, e.g., QWERTY maps on to A9 and TUIOP on to A13. Each of the five columns maps on to one of the data lines D0-D4, e.g., three EDX maps on to D2. At the end of each frame, the monitor issues an I/O read instruction.

A Z-80 read instruction places a specified eight-bit value on address lines A8-A15. The monitor sets one bit low and the remainder high, cycling through all the eight lines on successive reads.

If a key is depressed, when the address line for its row is set low on the next keyboard scan, the data line for that key is pulled low — the data lines are held high by R13-R17 — so that the ZX-80 sets that bit low and the remaining bits high — unless more than one key in the same row is struck — on the completion of the I/O read.

One can study the action of the keyboard by use of the UST function. An alternative technique to that given in the August issue for placing machine code is to make use of an array as follows:

```
10 DIMA(n) REM reserves 2(n+1) bytes;
   must be first statement defining a variable
20 LET Q = PEEK (16392) + PEEK (16393)*
   256+2 REM set up Q with address of first
   byte in A
30 LET A = Q REM first POKE address
(n) load program byte by byte using POKE A,
   byte, LET A = A + 1 etc
(n) PRINT (or whatever) USR(Q)
```

The machine code must be self-relative because the monitor shifts variables about as the Basic program expands and contracts. Note that after editing the program, Q must be re-set, e.g., by GOTO 20, since the address of the first byte of the array may have changed. That technique allows the machine code to be SAVEd with the Basic program, which is useful, since the chances are your machine code will cause a system hang-up until it is bug-free.

(continued on page 107).

(continued from page 105)

Machine code can be conveniently loaded by inputting it as a string of Hex characters, and byteing off successive characters of the string along the lines of:

```
10 INPUT S$
20 LET V=0
30 IF CODE(S$)=0 OR TL(S$)=" " THEN
   GOTO 70
40 LET V= V*16 + (CODE(S$)—28)
50 LET S$ = TL(S$)
60 GOTO 30
70 POKE A,V
80 LET A = A+1
90 IF TL(S$) = TL(S$)
110 GOTO 20
```

ZX-80 as mathematician

DAVE SAMPSON of Coventry, West Midlands, has sent us a copy of his mathematics program for the Sinclair ZX-80.

```
1 LET T$="HELLO"
2 PRINT T$
3 PRINT
4 PRINT ,"I AM A COMPUTER"
5 PRINT
6 PRINT"MY NAME IS ZX8Ø"
7 PRINT
8 LET X=1
9 LET W=Ø
1Ø PRINT"WHAT IS YOUR NAME?
2Ø INPUT A$
3Ø CLS
4Ø PRINT T$;A$
5Ø PRINT
6Ø PRINT"KEY:1(+),2(—),3(*),4(DIV)
7Ø PRINT" OR 5(POT LUCK)
8Ø INPUT Z
9Ø CLS
1ØØ LET R=RND(40)—20
11Ø IF R=Ø THEN GOTO 1ØØ
12Ø LET G=RND(40)—20
13Ø GO SUB Z*1ØØØ
14Ø PRINT"QUESTION ";X
15Ø PRINT
16Ø PRINT P;U$;R;" =?"
17Ø PRINT,,"YOUR ANSWER ";
18Ø INPUT D
19Ø PRINT D
2ØØ PRINT
21Ø IF D=Q THEN GOTO 26Ø
22Ø PRINT"YOU ARE WRONG "; A$
23Ø PRINT
24Ø PRINT"THE ANSWER IS "; Q
25Ø GOTO 28Ø
26Ø LET W=W+1
27Ø PRINT"THAT IS CORRECT "; A$
28Ø PRINT
29Ø PRINT,"SCORE=";W;"OUT OF";X
3ØØ PRINT
31Ø IF X=1Ø THEN GOTO 37Ø
32Ø LET X=X+1
33Ø INPUT N$
34Ø IF N$ = "N" THEN STOP
35Ø CLS
36Ø GOTO 1ØØ
37Ø INPUT W$
38Ø IF W$ ="N" THEN STOP
39Ø CLS
4ØØ GOTO 1ØØ
1ØØØ LET U$ =" ADD "
1Ø1Ø LET P=G
1Ø2Ø LET Q=G+R
1Ø3Ø RETURN
2ØØØ LET U$ =" SUBTRACT "
2Ø1Ø LET P=G
2Ø2Ø LET Q=G—R
2Ø3Ø RETURN
3ØØØ LET U$ =" TIMES "
3Ø1Ø LET P=G
3Ø2Ø LET Q=G*R
3Ø3Ø RETURN
4ØØØ LET U$ =" DIVIDED BY "
4Ø1Ø LET P=G*R
4Ø2Ø LET Q=G
4Ø3Ø RETURN
5ØØØ GOTO RND(4)*1ØØØ
```

Instructions: key N New line to stop. The sums can be made harder or easier by changing the values of R and G at address 100 an 120, i.e., LET R=RND(12). The correct spacing — space/,/; — is important on PRINT functions.

Program run:

```
Screen Display                    Inputs
HELLO                             RUN N/L
I AM A COMPUTER
  MY NAME IS ZX80
WHAT IS YOUR NAME ?
  ——CLS——                         DAVE N/L
HELLO DAVE
KEY:1(+),2(—),3(*),4(DIV)
  OR 5(POT LUCK)                  5 N/L
  ——CLS——
QUESTION 1
1 SUBTRACT 4 =?
     YOUR ANSWER
  ——CLS——                         5 N/L
QUESTION 1
1 SUBTRACT 4 =?
     YOUR ANSWER 5
 YOU ARE WRONG DAVE
  THE ANSWER IS —3
     SCORE 0 OUT OF 1
  ——CLS——                         N/L
QUESTION 2
20 DIVIDED BY —5 =?
     YOUR ANSWER
  ——CLS——                         —4 N/L
QUESTION 2
20 DIVIDED BY —5 =?
     YOUR ANSWER —4
THAT IS CORRECT DAVE
     SCORE 1 OUT OF 2             N/L
```

Tape problems

ALLOW ME to comment on the apparently vexed question of ZX-80 and tapes writes Peter Smith of Nantwich, Cheshire.

Your own review in the July 1980 issue, in common with all others that I have read dwell on this topic.

I decided to obtain the circuit diagrams and a Z-80 machine-code book, to discover how to automate the process. The result is the tape header and loader program attached. To use the program:

- Save it at the start of each cassette side.
- Leave enough space between programs to allow a little space for expansion and for inaccuracy when over-recording. The program itself must be loaded, modified and re-recorded whenever the tape contents are changed.
- Save the programs one after the other — bear in mind the second point.

Then to select a program:

- Re-wind the tape to start.
- Load the first program — stop tape.
- Run the program, examine the contents on screen, and make selection.
- Start the tape simultaneously with, or a little before, pressing newline on making selection.
- WAIT.

The program is very slow in operation because it uses a simple sequential search of the tape to locate the selected program. It reads the cassette input and decides when a program ends and when a new program begins. The machine-code routine is:

```
LD   H,0
LD   C,0
IN   L,(C)
RET
```

The result of the routine is left in HL and is the value of the USR call. The cassette input bit is in bit position 7 — hence the AND 128 — and the lower six bits have keyboard information.

```
1 REM
2 REM CASSETTE HEADER PROGRAM
3 REM
4 REM    RUN THIS PROGRAM TO SEE
5 REM    TAPE CONTENTS AND LOAD.
6 DIM U (3)
10 PRINT "TAPE NUMBER 1 SIDE NO. 1"
11 PRINT "      CONTENTS"
12 PRINT " 1. PROG1"
        etc.
20 LET NPROGS=number of programs on
   tape
30 PRINT "ENTER SELECTION (NOTE
   99 = QUIT)"
40 INPUT NP
50 IF NP=99 THEN LIST 1
60 IF NP<0 OR NP>NPROGS THEN
   GOTO 30
70 LET A=PEEK(16393)*256+PEEK
   (16392)+2
80 LET U(0)=38
90 LET U(1)=14
100 LET U(2)=26861
110 LET U(3)=201
200 GOSUB 300
201 IF N1>9 THEN GOTO 200
210 GOSUB 300
211 IF N1>9 THEN GOTO 200
220 LET NP=NP—1
230 IF NP=0 THEN LOAD
240 GOSUB 300
241 IF N1<10 THEN GOTO 240
250 GOSUB 300
251 IF N1<10 THEN GOTO 240
260 GOTO 200
300 LET N1=0
301 FOR I=1 TO 50
302 IF (USR (A) AND 128)>0 THEN LET
    N1=N1+1
303 NEXT I
304 RETURN
```

Memory-mapped access

HERE IS a revised version of J C Minter's program, Memory-mapped access, which appeared in November.

```
1 CLS
2 LET P=Ø
3 LET N=Ø
4 LET SC=Ø
5 LET L=2ØØ
10 FOR X=1 TO 512
20 PRINT" ";
30 NEXT X
40 PRINT"————————————————"
50 LET S=PEEK(16396)+PEEK(16397)*
   256+4
100 INPUT A
105 POKE S,P+N
107 IF NOT SC=Ø/ AND NOT N=Ø THEN
    POKE S,SC
110 GO TO 12Ø+A*2
120 INPUT SC
121 GO TO L
122 STOP
130 LET S=S—1
131 GO TO L
132 LET S=S+S+33
133 GO TO L
134 LET S=S—33
135 GO TO L
136 LET S=S+1
137 GO TO L
138 LET N=N+128
139 IF N > 128 THEN LET N=Ø
200 LET P=PEEK(S)
205 IF P=3 AND NOT SC=3 THEN LET
    S=S—33
210 POKE S,2Ø
220 GO TO 1ØØ
```

For all users of systems based on the Z-80 chip, Z-80 Zodiac offers an opportunity to have programs and ideas published. We pay at least £5 for each contribution used.

Creeping X

HAVING read the editorial in the September issue, I thought you might like to see a simple program which shows imagination, William Caunt of Worksop, Nottinghamshire.

Initially, I wrote the program to explore the VDU system of the Nascom 1. I wanted to see how fast you could program the VDU memory and retain a picture. The synchronic nature of the Nascom VDU can lead to the display of incomplete characters.

In the program, I have arranged for characters to alter their composition line by line at a creeping pace, hence the title, Creeping X.

While a programmer may have resorted to graphics, the program does not. By modification of the program, a whole range of effects can be seen which have only, to my knowledge, been attempted using long graphics programs. The program shows two pairs of two Xs creep from right to left on one line of the VDU screen.

The program is for the Z-80 at 2MHz; Nascoms 1 and 2.

```
0D00 21 37 0A START:  LD     HL, 0A 37
 Set pointer.
 03 06 30             LD     B, 30
 Set line counter.
 05 36 58   PRINT:    LD     (HL), 58
 Print 'X'.
 07 23                INC    HL
 Set pointer two
 08 23                INC    HL
 places behind.
 09 36 20             LD     (HL),20
Print ' '.
 0B 2B                DEC    HL
Re-set pointer and
 0C 2B                DEC    HL
advance to next
 0D 2B                DEC    HL
place.
 0E C5                PUSH   BC
Save line counter.
 0F 06 78             LD     B, 78
Set delay counter.
 11 10 FE   DELAY:    DJNZ   DELAY
Dec count to zero.
 13 00                NOP
Four NOP instructions.
 14 00                NOP
This is to make a
 15 00                NOP
fine delay of a few
 16 00                NOP
microcycles.
 17 C1                POP    BC
Restore line counter.
 18 10 EB             DJNZ   PRINT
Dec line count, if
 1A 18 E4             JR     START
zero, re-start.
```

By adjusting the value of the delay counter, i.e., 78 at 0D10 different dates, direction and number of Xs will be seen. Fine adjustment is achieved by changing the number of NOPs, but remember the jumps which follow are in the relative address mode, if you change the number of NOPs, change the relative part of those instructions. Thus for three NOPs:

```
16 C1
17 10 EC
19 18 E5
```

Two Xs may stay on the left of the screen by changing line 0D00 from 21 37 0A to 21 3A 0A. The program is re-locatable and can be used anywhere in memory. The address 0A 3A is the location of the VDU memory, for a line half-way down the screen, and a position at the right of the screen.

A TV picture is built-up of lines; each line contains a number of character lines. Remember that a character is built from a six to eight dot matrix, eight lines of six dots or on/offs.

To produce a video signal the VDU circuit must scan its memory in sequence and process that information via a ROM and a shift register.

The ROM contains for each character eight lines of information, each line containing six bits. Thus an X is:

```
o = off  oooooo
I = on   IoooIo     I   I      *   *
         IoooIo     I   I      *   *
         oIoIoo      I I        * *
         ooIooo  =    I    =     *
         oIoIoo      I I        * *
         IoooIo     I   I      *   *
         IoooIo     I   I      *   *   as seen.
```

The line of 'o's around is to give a space between characters and lines on the screen. For two Xs.

```
*   *   *   *
*   *   *   *
 * *     * *
  *       *
 * *     * *
*   *   *   *
*   *   *   *
```

If the CPU changes the X to a blank between the VDU individual line scans:

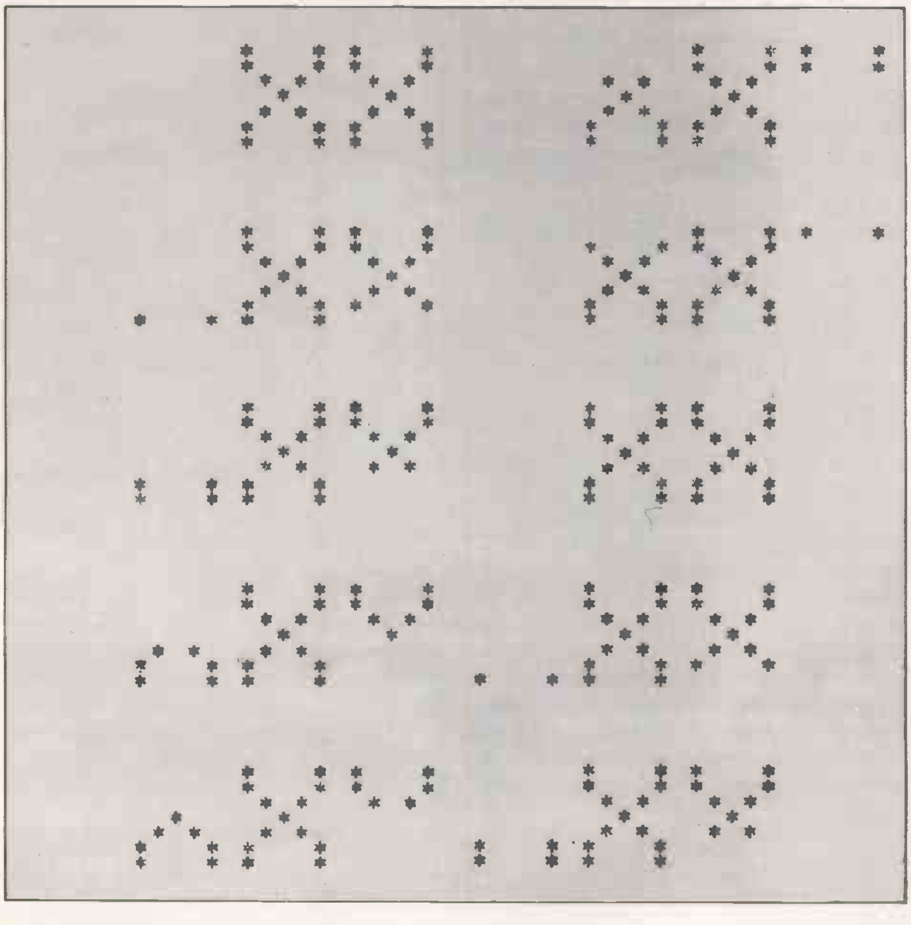
```
*   *   *   *
*   *   *   *
 * *     * *
  *       *
 * *
*   *
*   *          Is the result.
```

If the CPU builds-up at the same time by the reverse principle another X, we see:

```
        *   *   *   *
        *   *   *   *
         * *     * *
          *       *
 * *     * *
*   *   *   *
*   *   *   *          ——————
```

The CPU has changed the memory contents between those line scans. In the program, the VDU times relative to the CPU change slowly, thus one of the two Xs diminishes slowly as another builds-up. Also, the VDU circuit manages to collect two sets of two Xs.

The program relies on coincidence; it writes Xs to all locations in turn and in turn, two places behind, removes them. Thus the VDU has time only to collect information in two pairs. Before it makes the third, the third is removed. Nor does it have time to obtain, in some cases, all the information on one of them. The CPU has re-written it too quickly.



ALL ABOUT PET...

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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.

Program transfer

ONE of the problems encountered when moving from a tape-based TRS-80 to a disc-based system is that a number of assembler programs execute from the area that TRS DOS or one of the other DOS systems normally uses writes Arne Rohde of Struer in Denmark.

One method of operating the problem is to move the program in memory and precede it with a short routine which will move it to the correct position in memory after it has been loaded from disc. That works well for most cases, and NewDOS even has a utility called LMOFFSET which will do all the work required for that approach.

At the same time, however, the NewDOS has a catch for the unwary, since the system normally intercepts the keyboard input routine to provide debounce and the "JKL", "123", and various other functions. If the system has been booted with the debounce routine active, loading a routine which overlays the DOS area will normally cause havoc.

NewDOS allows the user to boot the system with the debounce routine de-activated, by holding down shift and up-arrow during the boot process. However, it is easy to forget that when booting the system, and it should not really be necessary. Another solution is to let the program load routine do the necessary re-setting of the keyboard intercept. It is reasonably easy to achieve, although the program will use more disc space when saved.

The extra amount should normally be insignificant. To illustrate the method, we shall see how a program can be moved from tape to disc. A monitor such as RSM2 is useful for that purpose.

The first step involves loading RSM2 into a portion of memory which will not be used for the remainder of the process. The TRS-80 is then re-set with the break key held down. That initialises the area from 4000 to 42E9 to the values normally used in a tape system. The memory-size question must be answered with a specific value to avoid all of memory being cleared while the system finds the end of memory address.

RSM2 will still be resident in memory. SYSTEM is typed, and the program read from tape to memory. Instead of starting the program just loaded, / is entered followed by the RSM2 entry address.

If preferred, the program can also be loaded by the system tape-load routine in RSM2 instead of using SYSTEM. RSM2 is then used to move not only the program itself but the whole area from 4000H to the end of the program to a position above the end address of NEWDOS, for example 7100H.

The program will thus consist of the program code plus the initialised values from reserved memory. That code is then preceded by the instructions needed to

disable interrupts, move it to the correct position in memory, and jump to the correct entry point. The code can be inserted with RSM2. The NewDOS system can then be booted again, and the portion of memory DUMPed to disc.

When the program is executed, the NewDOS keyboard intercept routine will be removed, and the program will run without any keyboard debounce.

If keyboard debounce is required in the program, the debounce routine can be placed in the free memory area from 4060H to 407FH. A program which will achieve this was shown in Tandy Forum, April 1980. The same area can also contain a video driver for lower-case letters. Those routines should be loaded before the main SYSTEM program is loaded into memory and RSM2 entered.

Even programs such as Microchess can be saved on disc using the method, although it has been made slightly more difficult by the loading method employed. The first short program on the Microchess tape is merely a special load routine to load the remainder of the program and start it automatically. Before being run, the loader routine must be modified so that it will enter RSM2 instead of Microchess, and so that the display text will be loaded into memory. The necessary addresses are 4FEDH for the JP instruction to the entry point. The address in the instruction is modified to jump to the RSM2 entry point.

The screen area start address is loaded in 4FDCH into HL, and that should be modified to an area starting on a 256-byte boundary, for example 7100H. The end of load is checked in 4FE4H, and the value should be the MSB of the start address + 4, or 75H in our case, making the instruction load A with this value. The load routine can then be entered at address 4FA1H, and when completed, RSM2 should be invoked.

The area from 4000H to 4FFFH can then be moved to the area from 7500 to 84FFH, and the move routine appended in front of 7100H to move the entire area from 7100H to 84FFH to the area starting at 3C00H. A jump to the entry address (41FDH) is also inserted. NewDOS can then be used to dump the Microchess program to disc.

The instructions needed in front of the code to achieve the move could be coded as follows:

```
70F0 F3       DI
70F1 010044 LD    BC,4400H  ;length to move
70F4 02003C LD DE,3C00H     ;destination
                             address
70F7 030071 LD    HL,7100H  ;move from
                             address
70FA EDB0 LDIR              ;move to
                             destination
70FC C3FD41 JP  41FDH       ;start
                             Microchess
```

Note that interrupts are disabled, since they may occur during the LDIR instruction and cause havoc.

Chess-board

HERE is a routine which some programmers might find useful writes Colin Barton of Bracknell, Berkshire. It uses the ASCII code 191 to produce a chess-board. Each block is made up of white graphics blocks two high by six long.

```
10 REM *** CHESS BOARD —
     C.J.BARTON. ***
20 CLS
30 J=15361
40 GOSUB 120
50 J=15495
60 GOSUB 120
70 FOR A=0T047
80 SET(3,A)
90 SET(100,A)
100 NEXT A
110 GOTO 110
120 FOR V = 1T02
130 FOR X=1T04
140 FOR Y=1T048 STEP12
150 FOR W=Y+J TO Y+J+5
160 POKE W, 191
170 NEXT W,Y
180 J=J+256
190 NEXT X
200 J=J—960
210 NEXT V
220 RETURN
```

Hexadecimal converter

WHEN using my Superboard II computer, I find I regularly need to convert numbers from Hexadecimal, i.e., base 16, to decimal and vice versa writes Jack Pike of Chawston, Bedfordshire. Many other people must need the same conversion and may be interested in a Basic program I have written to do the job. The program is written in standard Basic and should run on most systems:

```
  1 REM HEXADECIMAL TO
  2 REM DECIMAL CONVERSION
  3 REM AND VISE?VERSA
  4 REM FOR FIVE INTEGERS
  5 REM
  6 REM ANY NO-HEX CHAR.
  7 REM CHANGES DIRECTION
  8 REM INTEGER BASICS D0
  9 REM NOT NEED LINE 250
 10 LET C = 10
 20 LET C = 26—C
 30 LET S$ = "DEC = "
 40 IF C = 10 THEN 60
 50 LET S$ = "HEX = "
 60 PRINT
 70 PRINT S$
 80 INPUT N$
 90 LET N = 0
100 IF LEN(N$) = 0 THEN 20
109 REM HEX TO DEC
110 FOR I = 1 TO LEN(N$)
120 LET D = ASC(MID$(N$,I,1))—48
130 IF ABS(D—13) < 4 THEN 20
140 IF D < 10 THEN 160
150 LET D = D—7
160 IF D < 0 THEN 20
170 IF D> = C THEN 20
180 LET N = C*N + D
190 NEXT I
200 IF C = 10 THEN 230
210 PRINT "DEC = ";N
220 GOTO 60
229 REM DEC TO HEX
230 LET A$ = " "
240 LET L = N/16
250 LET L = INT(L)
260 LET M = N—16*L
270 IF M < 10 THEN 290
280 LET M = M + 7
290 LET N = L
300 LET A$ = CHR$(M + 48) + A$
310 IF N > = 1 THEN 240
320 PRINT "HEX = ";A$
330 GOTO 60
```

Incidentally, following your article on Adventure II in the August issue, readers may be interested to know that a very expanded version of the original Adventure — also called Adventure II — written in standard Fortran IV is now running on a variety of mainframes in the U.K. If anyone is interested in a papertape for their mainframe, they should contact me.

Special-section program

I ENJOY working in machine code and would like to see more programs published in that form writes A E Prinn of Newton in Merseyside. Although I realise the appeal of Basic, its ubiquituous use means that I gain little — except ideas — from any of the current computing magazines.

The program, although hardly earth shattering, is an attempt to make your 6502 special section into what its title suggests, rather than a selection of Basic programs to be run on machines which may or may not contain 6502 micropro-

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.

cessors. When displaying a machine-code program on a VDU, it is easier to read if each line contains either one, two, or three bytes as specified by the op code rather than, for example, the first 16 bytes followed by the next 16 bytes, etc.

The program was written to determine the number of bytes each 6502 op code requires and to return with this value in the X register.

If the op code is written as two Hex characters XY, a one-byte instruction has X0 — where X is 0,4, or 6 — or X8 or XA — where X is any number. A two-byte instruction has X0 — where X is any number except 0,2,4 or 6 — or XY — where Y is any number less than eight and X is any number.

A three-byte instruction has 20 or XY — where Y is any number greater than B and X is any number. The op code X9 is a special case; if X is even, the op code requires two bytes, otherwise it is three bytes.

The program is re-locatable and is written as a JSR routine assuming that the temporary storage location Z0A holds the op code.

```
0200  A2 03         LDX # 03
0202  A5 0A         LDA Z0A     Get op code
0204  D0 04         BNE NEXT    Branch if not
                                equal to zero
0206  CA      ONE   DEX
0207  CA      TWO   DEX
0208  D0 1E         BNE END     Always
                                branch
020A  29 DF   NEXT  AND # DF
020C  F0 1A         BEQ END     Branch if op
                                code 20
020E  C9 40         CMP # 40
0210  F0 F4         BEQ ONE     Branch if op
                                code 40 or 60
0212  A5 0A         LDA Z0A     Get op code
0214  0A            ASL
0215  0A            ASL
0216  0A            ASL         Move the
                                LSB of the
                                high nibble
0217  0A            ASL         into the carry
0218  85 0A         STA Z0A     Remember
                                the low
                                nibble
021A  F0 EB         BEQ TWO     Branch if op
                                code is X0
021C  A9 10         LDA # 10    An elegant
                                way of
                                testing
021E  24 0A         BIT Z0A     three bits
0220  10 E5         BPL TWO     Branch if op
                                code is < X8
0222  70 04         BVS END     Branch if op
                                code is > XB
0224  F0 E0         BEQ ONE     Branch if op
                                code is X8
                                or XA
0226  90 DF         BCC TWO     Branch if
                                high nibble
                                is even
0228  60      END   RTS
```

The program does not differentiate between data or illegal op codes and genuine op codes, but has proved adequate in practice. I should be most interested if anyone can think of a simpler system, particularly if it returns with X = 01 for illegal op codes, i.e., data.

Character-set display

THIS PROGRAM was written for an unexpanded Microtan 65. It displays the Microtan complete character set one character at a time with the Hexadecimal code for that character writes S Russell of Solihull in the West Midlands.

After displaying a character, the program pauses for a time before displaying the next character. When the program reaches Hex code 7F, it jumps back to 0048 and starts again. The program starts at Hex 20 which is a space, so the first character to be printed is "!".

The first character to be printed can be altered by changing the Hex code at 0049 to the code of the first character to be output. When the program jumps back to 0048 it will start again by outputing 20 and a space unless 0081 is changed.

```
0040  A0 0F     LD F          ; Clear Screen
0042  20 73 FE  JSR  OUTCR
0045  88        DEY
0046  D0 FA     BNE
0048  A9 20     LDA  20       ; Load
   acc. with ASCII space
004A  99 C3 03  STA  03 C3    ;
004D  CA        DEX           ; Delay
004E  D0 FD     BNE
0050  88        DEY
0051  D0 FA     BNE
0053  EA EA     NOP
0055  D0 F6     BNE
0057  A5 49     LDA  49       ; Load
   acc. with location 0049
0059  AA        TAX ; Load
   index X with acc.
005A  E8        INX
005B  86 49     STX
005D  20 73 FE  JSR  OUTCR    ; Scroll
                                display
0060  EA EA     NOP
0062  48        PHA
0063  20 73 FE  JSR  OUTCR    ; Scroll
                                display
0066  68        PLA
0067  20 0B FF  JSR  HEXPNT
006A  20 73 FE  JSR  OUTCR    ; Scroll
                                display
006D  EA EA     NOP
006F  A5 49     LDA  49       ; Load
   acc. with location 49
0071  C9 80     CMP  80
0073  D0 CF     BNE
0075  A9 20     LDA  20
0077  99 C0 03  STA  03 C0    ; Load
   acc. with ASCII space
007A  A9 20     LDA  20       ;Load
   acc. with ASCII space
007C  99 C1 03  STA  03 C1
0080  A9 20     LDA  20       ; Load
   acc. with ASCII space
0082  85 49     STA  49
0084  4C 48 00  JMP  48       ; Jump to
   location 48
```

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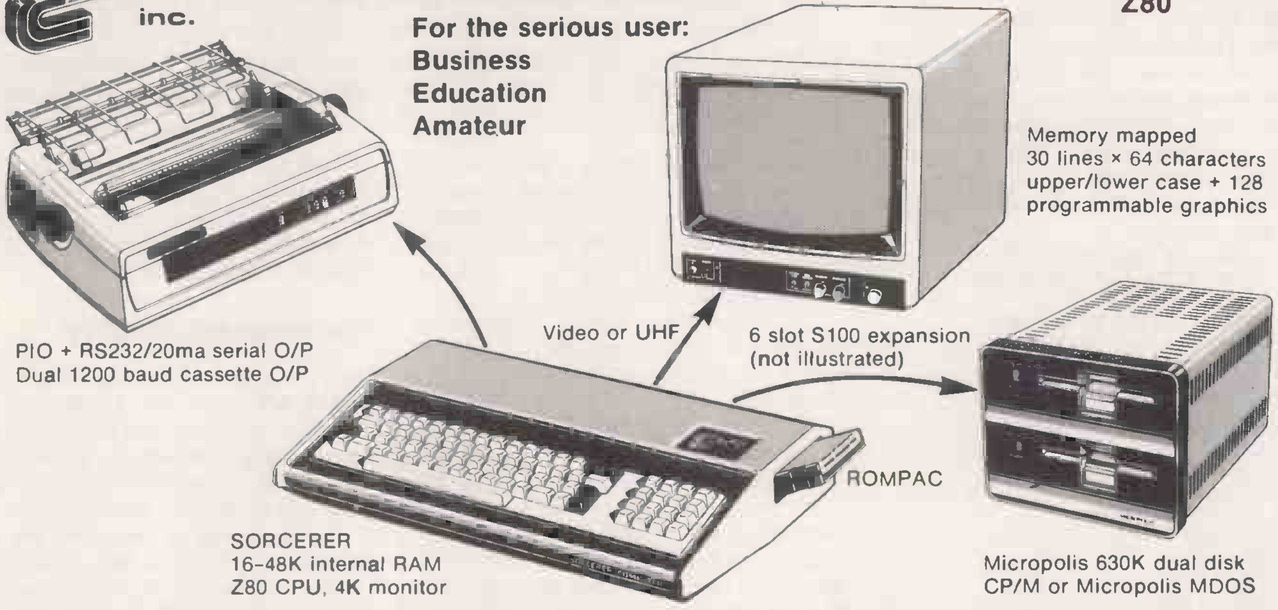

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Program of sorts

THE TWO sorts most often used in Basic writes W H Skipton of Abel Computer Systems, Tamworth in Staffordshire, are either:

- Repeatedly read through an array of values swopping over any pair which are out of sequence and ending when no swops are made in the last scan.
- Repeatedly read through an array picking out the largest or smallest.

The first is the faster when the array is close to being in sequence, the second is faster otherwise. This code combines the virtues of both to give results normally as fast or faster than either.

The sort takes place in lines 60 to 120. The extra lines at the start and end allow you to input a number of values which are printed-out after sorting so that the sort algorithm may be evaluated.

```
10 REM ANOTHER SORT
20 INPUT "HOW MANY ?";C
30 DIM A$(C)
40 FOR I = 1 TO C: PRINT I" ?";: INPUT
   "";A$(I):NEXT I
60 FOR I = C TO C / 2 STEP — 1:P =
   I:SW = 0:Q = C + 1 — I
70 FOR J = Q TO I — 1
80 IF A$(J) > A$(J + 1) THEN S$ = A$(J):
   A$(J) = A$(J + 1):A$(J + 1) = S$:SW
   = 1
95 IF A$(J)  <A$(Q) THEN Q = J
100 NEXT
105 IF Q <  >C + 1 — I THEN S$ = A$
   (Q):A$(Q) = A$(C + 1 — I):A$(C + 1
   — I) = S$:SW = 1
110 IF SW = 0 THEN 200
120 NEXT
200 PRINT : PRINT
210 FOR I = 1 TO C: PRINT A$(I): NEXT
```

Disc map display

HERE IS the listing of a program to display a map of an Apple II disc submitted by Paul Cole of Swindon, Wiltshire.

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.

It uses the RWTS subroutine to load the VTOC from track 17 sector 0,PEEKs the track bit map and converts the two-byte number into a 16-bit binary number and uses the last 13-bits to make up a display of the disc tracks and sectors. Tracks 0, 1 and 2, contains DOS and so will always be full, as will track 17 which holds disc information, e.g., Catalogue VTOC.

Error routine

I THOUGHT you may like to see one of the subroutines I use in most of my programs writes Simon Moss of Shrewsbury, Salop. It is an error routine designed to do away with pages scrolling-up due to innumerable "ERROR", "TOO BIG", RE-ENTER"'s, etc., being typed by the program.

A typical input routine appears thus:

```
100 INPUT "HOW MANY TYPEWRITERS
    PER MONKEY"; NO
110 IF NO > 5 THEN 100
```

My modification would be this:

```
100 UTAB 5 : INPUT "HOW MANY
    TYPEWRITERS PER MONKEY?";NO
110 IF N < = 5THEN 150
120 M$ = "TOO MANY TYPEWRITERS:
    MAX IS 5"
130 GOSUB 10000
140 GOTO 100
150 REM ** REST OF PROG **
```

The subroutine 10000 would let out a rasp, print the message contained in M$ in either inverse or flashing mode, wait, wipe out the message and return. Here is a copy of this subroutine.

All my input statements have an associated VTAB so that the page is carefully laid-out and neat. I think that the VTAB statement is the best Microsoft invention since the proverbial sliced bread and full use should be made of it. The result is a very striking and explicit message which promptly wipes itself out after a few seconds, leaving the page uncluttered.

```
10000 REM **ERROR ROUTINE**
10010 REM TO RUN ON AN APPLE 2+
10020 VTAB 23
10030 REM TO CENTRALISE MESSAGE
      ON PAGE
10040 L = LEN(M$)
10050 PRINT TAB (20-L*0.5);
10060 REM TO MAKE A RASP
10070 S = — 16336
10080 FOR BEEP = 1 TO 200: SOUND =
      PEEK(S)—PEEK(S) + PEEK(S)—
      PEEK(S):NEXT
10090 REM PRINT THE MESSAGE
10100 FLASH:PRINT M$:NORMAL
10110 REM WAIT A BIT
10120 REM 1150 LOOPS = APPROX 1 SEC.
10130 FOR DD = 1 TO 2300:NEXT
10140 REM WIPE IT OUT
10150 VTAB 23:1 + TAB 1
10160 CALL —868
10170 HTAB 1
10180 RETURN.
```

The disc map display program

```
******************************************
*                                        *
*              DISC MAP                  *
*                                        *
*                          BY PAUL COLE  *
******************************************

10   HOME : GOSUB 10000
20   DIM B(20)
30   TEXT : HOME : PRINT  SPC( 17)
      "DISC MAP": PRINT
40   PRINT "  T ":: FOR I = 0 TO 3
      .4 STEP .1: PRINT  INT (I)::
       NEXT : PRINT
50   PRINT  SPC( 4):: FOR I = 0 TO
      2: FOR Q = 0 TO 9: PRINT Q::
       NEXT : NEXT : PRINT "01234"

60   PRINT "S": FOR I = 0 TO 9: PRINT
       SPC( 2)I: NEXT
70   FOR I = 10 TO 12: PRINT  SPC(
      1)I: NEXT
80   FOR Q = 5 TO 39
90   GOSUB 1000
100   FOR I = 3 TO 15
110 W = W + B(I)
120   IF B(I) = 0 THEN  INVERSE
130   HTAB (Q): VTAB (I + 3): PRINT

      " ":: NORMAL
140   NEXT
150   NEXT
160   PRINT : PRINT : PRINT "THE W
      HITE AREAS SHOW DISC SECTORS
       THAT  ARE IN USE. BLACK ARE
      AS ARE FREE."
170  PRINT "AND YOU HAVE "W" FREE
       SECTORS."
180  END
1000 Z = 16440 + (Q - 5) * 4
1100 A = 256 *  PEEK (Z) +  PEEK
     (Z + 1)
1200  FOR I = 0 TO 15:A = A / 2:B
     (I) = ( INT (A) <  > A):A =
      INT (A): NEXT
1300  RETURN
10000  POKE 16640.169: POKE 16641
     .65: POKE 16642.160: POKE 16
     643.9: POKE 16644.32: POKE 1
     6645.217: POKE 16646.3: POKE
     16647.96: POKE 16649.1: POKE
     16650.96
11000  POKE 16651.1: POKE 16652.0
     :: POKE 16655.26: POKE 16656
     .65: POKE 16657.0: POKE 1665
     8.64: POKE 16664.96: POKE 16
     665.1: POKE 16666.0: POKE 16
     667.1: POKE 16668.239: POKE
     16669.216
12000  POKE 16653.17
13000  POKE 16654.0
14000  POKE 16661.1
15000  CALL 16640
16000  RETURN

******************************************
******************************************
```

Un-crashing method

I THOUGHT you might like my 100 percent software method of un-crashing a new-ROM Pet writes Kevin Jones of Lytham St Annes, Lancashire. It adds a small routine — starting at 0345 Hex — to the interrupt routine which is called every 1/60 of a second by the Pet hardware. While it provides a far cheaper way of un-crashing than a hardware add-on, it will not work with the interrupt disable set.

The routine at 033A Hex is to initialise the routine by altering the RAM IRQ vector. Of course, the interrupt disable has to be set first to eliminate any chance of an interrupt being called during the change, with disastrous effect.

The routine uses the Pet convention of making sure a key is pressed for at least two interrupts before it registers — a check against keyboard bounce.

```
033A SEI           78         Sets interrupt
                              disable
033B LDA #$45      A9 45      Set IRQ RAM
                              vector
033D STA $90       85 90
033F LDA #$03      A9 03
0341 STA $91       85 91
0343 CLI           58         Clears interrupt
                              disable
0344 RTS           60
0345 LDA $E812     AD 12 E8
0348 CMP #$EF      C9 EF      Stop key
                              depressed?
034A BEQ $0350     FO 04
034C LDA #$FE      A9 FE
034E STA $00       85 00
0350 INC $00       E6 00
0352 BEQ $0357     F0 03      Depressed 2
                              interrupts?
0354 JMP $E62E     4C 2E E6   Continue
                              interrupt routine
0357 JMP $C73F     4C 3F C7   Break message
                              and recover.
```

00 Hex is one of the very few safe locations on zero page — and then only if USR is not being used.

The program could be adapted easily to old ROM within a few minutes, but I generally find that old ROMers do not indulge in practices likely to crash the machine. Also, if you want to use the second cassette buffer, you can soon re-locate the program to the top of memory or wherever — only the new IRQ RAM vector has to be changed.

Extending function

PAUL Robson of Norwich has submitted a short machine code re-locatable, for extending the DEF FN function so that the code can consist of non-assignment statements by passing parameters to and from a subroutine directly. All code will work as normal.

The program was written and tested on and old-ROM Pet so notes are enclosed to convert it to a new-ROM system. The conversion has not been tested. The USR vector specified (51072) is the start of the GOSUB handling code in the Basic ROMs. Memory location 152 is the location of the variable to which the result of a LET statement is sent. Locations 88,89 are at the end of the input buffer

and are not in use during an assignment statement.

```
826 LDA 152       165 152
828 STA 88        133 88
830 LDA 153       165 153
832 STA 89        133 89
834 RTS           96
835 LDXim 4       160 4
837 LDAiy 152     177 152
839 STAiy 88      145 88
841 DEY           136
842 BPL 837       16 249
844 RTS           96
```

POKE1,128:POKE2,199 sets up the USR VECTOR

To set up a function:DEFFNA(X) = USR (X) line number.

To call it   Variable = FNA(Parameter)

The subroutine structure must be:

```
line no   SYS(826)
   .      Any code required. In the examples
          given,
   .      the parameter is now in variable X.
   ..     Variable X should not be used in
          main program.
```

assignment statement, the result of which is to be passed back via

DEF FN

RETURN

Modification for New ROMs

USR vector is 51088.

Locations 152,3 become locations 70,71

Locations 88;9 should be replaced by any two free consecutive page zerio locations.

Cursor Movement Control

Call X = FNA(ddaa) where d is position down the screen
a is position across

```
100 DEFFNA (X) = USR(X) 200
110 END
200 SYS(826): D = INT (X/100):A = X—D*
    100
210 ?LEFT$ ("Home,25cd",D + 1) TAB(A);
220 X = X:SYS(835):RETURN
```

Sorting routine

THE MACHINE-code sorting routine in your April 1980 issue performs admirably when all the character strings are quite distinct writes David Pirie of Glasgow. It goes somewhat awry, however, when one of the strings is identical with the leftmost part of a longer, preceding string.

I hope these examples — from a 32K Pet and Anadex printer — will show what I mean. There is no disc unit on this Pet but it is fitted with a Toolkit. Perhaps your author could shed a little light on the mystery?

```
100 FORJ = 1TO5: READG$(J):NEXT
110 !S,G$
115 OPEN1,4
120 FORJ = 1TO5:PRINT£1,G$(J):NEXT
125 CLOSE1
130 DATATHOMSON,THOMS,THOM,
    THOMPSON,THOMAS
READY,
THOMSON
THOMS
THOM
THOMAS
THOMPSON
```

NOW CHANGE 'THOM' TO 'THOME ....

```
130 DATATHOMSON,THOMS,THOME,
    THOMPSON,THOMAS
READY.

READY.
THOMAS
THOME
THOMPSON
THOMSON
THOMS
```

Disassembling ROM

AFTER programming my Pet with the 6502 disassembler program published in the November 1979 edition of *Practical Computing,* I set about adding to it to enable it to disassemble the Pet peek-protected ROM writes A Freeman of Catford, London.

The following is the result, using a small machine-code subroutine in the second cassette buffer to peek the locations and to assign the variables.

The following lines are added to the main program:

```
1 FORP = 826TO832:READQ:POKEP,
  Q:NEXT
2 DATA 173,0,0,141,72,3,96
90Z = A:GOSUB3000:POKE827,LB:
  POKE828,MB:SYS826:D = PEEK(840)
91Z = A + 1:GOSUB3000:POKE827,LB:
  POKE828,MB:SYS826:L = PEEK(840)
92Z = A + 2:GOSUB3000:POKE827,LB:
  POKE928,MB:SYS826:H = PEEK(840)
3000MB = INT(Z/256):LB = INT(Z—(256*
  MB)):RETURN
```

Tape counter

I WOULD like to pass on a Pet tip I use, writes John Taylor of Orpington, Kent. The Pet does not have a tape counter on its tape recorder. That makes it very hard to find ones place on the tape. The way I find my way about the tape is by saving a dummy program at the end of the tape, i.e., after the last recorded program.

If, like me, you write a program, and then wish to place it on tape, one has to take a chance about the position on the tape — either record over one program or have a new tape for each program.

If you can tell the computer to verify the program in the memory, the computer will tell you when it has found the dummy program. You can then wind the tape back a little, and record the program on to the tape.

That can also be done when finding the end of a tape, but you tell the computer to load "DUMMY" program.

```
10 REM ***************************************
20 REM ***************************************
30 REM THIS IS THE DUMMY PROGRAMME .
40 REM BY SAVING THIS PROGRAMME ON
50 REM TAPE AFTER YOUR FINAL PROGRAMME
60 REM YOU WILL BE ABLE TO FIND
70 REM YOUR PLACE ON THE CASSETE
```

```
80 REM IF YOU DO NOT HAVE A TAPE COUNTER
90 REM
100 REM TELL THE P.E.T. TO :-
110 REM LOAD"DUMMY" - IF YOU WANT TO FIND YOUR
120 REM PLACE ON THE TAPE & YOU DO NOT HAVE
130 REM A PROGRAMME IN THE MEMORY ALREADY
140 REM VERIFY"XXXXX" - IF YOU DO NOT HAVE
150 REM PLACE ON THE TAPE AND A PROGRAMME
160 REM IN THE COMPUTERS MEMORY
170 REM YOU WILL HAVE TO WIND THE TAPE BACK
180 REM SO THAT YOUR PROGRAMME WILL RECORD
190 REM OVER THIS DUMMY PROGRAMME
200 REM ***************************************
210 REM ***************************************
```

Reaction timing

CHRIS Smith's notes in Pet Corner, July 1980 on measuring reaction times in milliseconds on the Pet using a machine-code counter is very interesting writes W Withers of Hampton Hill, Middlesex.

It would be far more useful, however, if external key could be used, say on the user port instead of the Pet keyboard. Also a program to Poke similarly-timed outputs to the user ports in succession would be of great use in psychology for switching on external visual displays, etc. I hope contributors have some further thoughts on doing achieving those aims.

Pet hints

IT IS possible to re-set the Basic system by calling SYS (64721) writes John Bertin of Old Stevenage, Hertfordshire. That will clear all memory locations above 1023 and re-set the vectors.

Wait 6502 — any integer in range 0-255 — causes, what seems to me to be, a surprising if pointless result.

Multiple key presses

MOST highly-interactive Pet games I have seen involve only one player — writes I Mercer of Loughborough. The reason for that is simple : the commands on the Pet do not allow multiple key presses to be detected. By that, I mean that you cannot write a program using GET or PEEK(515) which will be able to tell if the operator is holding down both the A key and the X key. Both GET and PEEK(515) also have other disadvantages.

GET cannot provide continuous input — using GET, it is impossible to tell how long a key has been held down for or when that key is released. PEEK(515) can provide continuous input but it is not a standard Pet function and will not work on new-ROM Pets.

So, faced with those problems, I set about writing a machine-code routine which would scan the keyboard and store a map of it in memory where it could be examined by a Basic program. The routine I produced resides at $0398 — 920 decimal — and copies the keyboard into a block of memory from $0348 to $0352, 900-909 decimal — figure 1.

To enter the routine, you can use the Basic program in figure 2. Once the routine has been entered, you can call it up using SYS 920. That will scan the keyboard once and store a map of it in memory — for the details, see figure 3.

Now you can PEEK at the relevant location and test the BITs in it. The easiest way to do that in Basic is to use the AND function, e.g., if you wanted to discover if the RETURN key was being held down you could use the following BASIC line:
10 IF (PEEK(906) AND 32) THEN

The location you PEEK at is contained in the table's row number and the number with which you AND that is contained in the table's column number.

Besides making two-player games possible, the routine can enhance one player games — now you can move and fire at the same time. It also makes machine-code games easier by providing an easy to use keyboard input routine.

```
READY.
 20 FORT=920TO946:READH:POKET,H:NEXT
 30 DATA 162,0,173,16,232,41,240,141,16,232,173,18,232
 40 DATA 73,255,157,132,3,232,238,16,232,224,10,208,240,96
READY.
```

Figure 2.

```
0398  A2 00     LDX #00       ;set pointer = 0
039A  AD 10 E8  LDA $E810     ;  reset
039D  29 F0     AND #F0       ; keyboard
039F  8D 10 E8  STA $E810     ;    scan
03A2  AD 12 E8  LDA $E812     ;read back
03A5  49 FF     EOR #FF       ;invert
03A7  9D 84 03  STA $0348,X   ;store it away
03AA  E8        INX           ;inc pointer
03AB  EE 10 E8  INC $E810     ;next column.
03AE  E0 0A     CPX #0A       ;finished ?
03B0  D0 F0     BNE $03A2     ;no - loop back
03B2  60        RTS           ;return
READY.
```

Figure 1.

Figure 3.

	128	64	32	16	8	4	2	1
900	⇦ ⇨	CLR HOME	←	(	&	%	#	!
901	INST DEL	⇧ ⇩		)	\	'	$	"
902	9	7	↑	O	U	T	E	Q
903	/	8		P	I	Y	R	W
904	6	4		L	J	G	D	A
905	*	5		:	K	H	F	S
906	3	1	return	;	M	B	C	Z
907	+	2		?	,	N	V	X
908	−	0	shift	>		]	@	shift
909	=	.		RUN STOP	<	space	[	OFF RVS

Computer programming made simple

By J Maynard, W H Allen Ltd, Second Edition, 1980, 350 pages, softback, ISBN 0 491 00872 4, £2.50.

THIS IS the second, enlarged, edition of a book which first appeared in 1972 and which has been selling well ever since. It aims to give a good grounding in computer programming, starting from first principles and requiring no mathematical or electronics background.

The first section describes the basics of computers, concentrating on the kind of system and peripherals which might be found in a typical commercial mainframe machine room of the early 1970s. Flowcharting and problem analysis are then explained, and an overview of systems software presented. The section ends with a description of data structures and number systems.

Section two is a lengthy — 150 pages — description of the Cobol language, used widely for applications programming for business users. Section three is a shorter — 50 pages — Fortran programming course — Fortran is a programming language used widely for scientific calculations, particularly on IBM computers and in the U.S.

Those first three sections appear to be substantially unchanged since the 1972 first edition. The introduction to computers makes no mention of microprocessors, floppy discs, cassettes or other reasonably recent developments. The Cobol section was written before the ANSI standard of 1974 and more importantly, the Fortran section has no reference to the 1977 new standard for the language. The ideas of program design are equally old-fashioned.

Sections four and five have been added for the new edition. Section four provides an introduction to Basic, using the Mostek Sys-80F Basic for all examples. Section five is a very brief overview of the terms used in describing microprocessor systems — little more than a brief glossary.

The book is far from ideal for any class of reader, yet it contains an enormous amount of information at a truly

bargain price. The descriptions of computer peripherals and recording formats is useful background for any programmer. The comprehensive Cobol section provides a useful introduction to commercial data processing, although some of the examples from payroll programs clearly pre-date the Sex Discrimination Act.

Similarly, the Basic and Fortran sections provide the flavour of the languages — without, unfortunately, being very suitable for learning either language in detail.

That is the real failing of this book; whatever you want to learn, there is certainly a book available which teaches it better.

Conclusions

- **Good value if you want an overview of three computer languages without learning any one in detail.**
- **Not recommended as an introduction to personal computing or microcomputer use in small business.**
- **Worth adding to your library for general background reading, but only because it is so cheap.**

The first book of Ohio Scientific: Volume 1

By J Clothier and W Adams. Published by Elcomp at $7.95. 190 pages paperback, no ISBN — the Elcomp reference number is 157.

OHIO Scientific is a company dedicated to making and selling microcomputer systems. Its Challenger and Superboard ranges of machines are well known in this country and are sold widely. Unfortunately, there has been a shortage of technical documentation readily available for Ohio Scientific hardware and software — that is the gap which Elcomp is attempting to fill.

The book is bursting with information. Articles have been collected from many sources, arranged into some semblance of order, and published. The whole collection exudes enthusiasm, energy and haste.

The level of information presented ranges from manufacturers' to detailed explanations of debugging; from starting Basic, to machine-code monitor routine listings; from building an RS232 interface for the Challenger C-1P, to a program to circumvent the garbage collection problem in computers with Ohio Scientific Basic in ROM.

Only you can tell if it is the book you need, and only then, by looking at the contents list to see if the information you want is there. My guess, however, is that owners of Challenger or Superboard systems will feel much happier with the book on their shelf where they can refer to it if they want it in a hurry.

Elcomp has already announced two further volumes of the series, and more are planned. Volume two covers the Ohio Scientific-65D disc-operating system Version 2.0, the OS-65U operating system and editor, the Ohio Scientific WP-2 word processor and much more. Volume three is intended for hardware buffs who want expansion and interface details for their systems.

Conclusions

- **An eclectic work, worth investigating if you have an Ohio Scientific system and feel short of technical information.**
- **Could be invaluable if you are looking for the specific details it contains.**

Understanding microprocessors with MK14

By Ian Williamson and Rodney Dale, Published by Macmillan (1980), more than 200 pages paperback £5.95. ISBN 0 333 31075 6.

THE MK14 is a single-board computer from Science of Cambridge and costs from £39. It was reviewed in *Practical Computing* in May 1979. At the heart of the MK14 is the 8060 microprocessor, which has an eight-bit, seven-register, single-accumulator architecture.

The book uses the MK14 to teach the fundamentals of microprocessor use and assembly-language programming. The principles are explained first, then, step by step, the architecture of the MK14 is used to clarify each point and to provide practical examples and hands-on experience. The text is peppered with questions and answers, to enable readers to check their understanding, page-by-page.

The 8060 microprocessor is covered in great detail, so that anyone working through the book will have a thorough understanding of its architecture, and of the precise effects of all 46 instructions. Input-output and interrupts are described and explained, and examples are provided which show how multi-processor systems can be built; how direct memory access, DMA, works, and how the MK14 can be used for real-time data acquisitions.

The book is a model which other authors should follow. It is attractively laid-out, easy to ready, accurate and complete.

The result is a book which can be read cover-to-cover with little previous knowledge of microprocessors, but which will remain in use long after the reader has become expert, as a reference book for the 8060 architecture, as a source of ideas and techniques, and as a demanding standard against which to measure the quality of other documentation.

Conclusions

- **An excellent book, strongly recommended for anyone who wants to learn about machine-language programming and microprocessor architecture.**
- **If you own a Science of Cambridge MK14, this book should be the next thing you buy.**
- **If you do not own a MK14, this book is the best possible reason for buying one.**
- **Recommended for anyone who needs to work with microprocessors at a very low level, or for experienced high-level language programmers who want greater insight into what assembly-language programming is all about.**

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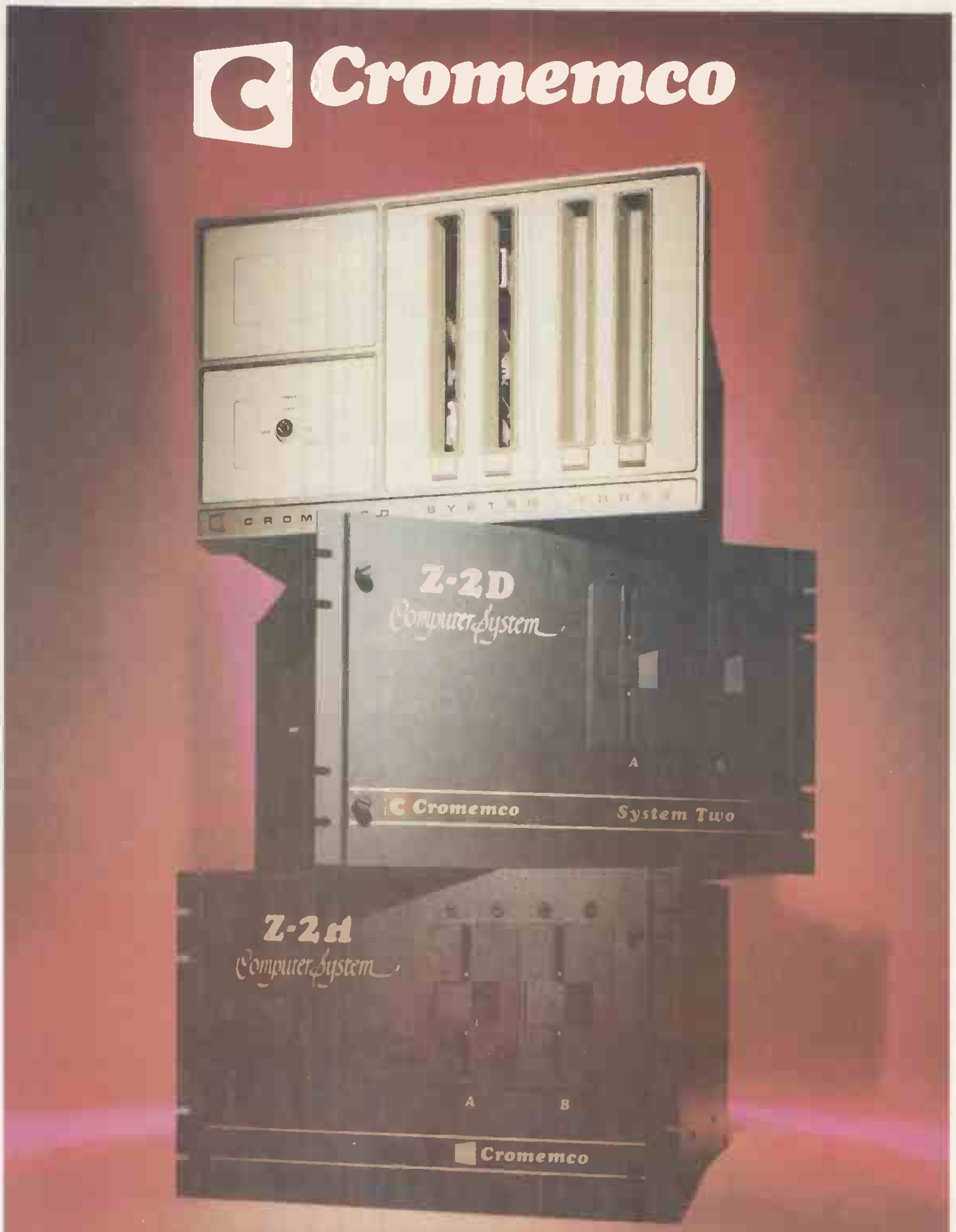

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150 LET T(N)=X
160 NEXT I
165 PRINT
167 PRINT
170 PRINT "NUMBER OF DUPLICATES IS ";D
180 STOP
200 LET N=(N+1)-((N+1)/75)*75
210 GO TO 130
A Course in BASIC Programming
sinclair
ZX80
ZX80 Operating Manual

User Groups is a region-by-region list of microcomputer clubs in Britain whose activities have been brought to our attention. It should prove a useful guide to anyone interested in sharing this hobby with others. If a new club has been formed, send us the details and we will include them in the next available issue.

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Bristol BS14 0HY.
Tel: 0272 832453.
Brunel Computer Club
S W Rabone
18 Castle Road
Worle
Weston-Super-Mare
Avon BS22 GJW.
Tel: 0934 513068.

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U.K. Intel MDS Users' Group
Lewis Hand
29 Chaucer Road
Bedford.
Tel: 0234 41685.
6502 Users' Club
Joe Manifold
16 Bun Yam Close
Pirton, near Hitchin
Hertfordshire.
Tel: 0462 78522.

BERKSHIRE
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M Gulliford
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Slough Industrial Estate
Slough, Berkshire.
Tel: 0753 74111.

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Sycamore Road
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Tel: 0733 76681.

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(continued on next page)

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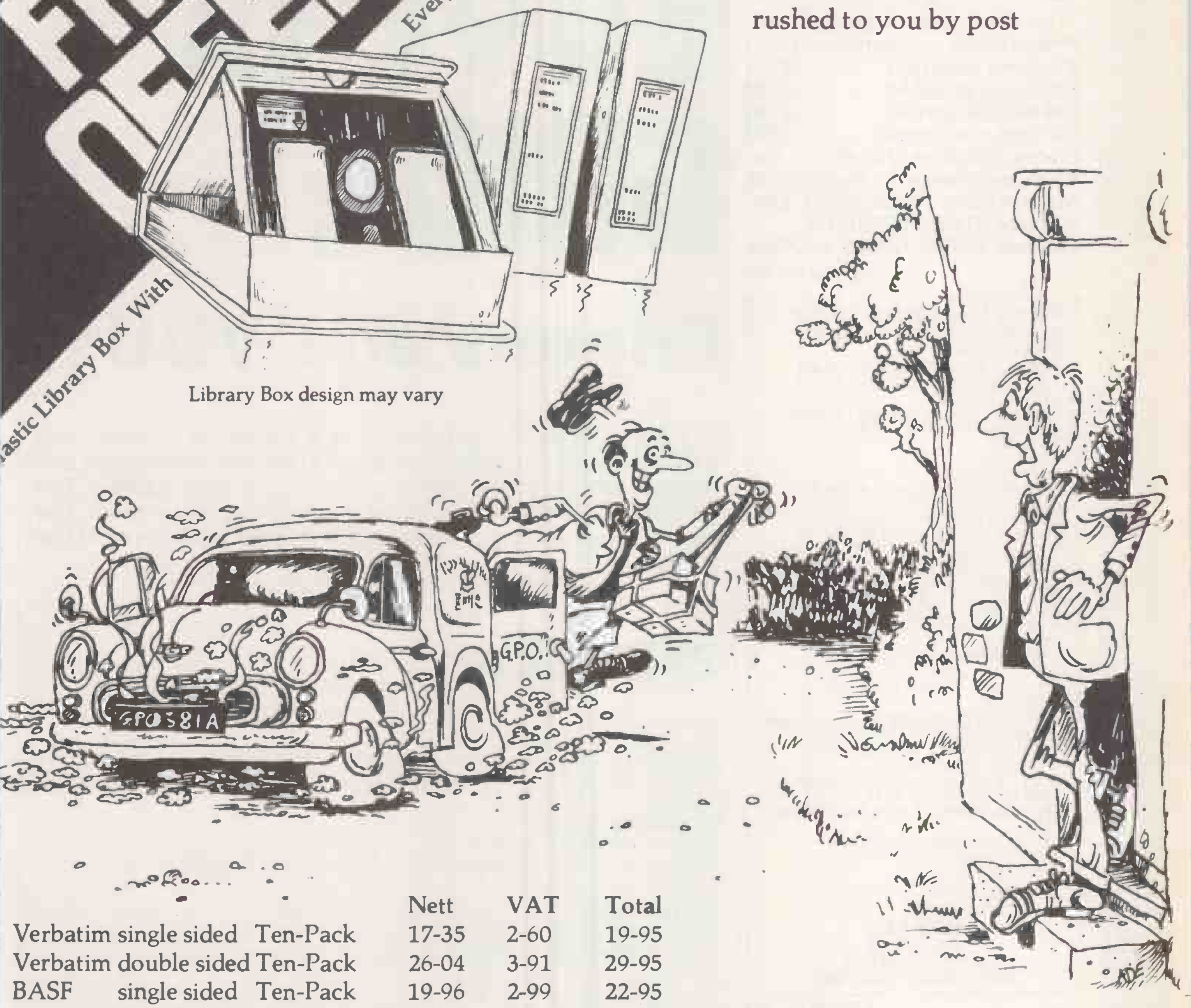

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BUYERS' GUIDE

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The Peripherals Buyers' Guide is a survey of printers and VDUs suitable for small computers. We have excluded any system which costs significantly more than £2,000. The printers and VDUs are listed in alphabetical order. The addresses of the main suppliers are listed at the end of the guide.

PRINTERS

ADDMASTER

420/426 receive only *£246*
Impact column printer, grade-one Tally roll paper at £5 for 20 rolls. BCD serial or 10-line serial interfaces, 12 cpl, 36 cps. Main U.K. agent Clary Ltd.

400 receive only *£242*
Impact column printer, uses 2½in. Tally roll paper at £5 per 20 rolls, parallel and serial interfaces. 16 cpl, 48 cps. Main U.K. agent Clary Ltd.

AGILE CORPORATION U.S.A.

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Agile 4200 uses Diablo HY-type mechanism, Agile A1 uses Qume Sprint 3 mechanism, uses paper up to 15in., 132/158 print positions, 55 cps on both models, RS232C EIC with current loop optional interfaces. Main U.K. agent ISG Data Sales Ltd.

ANADEX

DP-500 *from £367*
Impact drum printer, uses plain paper, parallel interface, 18 cpl, 45 cps. Main U.K. agent Anadex Ltd, OEM sales, U.K. and Europe.

DP-660 *from £700*
Impact drum printer for printing labels, uses sprocket feed. Parallel interface. 19 cpl, 57 cps. Main U.K. agent Anadex Ltd, OEM sales, U.K. and Europe.

DP-750A *from £800*
Impact drum printer, RS232C 20mA current loop interface, 21 cps, 25 cps. Main U.K. agent Anadex Ltd, OEM sales, U.K. and Europe.

FP-600 *from £65*
Impact drum printer with ticket or form printer, from four columns to 19 columns parallel interface, 19 cpl, 44 cps. Main U.K. agent Anadex Ltd, OEM sales U.K. and Europe.

DP-9500 Series *£895 upwards*
Alpha-numeric line printers with nine-wire print head, adjustable tractor feed with bi-directional printing, three ASCII interfaces as standard — parallel bit, RS232C, current loop — 120-200 cps, 132-220 columns, 7×9, 9×9 or 11×9 matrices depending on model. Main U.K. agents Anadex Ltd, OEM sales U.K. and Europe, Peripheral Hardware, Kode Services, Robox, Stack Computer Services and Data Design Techniques Ltd.

DP-8000 *£550*
Alpha-numeric line printer with sprocket feed and bi-directional printing, fan-fold paper up to 9.5 in., produces up to three copies, cost of paper £14 for box of 2000 sheets. Three ASCII interfaces as standard — parallel bit, RS232C, current loop — 112 cps, 80 column, 9×7 matrix. Main U.K. agents Anadex Ltd, OEM sales U.K. and Europe, Peripheral Hardware, Kode Services, Robox, Stack, Computer Services and Data Design Techniques Ltd.

DP-1000 Series *from £395*
Dot matrix, impact digital printers, includes internal data storage facilities. Friction feed, uses roll-type paper for 40 columns at £11 for box of 10 rolls, three basic ASCII-compatible interfaces are available. 40 cpl, 50 cps, 40 columns, 5×7 matrix. Main U.K. agents Anadex Ltd, OEM sales U.K. and Europe, Peripheral Hardware, Kode Services, Robox, Stack Computer Services.

AXION CORPORATION

EX-820 receive only *£500*
High-speed electro-sensitive dot matrix includes plotting capability for full graphics, at £3 for a 240ft. roll, RS232C or 20mA serial and ASCII parallel input as standard, 20/40/80 cpl and up to 160 cps, 5×8 matrix. Main U.K. agent Memec Systems Ltd.

EX-850 Video Printer *£500*
High-speed electro-sensitive dot matrix, uses aluminised paper at £3 for a 240ft. roll. By using a video controller, the EX-850 dispenses with the need for any interfacing between the user's CRT display/terminal and printer — needs only the video signal. Normal resoltuion 13.5 seconds per screen, high resolution 27 seconds per screen. Main U.K. agent Memec Systems Ltd.

EX801/802 receive only *£279*
Electro-sensitive, dot matrix, uses aluminised paper at £3 for a 240ft. roll, RS232C, Centronics, Apple, Pet, and Tandy interfaces, 20/40/80 cpl, 160 cps, 5×8 matrix. Main U.K. agent Memec Systems Ltd.

BASE 2

800-MST *from £385*
Impact dot matrix, bi-directional, uses plain paper up to 9½in., RS232C, 20mA, IEEE-488, Centronics and parallel interfaces, up to 132 cpl and 60 cps, with 5×7 matrix. Main U.K. agents Microbyte and Maclin-Zand Electronics Ltd.

CENTRONICS

Models 700, 701, 702 and 703 *P.O.A.*
Impact dot marix, uses fan-fold paper, parallel, serial RS232C interfaces 132 cpl, up to 180 cps, 5×7 or 7×7 matrices. Main U.K. agents Sintrom Distribution, ITT Electronic Services, Cable and Wireless, Dacoll Engineering.

Model 791 — *P.O.A.*

Demand-document printer, impact, dot matrix, uses multi-part forms, up to 12-part using bottom feed tractors, standard parallel interface, with serial RS232C interface option, 80 cpl, 60 cps, 5×7 matrix. Main U.K. agents Sintrom Distribution, ITT electronic services, Cable and Wireless, Dacoll Engineering.

Model 730 — *P.O.A.*

Impact, dot matrix, uses roll paper up to 8.5 in. wide, fan-fold paper up to 9.5 in. wide and cut sheet up to three-ply paper and two carbons, parallel-standard interface with serial RS232 option, 80 cpl, 100 cpls, 7×7 matrix. Main U.K. agents, Sintrom Distribution, ITT Electronic Services, Cable and Wireless, Dacoll Engineering, Datac Ltd, Rair Ltd, Comma Computers and MIBF.

Model 737 — *P.O.A.*

Impact dot matrix, roll fan-fold or cut sheet paper, standard parallel interface, serial RS232C option, 80 cpl mono-spaced mode, 50 cps mono-spaced mode, 80 cps proportional mode, 7×8 matrix mono-spaced, 9×9 proportional. Main U.K. agents Sintrom Distribution, ITT Electronic Services, Cable and Wireless, Dacoll Engineering, Datac Ltd.

Model P1 Microprinter and Model S1 Microprinter — *P.O.A.*

Non-impact dot matrix electro-sensitive uses aluminium-coated paper roll, P1 — parallel interface, S1 — serial RS232C interface, up to 80 cpl, and 150 lines per minute, up to 200 cps. Main U.K. agent, Sintrom Distribution, ITT Electronic Services, Cable and Wireless, Dacoll Engineering, Datac Ltd.

Model 780 — *P.O.A.*

Impact, dot Matrix, pinch-roll paper feed for roll paper, tractor-feed option for rear- and bottom-feed forms and fan-fold paper, standard parallel interface with serial RS232C option, 80 cpl, 60 cps, 5×7 matrix. Main U.K. agents Sintrom Distribution, ITT Electronic Services, Cable and Wireless, Dacoll Engineering.

Model 779 — *P.O.A.*

Impact, dot matrix, pinch-roll paper feed for roll paper, with fan-fold, tractor feed option, standard parallel interface with RS232C serial option, 80-132 cpl, 60-110 cps, 5×7 matrix. Main U.K. agents Sintrom Distribution, ITT Electronic Services, Cable and Wireless, Dacoll Engineering.

Model 704 — *P.O.A*

Impact, dot matrix, uses fan-fold paper, RS232 serial interface, 132 cpl, 180 cps using 7×7, 9×9 and 9×9 matrices. Main U.K. agents Sintrom Distribution, ITT Electronic Services, Cable and Wireless, Dacoll Engineering.

Model 761 read only or keyboard send/receive — *P.O.A.*

Impact, dot matrix, uses fan-fold paper, RS232C/CCITT V24 or DC current loop interfaces, 132 cpl, 60 cps, 7×7 matrix. Main U.K. agents Sintrom Distribution, ITT Electronic Services, Cable and Wireless, Dacoll Engineering.

COMMODORE

CBM 3022 — *£425*

Tractor-feed printer, uses fan-fold paper with three-in. to 12in. width, cost of paper £10 per 1,000, IEEE interface, 80 cpl, 150 cps, 6×7 matrix. Main U.K. agent Davinci Computers Ltd.

COMPUTER DEVICES INC

Miniterm 1201, 1202, 1203 — *From £936*

Thermal mechanism, uses Thermal Type B paper at £2.40 per roll, RS232 or parallel — 1201 only — interfaces, 80 or 132 cpl, 10/30 cps, 7×5 matrix. Main U.K. agent Teleprinter Equipment Ltd.

DATAC

414 free-standing assembly receive only — *£130*
Electro-sensitive, matrix printer type 245L, electro-sensitive roll paper, 59mm. wide × 30n.. long at 90p per roll for 20 off, six-bit parallel ASCII, character serial interfaces, 16, 20, 32 or 40 cpl, 32 to 80 character per serial, 7×5 matrix. Main U.K. agent Datac Ltd.

DMI-40P free-standing terminal, receive only — *£350*
Impact, matrix, uses pressure-sensitive roll paper, 10mm.-wide ordinary paper version, using ink ribbon. Cost of paper £1 per roll, seven-bit parallel ASCII, character serial, buffered asynchronous or EIA/RS232C or graphics mode, direct control of needles interfaces, 40 or 20 cpl under software control, up to 80 cps, 7×5 matrix. Main U.K. agent Datac Ltd.

411C compact panel mounting, receive only — *£209*
Electro-sensitive matrix type 245 L or R, uses electro-sensitive roll paper, 59mm. wide × 30m. long at 90p per rol, six-bit parallel ASCII, character serial interfaces, 16, 20, 32 or 40 cpl, 32 to 80 cps, 7×5 matrix. Main U.K. agent Datac Ltd.

411 panel mounting, receive only — *£189*
Electro-sensitive matrix printer type 245 L or R, uses electro-sensitive roll paper, 59mm. wide × 30m. long at 90p per roll. Interfaces include six-bit parallel ASCII, character serial, four-bit parallel BCD, character parallel EIA/RS232C, CCITT/V24 and 20mA current loop, under development 40 cpl, 32 to 80 cps, 7×5 matrix. Main U.K. agent Datac Ltd.

313 panel-mounting, receive only and
312 free-standing, receive only — *£269*
Impact matrix type PU-1100, Tally roll paper, 59mm. wide × 36m. long at 60p per roll, CCITT/V24 or EIA RS232C or 20mA current loop interfaces, up to 20 cpl and up to 36 cps, 7×5 matrix. Main U.K. agent Datac Ltd.

412/1 and 412/5 receive only — *£255*
Electro-sensitive dot matrix type 245L, uses electro-sensitive aluminium-coated paper, 59mm. × 30m. at 90p per roll, six-bit parallel, ASCII, character serial and four-bit parallel BCD, character parallel, RS232C/V24 interfaces, 20mA current loop (/4) under development, 16, 20, 32 or 40 cpl, 32-80 cps, 7×5 matrix. Main U.K. agent Datac Ltd.

522/1 and 522/4 receive only — *£499 522/1) £535 (522/4)*
Impact matrix type 115DR, uses ordinary roll paper, 114mm. × 75m. up to three copes plus original, cost of paper £1.10 per roll. Parallel interface (552/1) and RS232C, 20mA current loop and parallel buttered, asynchronous interfaces — (522/4). 40 cpl, 100 cps instantaneous rate, 33 cps average rate — including CR and LF. 7×5, 4×5, 7×10 — 4 version only, under software control. Main U.K. agent Datac Ltd.

DATA DYNAMICS

303 Printer — *£980*
Dot matrix, high-definition printer, uses up to six-part stationery width from 3m to 15.375in., CCITT V24 (EIA RS232C) 20mA current loop, 132 cpl, 30 or 60 cps, 7×7 matrix. Main U.K. agent Data Dynamics.

ZIP ASR/K7 twin cassette — *£2,000*
Seven-needle head prints the full ASCII character set in dot matrix format, uses standard Telytype roll paper, V24, RS232C, or 20mA current loop operating at half or full duplex, 80 cpl, 10 or 30 cps switch selected, 5×7 matrix. Main U.K. agent Data Dynamics.

ZIP 30 keyboard printer, RO, ASR, or KSR — *ASR £1,800 RO & KSR £950*
Dot matrix printer, uses standard roll paper, 20mA half or full duplex current loop or V24 CCITT, RS232C, interfaces, 80 cpl, 10 or 30 cps — switch selected, 5×7 matrix. Main U.K. agent Data Dynamics.

390 eight-level and 392 five-level — *ASR from £1,250 LSR from £900 RO from £800*
Available in ASR, KSR and read-only versions. Impact printers, use friction or sprocket feed uses 8½in. paper with maximum roll diameter of 5in. 74 or 86, 6.6 or 10 cps. Main U.K. agent Data Dynamics.

Models 32 and 33 page printers — *ASR from £1,100; KSR from £800; RO from £700*

Available in ASR, KSR and receive-only versions. Friction or sprocket feed, 20mA or 60mA parallel input and output interfaces, up to 86 cpl, 6.6 or 10 cps. Main U.K. agent Data Dynamics.

DATA GENERAL CORPORATION

Dasher TP1 Printer models 6040 and 6041 — *from £1,598*

6040 uses a standard typewriter keyboard and has an off-line mode which enables it to be used as a typewriter, the 6041 is a receive-only terminal printer without a keyboard, 30 or 60 cps, switch selectable, EIA-RS232C interfaces. 5×7 dot matrix. Main U.K. agent Data General.

DATAPLUS

400 series receive-only Model 480 — *£475*

Impact dot matrix, uses standard Tally roll, up to 3.75in. wide, from 80p per roll, RS232C, V24, 20mA current loop, bit parallel IEEE, Pet and Apple interfaces, 30/40 cpl, 110 cps, 7×5 and 7×10 matrices. Main U.K. agent Dataplus Ltd.

DATASOUTH CORPORATION

DS-180 — *£1,360*

Impact, matrix printer, uses fan-fold paper, RS232C, Current loop, and parallel interfaces, 132 cpl, 180 cps, 9×7 matrix. Main U.K. agent Sigma U..

DIABLO

HY type II receive only — *P.O.A.*

Impact daisywheel plastic or metal print wheel, parallel, interface, 132 10-pitch cpl or 158 12-pitch cpl, 40/45/55 cps. Main U.K. agent Diablo Systems Ltd.

1650 receive only and keyboard send/receive — *RO £2,200; KSR £2,525*

Daisywheel impact printer using metal printwheels, uses standard listing or single-sheet paper, RS232C CCITT V24, parallel and current-loop option interfaces, 132 cpl at 10 pitch, 158 cpl at 12 pitch, up to 38 cps, line speeds to 9,600 bauds. Main U.K. agents Geveke Electronics Ltd, Rair Ltd.

1640 receive only or keyboard send/receive — *RO £2,100; KSR £2,400*

Daisywheel, impact printer using plastic printwheels, uses standard listing or single-sheet paper, RS232C CCITT V24, parallel and Current loop interfaces, 132 cpl at 10 pitch, 158 cpl at 12 pitch, up to 40 cps, line speeds to 9,600 bauds. Main U.K. agents Geveke Electronics Ltd, Rair Ltd.

630 receive only — *£1,725*

Daisywheel, impact printer with interchangeable metal/plastic printwheels, uses standard listing or single sheet paper, RS232C, CCITT V24 with optional bus interface, 132 cpl at 10 pitch, 158 cpl at 12 pitch, 198 cpl at 15 pitch, up to 40 cps with automatic bi-directional printing. Main U.K. agent Geveke Electronics.

DIGITAL EQUIPMENT

DecWriter LA34 KSR — *£824*

Dot matrix, uses roll or fan-fold paper, friction feed, up to five copies, V24 or 20mA interfaces, adjustable up to 256 cpl, 30 cps, 7×9 matrix. Main U.K. agent Extel.

ELECTROGRAPHIC AV

EG-800 receive only — *from £450*
Impact, matrix printer, uses any type of paper, parallel, RS232C, TRS-80, Apple interfaces, 80 cpl, 150 cps, 7×5 or 7×6 matrix. Main U.K. agent Electrographic AV Ltd.

500 series receive only — *from £175 for mechanism only*
Impact, matrix printer, uses 3½in. Tally roll paper and flat documents, serial or parallel interfaces, 40 cpl, 120 cps, 7×5 or 7×6 matrices. Main U.K. agent Electrographic AV Ltd.

EPSON

TX-80 — *£395*
Impact, dot matrix, friction-feed version uses Telex rolls, tractor feed version uses computer-type listing paper, cost from £1 per roll, RS232C, V24, 20mA current loop, bit parallel, Centronics, IEEE, Pet, Apple and TRS-80 interfaces, 80 CPL, 150 cps, 7×5 or 7×10 matrices and graphics. Main U.K. agent Dataplus Ltd.

EXTEL CORPORATION

M30 receive only keyboard send/receive and automatic send/receive — *£895*
Impact, dot matrix printer, uses roll or fan-fold paper, V24 or 20mA interfaces, 80 cpl, 30 cps (50 with buffer) 5×7 matrix, 5- or 8-level operation. Main U.K. agent Extel.

M30 B208L keyboard send/receive — *£1,270*
Dot matrix, uses roll paper, V24 or 20mA interfaces, 80 cpl, 30 cps, 5×7 matrix, 5- or 8-level operation. Main U.K. agent Extel.

FACIT

4520 and 4521 — *£583*
Seven-wire print head, uses roll paper Telex type (Facit 4520), friction feed, fan-fold (Facit 4521) pin feed, serial, V24/RS323C, Centronics parallel interfaces, both fitted as standard, 80 cpl, 100 cps at 12 characters per inch, 9×7 matrix. Main U.K. agent Facit Ltd.

GENERAL ELECTRIC, U.S.A.

ITT 3330 — *£1,496*
Impact dot matrix, uses plain paper, sprocket feed, V24 interface, 132 cpl, 10, 20 or 30 cps, 7×9 matrix. Main U.K. distributor ITT Business Systems U.K.

HEATH ELECTRONICS

WH14 — *£510*
Dot matrix, uses edge-punched fan-fold paper, at £24, 20mA, RS232C Interfaces, 80, 96, 132 cpl, 132 cpls, 5×7 matrix. Main U.K. agent Heath Electronics U.K. Ltd. (OEM sales)

INTEGRAL DATA SYSTEMS

Paper Tiger Model 460 — *from £700*
Dot Matrix, impact printer, uses pin-feed or fan-fold paper at £7 per 1,000 sheets or £9.65 per 1,000 sheets with vertical perforations, parallel, RS232C and standard interfaces, 134 cpl, in excess of 150 cps, 24×9 matrix. Main U.K. agent Teleprinter Equipment Ltd.

SHOPWINDOW

J WALTERS

ADC 1251 — *£560*
Matrix printer, uses continuous paper at £13 per box, serial, RS232 V-24 Centronics and IEEE interfaces, 80/132 cpl, 125 cps, 7×9 matrix. Main U.K. agent Access Data Communications Ltd.

ADC 2401 — *£1,350*
Matrix printer, uses continuous paper at £13 per box, serial, RS232 V-24, Centronics and IEEE interfaces, 136 cpl, 240 cps, 9×9 matrix. Main U.K. agents Access Data Communications Ltd.

LEAR SIEGLER INC

300 series — *from £965*
Ballistic-matrix, uses standard paper, RS232C, 20mA parallel interfaces Centronics 701/703 type 132 cpl, 180 cps, 9×7 or 9×9 matrices. Main U.K. agent Penny & Giles Data Recorders Ltd.

LOGABAX

LX-213 — *£1,590*
Nine-wire matrix printer, uses plain paper, fan-fold or cut up to six-ply, RS232C or V24 interfaces, 132 cpl at 10 pitch, 218 cpl at 16.5 pitch, 180 cps, 9×7 matrix, optimised bi-directional printing. Main U.K. agent Brospa Data Ltd.

LRC EATON

7000+ — *£250*
Impact, matrix printer, uses roll paper, RS232, IEEE, current loop and parallel interfaces, 20 and 40 cpl selectable by software, 20, 32, 40 and 64 cpl software selectable by option, 40 cps, 7×7 matrix. Main U.K. agent Sigma U.K.

MALIBU ELECTRONICS CORPORATION

Masterprint 165 — *£1,400*
Impact matrix, dot-addressable by software, uses fan-fold paper, RS232C, current loop and parallel interfaces, 132 cpl, 165 cps, 10×9 matrix with 18×9 matrix character set which approached word-processing quality and full graphics capability. Main U.K. agent MBS Terminals Ltd.

MANNESMAN TALLY

M-80 MC — *from £875*
seven/nine needle-head mechanism, uses 9½in. standard listing paper, all interfaces, 80/132 cpl, 200 cps, 7×9 or 9×9 matrices. Main U.K. agent Data Design Techniques Ltd.

T1612 keyboard send/receive — *£1,612*
Seven/nine needle-head mechanism, uses standard, single or multi-part paper, RS232C or 20mA interfaces, 132/218 cpl, 160 cps, 7×9 or 9×9 matrices. Main U.K. agent Data Design Techniques Ltd.

T1612 receive only — *£1,475*
T1602 — *£1,395*
Seven/nine needle-head mechanism, uses standard, single- or multi-part paper, Data Products, Centronics and serial interfaces, 132 cpl, 160 cps, 7×9 matrix. Main U.K. agent Data Design Techniques Ltd.

T2000 — *from £2,000*
Comb print mechanism, uses standard, single- or multi-part paper, all interfaces, 132 cpl, 200 lines per minutes, 7×7 or 9×9 matrices. Main U.K. agent Data Design Techniques Ltd.

MICRO PERIPHERALS INC

MPI-88T — *£535*
Impact, matrix printer, uses fan-fold, roll and cut-sheet paper, RS232C, Current loop and parallel interfaces, 80/96/120/132 cpl, all software-selectable, 120 cps, 7×7 matrix. Main U.K. agent Sigma U.K.

NEC

Spinwriter — *£2,195*
High-quality printer, uses ordinary paper, RS232C, Centronics, Diablo, Qume, Serial and parallel interfaces, up to 163 cpl, 55 cps, solid-font matrix. Main U.K. agent Memec Systems Ltd.

NEWBURY LABORATORIES

Model 8300 — *from £475*
Dot matrix, impact printer, uses pin-feed method for paper up to 9.5 in., £16.50 per box, eight-bit parallel interface or CCITT V24, RS232C interfaces, 10 characters per inch, 125 cps, 7×9 matrix. Main U.K. agent Newbear Computing Store.

NIPPON ELECTRIC COMPANY

Spinwriter — *£1,500*
Combines golf-ball daisywheel and thimble mechanism, uses continuous or single-sheet computer paper, RS232C serial (RO and KSR), Centronics-compatible and Diablo-compatible interfaces, 8080 input bus line, current loop and custom microprocessor-controlled interfaces, 55 cps, solid-font matrix. Main U.K. agent Memec Systems Ltd.

OKI

Microline 80 — *£500*
Dot matrix, 9×7, 80 cps, 80 or 132 characters per column, pin, traction or friction feed, RS232, 20mA Centronics. Main U.K. Agent, X-Data

QUME

Sprint 5/45 receive only — *£1,795*
Daisywheel mechanism, uses plain paper, fan-fold or cut appear A4 up to six-ply, RS232C or V24 interfaces, 156 cpl at 12 pitch, 45 cps. Main U.K. agent Brospa Data Ltd and Access Data Communications.

RAIR

820/825 Desk-top printer — *£1.090*
Dot matrix, RS232C interface, 132 cpl, 75 or 150 cps, 7×7 matrix. Main U.K. agent Rair.

DecWriter IV keyboard printer, KSR and read only — *£795*
Dot matrix, uses standard listing paper, RS232C current loop interface, 215 cpl, 30 or 180 cps, 9×7 matrix. Main U.K. agent Rair.

M200 — *£1,995*
Dot matrix, uses continuous paper, parallel or serial interface. 132 cpl, 340 cps, double 7×9 matrix. Main U.K. agent Rair.

SHOPWINDOW

Hyterm 1640 and 1650
Metal or plastic daisywheels, uses cut-sheet or continuous paper, serial or current loop interfaces, 215 plus cpl, up to 45 cps. Main U.K. agent Rair.
1640 without keyboard £2,100, wiht keyboard £2,350. 1650 without keyboard £2,200, with keyboard £2,450.

DecWriter III
Dot Matrix, uses continuous listing paper, RS232C or 20mA, current loop interfaces, 132-215 cpl, 180 cps, 7×7 matrix. Main U.K. agent Rair Ltd.
£1,550

RICOH

RP-1600
Daisywheel mechanism, typeface, uses single-sheet or continuous paper, from £6 per 1,000 sheets, Centronics and compatible interfaces, 132 cpl, 60 cps. Main U.K. agent Nexos (U.K.) Ltd.
£1,295

S FARID (SPECTRONICS) MANUFACTURING

TP-40 and TP-64 receive only
Thermal, matrix, uses thermal paper, cost of paper £1.80 each roll, seven-bit parallel interface, push-button control and self-test, 40 or 64 cpl, 13 or 18 cps, 7×5 dot matrix. Main U.K. agent S Faird (Spectronics) Manufacturing Ltd.
from £660

SIGMA INTERNATIONAL INC

Sintelwriter
NEC 5500 range of thimbles, uses fan-fold paper, cut-sheet paper optional, RS232C and parallel interfaces, 136 or 163 cpl, up to 55 cps. Main U.K. agent Sigma U.K.
£2,064

TALLY

T1612 keyboard send/receive
Seven/nine needle-head mechanism, uses standard, single- or multi-part paper, RS232C or 20mA interfaces, 132-218 cpl, 160 cps, 7×9 or 9×9 matrices. Main U.K. agent Data Design Techniques Ltd.
£1,612

T1612 receive only
£1,475

T1602
Seven/needle-head mechanism, uses standard, single- or multi-part paper, Data Products, Centronics and serial interfaces, 132 cpl, 160 cps, 7×9 matrix. Main U.K. agent Data Design Techniques Ltd.

T2000
Comb print mechanism, uses standard, single- or multi-part paper, all interfaces, 132 cpl, 200 lines per minutes, 7×7 or 9×9 matrices. Main U.K. agent Data Design Techniques Ltd.
from £2,000

TELETYPE CORPORATION

Model 43 keyboard send/receive
Impact matrix printer, uses pin-feed or friction-feed, dual RS232C and 20mA Current loop interfaces, 132 cpl, 30 cps sustained 300 bauds, 4×7 matrix on 9-wire printhead. Main U.K. agent Geveke Electronics Ltd.
£800

TEXAS INSTRUMENTS

OMNI 800 series
Models 810, 820 and 825 — *from £1,090 to £1,650*

Available in keyboard send/receive and receive-only impact, matrix printers, uses plain paper, EIA, current loop, parallel interfaces, 132-216 cpl compressed print (models 820 and 825), 132 cpl (model 810), 75 cps (models 825), 150 cps (models 810 and 820), 9×7 matrix. Main U.K. agents Texas Instruments Ltd, and Rair Ltd.

Silent 700 model and 765 bubble-memory terminal — *£2,395*

Thermal mechanism, uses thermal paper at £1.50 for a 100ft roll, integral acoustic coupler, EIA interfaces, 80 cop, 30 cps, 5×7 matrix. Main U.K. agent Texas Instruments Ltd, and Rair Ltd.

Silent 700 model and 763 bubble-memory terminal — *£2,195*

Thermal mechanism, uses thermal paper at £1.50 per 100 ft roll, EIA, 20mA current loop interfaces, 80 cpl, 30 cps, 5×7 matrix. Main U.K. agent Texas Instruments Ltd, and Rair Ltd.

Silent 700 model and 745 portable — *£1,250*

Thermal mechanism, uses thermal paper at £1.50 per 100 ft. roll, integral acoustic coupler, EIA interface, 80 cpl, 30 cps, 5×7 matrix. Main U.K. agent Texas Instruments Ltd, and Rair Ltd.

Silent 700, 743 Keyboard send/receive version — *£1,105*

Thermal mechanism, uses thermal paper at £1.50 per 100ft. roll, EIA, 20mA current loop interfaces, 80 cpl, 30 cps, 5×7 matrix. Main U.K. agent Texas Instruments Ltd, and Rair Ltd.

TRANSDATA

313 Receive only — *£790*

Thermal, matrix mechanism, uses thermal paper at £60 per box of 24 rolls × 150 ft. RS232C and parallel interfaces designed for use as VDU hard copy, 80/132 cpl, 30 to 45 cps, 7×5 matrix. Main U.K. agent Transdata Ltd.

TRANSTEL COMMUNICATIONS

AHR receive only — *P.O.A.*

Impact, matrix, uses standard teleprinter paper, V24, current loop interface, 80 cpl, 30 cps, 7×5 matrix. Main U.K. agent Transtel Communications Ltd.

TREND COMMUNICATIONS

800 receive only — *P.O.A.*

Impact, matrix, uses standard Telex roll paper, current loop, RS232C 80-0-80 interfaces, 80-132 cpl, 30 cps, 7×5 matrix. Main U.K. agent Trend Communications Ltd.

UNITED SYSTEMS CORPORATION

DigiTec 6320 — *£483*

Electro-sensitive dot matrix, includes moving stylus, first line down, input line buffer, uses electro-sensitive line roll paper at £1.80 per roll, RS232C or isolated 20mA current loop selectable and handshake TTL-compatible interfaces; asynchronous/synchronous, 21 or 32 cpl, prints two lines per second, 1,200 Baud receive, 5×7 matrix. Main U.K. agent Aviquipo Ltd.

DigiTec 6330 — *£421*

Electro-sensitive dot matrix, includes moving stylus — first line down, input line buffer, uses electro-sensitive paper at £1.80 per roll, 8-bit parallel/character serial and handshake, TTL compatible, asynchronous/synchronous interfaces, 21 or 32 cpl, 5×7 matrix. Main U.K. agent Aviquipo Ltd.

DigiTec 6410 *£237*

Electro-sensitive dot matrix, includes moving stylus, first line up, input line buffer, uses electro-sensitive paper at £1.80 per roll, RS232C or 20mA current loop switch-selectable TTL-compatible, asynchronous/synchronous interfaces, 21 or 32 cpl, prints two lines per second, 110 or 300 baud receive, 5×7 matrix. Main U.K. agent Aviquipo Ltd.

DigiTec 6420 *£237*

Electro-sensitive dot matrix, moving stylus, first line up, input line buffer, uses electro-sensitive paper at £1.80 per roll, 8-bit parallel/character serial and handshake TTL-compatible, asynchronous/synchronous interfaces, 21 or 32 cpl, prints two lines per second, 1200 baud receive, 5×7 matrix. Main U.K. agent Aviquip Ltd.

DigiTec 6450 *£266*

Thermal, dot matrix, moving stylus, first line up, input line buffer, uses thermal paper at £1.80 per roll, RS232C or isolated 20mA current loop, switch-selectable TTL-compatible, asynchronous/synchronous interfaces, 21 cpl, prints two lines per second, 110 or 300 baud receive, 5×7 matrix. Main U.K. agent Aviquipo Ltd.

DigiTec 6460 *£266*

Thermal, dot matrix, moving stylus, first line down, input buffer line, uses thermal paper at £1.80 per roll, eight-bit parallel/character serial handshake, TTL-compatible, asynchronous/synchronous interfaces, 21 cpl, prints two lines per second, up to 1,000 baud receive, 5×7 matrix. Main U.K. agent Aviquipo Ltd.

DigiTec 6550 *£289*

Thermal, dot matrix, moving stylus, first line down, input buffer line, uses thermal paper at £1.80 per roll, RS232C or 20mA current loop, switch-selectable, TTL-compatible, asynchronous/synchronous interfaces, 21 or 32 cpl, prints two lines per second, 110 or 300 baud receive, 5×7 matrix. Main U.K. agent Aviquipo Ltd.

VECTOR GRAPHIC

MP printer *£599*

Uni-directional seven-wire × five-column dot matrix, original and one copy, maximum paper thickness 0.2mm., uses pin-wheel paper feed, 70 lines per minute, 150 cps, TTL level interface, two parallel output ports and one-parallel input port. Main U.K. agent Almarc Data Systems Ltd.

WALTERS MICROSYSTEMS

BD-80P *£475*

Process-controlled, full graphics set, user-definable graphics, fan-fold tractor feed, cost of paper £6 pet 1,000 sheets, IEEE, RS232C and parallel interfaces, 80 or 132 cpl, 130 cps, 9×7 matrix. Main U.K. agent Camden Electronics.

WENGER DATENTECHNIK

Penny & Giles matrix printer *from £700*

Uses standard paper, RS232C, 20mA, 60mA and parallel interfaces, Centronics-compatible, 80 cpl, constant throughput 80 cps, 55-1000 lines per minutes, 7×7 matrix. Main U.K. agent Penny & Giles Data Recorders ltd.

Penny & Giles hard copies *from £365*

Electro-static mechanism, uses RMP paper 127mm. × 70m. at £3.50 per roll, RS232C, parallel interface and current loop option, 80/40/20 cpl, user-programmable, 80 columns message, 110 lines per minujtes, 5×8 line printer, 5×7 message printer matrtx. Main U.K. agent Penny & Giles Data Recorders Ltd.

WHYMARK INSTRUMENTS

Model 201 *£440*
Dot matrix, Tally-roll plain-paper printer, IEEE, RS232C, serial, and parallel interfaces, 40 cpl, 40 cps, 52 character set with four-character sizes. Main U.K. agents Whymark Instruments Ltd.

Model 204 label printer *£515*
Dot matrix, impact printer for self-adhesive labels, IEEE, RS232C, serial and parallel interfaces, 40 cpl, 40 cps, 52 character set with four-character sizes. Main U.K. agent Whymark Instruments Ltd.

Model 3011 ticket/form printer *£690*
Dot matrix impact printer for plain paper, options automatic date and time, pre-programmed text, IEEE, RS232C, serial and parallel interfaces, 40 cpl, 40 cps, 52 character set with four character sizes. Main U.K. agent Whymark Instruments ltd.

Model 501 rack-mounting printer *£625*
Dot matrix impact printer for plain paper, options automatic date and time, pre-programmed text, IEEE, RS232C, serial and parallel interfaces, 40 cps, 40 cpl, 52 character set with four character sizes. Main U.K. agent Whymark Instruments ltd.

Model 801 80/120 column printer *£750*
Dot matrix, impact printer for plain or fan-fold paper, proportional spacing up to 120 cpl, 120 cps, bi-directional printing, user-definable character set, up to 4K selectable character fonts, graphics, and user-defined characters, also available; very large characters seven lines high. Main U.K. agent Whymark Instruments Ltd.

VDUs

APPLIED DIGITAL DATA SYSTEMS

Regent 60 *£599-£899*
Integral, separate and numeric pad keyboard, 12in. screen, 80 characters wide, switch-selectable cursor, buffered, protected fields, can transmit page line or modified data only, special character sets U.K., U.S., German, Swedish, Finnish, Danish, Norwegian, Spanish, French (Azerty), Arabic, V24, current loop, auxiliary interfaces. Main U.K. agent Terminal Display Systems Ltd.

CIFER SYSTEMS

2604 *£680*
Non-intelligent VDU, separate keyboard, no numeric pad, 12in. screen, 24×80 characters, blinking, underscore cursor, user-defined alternate character set available, V24 with optional current loop interface. Main U.K. agent Cifer Systems Ltd, OEM sales U.K. and Europe.

2684 *£1,995*
Intelligent VDU, with separate numeric pad, 12in. screen, 24×80 characters, blinking, underscore, soft-selectable cursor, includes integral floppy-disc unit, two Z-80 processors, 64K memory associated with disc processor, more than 150 commands associated with disc processor, optional character sets, V24 or optional current loop interface. Main U.K. agent Cifer Systems Ltd, OEM sales U.K. and Europe.

2632 *£890*
Semi-intelligent VDU with separate keyboard and numeric pad, 12in. screen 24×80 characters, blinking, underscoring, soft-selectable cursor, more than 150 commands, user definable character sets, V24 interface with current-loop option. Main U.K. agent Cifer Systems Ltd., OEM sales U.K. and Europe.

2653 *£890*

Non-intelligent VDU with separate keyboard DG6053 emulator, numeric pad, 12in. screen, 24×80 characters, blinking and undrscoring cursor, user-definable character sets, V24 interface with optional current loop. Main U.K. agent Cifer Systems Ltd, OEM sales U.K. and Europe.

2652 *£890*

Non-intelligent VDU with separate keyboard and numeric pad and VT52 emulator, 12in. screen 24×80 characters, blinking and underscoring cursor, user definable character sets, V24 interface with optional current loop. Main U.K. agent Cifer Systems Ltd., OEM sales U.K. and Europe.

2605 *£770*

Non-intelligent VDU, with separate keyboard and numeric pad, 12in. screen 24×80 characters, blinking and underscoring cursor, user-definable character sets, V24 interface with optional current loop. Main U.K. agent Cifer Systems Ltd, OEM sales U.K. and Europe.

CPU COMPUTERS

Pentland III *£594*

Non-intelligent VDU, integral keyboard, no numeric pad, 12in. screen, 24×80 characters, limited cursor control, RS232C and current loop interfaces. Main U.K. agent CPU Computers Ltd.

Pentland VI *£660*

Semi-intelligent VDU, integral keyboard with numeric pad, 12in. screen with bonded-face plate, 24×80, full cursor control, includes extra page of memory, line and page-scroll and row-interchange function, RS232C and current loop interfaces. Main U.K. agent CPU Computers Ltd.

DACOLL ENGINEERING SERVICES

M242 *£600*

Semi-intelligent VDU, with integral keyboard and numeric pad, 12in. screen 25×80 characters or optional 25×132 characters, underlining cursor, flashing or steady, includes Intel 8085 microprocessor, optional characters sets, RS232C and current loop interfaces. Main U.K. agent Dacoll Engineering Services Ltd.

M248 *from £795*

Intelligent VDU with separate keyboard and numeric pad, 12in. screen, 25×80 characters or an optional 25×132 characters, either underline or inverse video block cursor, blinking or steady, includes Intel 8085 microprocessor, optional character sets, RS232 and current loop interfaces. Main U.K. agent Dacoll Engineering Services Ltd.

M247 *£890*

Intelligent VDU, with separate keyboard and numeric pad, 12in. screen 25×80 characters, underlining cursor, blinking or steady with inverse video, includes Intel 8085 mircoprocessor, optional character sets, RS232C and current loop interfaces. Main U.K. agent Dacoll Engineering Services Ltd.

DATA GENERAL CORPORATION

Dasher D2 display 6053 *£1,728*

Operator-orientated, 96-character, upper- and lower-case alphanumeric display with detached keyboard, direct cursor positioning and sensing, 9×6 screen, 24 lines × 80 characters, asynchronous communications interface, RS232C and 20mA, 7×8 dot matrix. Main U.K. agent Data General.

Dasher D3 display 6093 *£1,885*

Operator-orientated, 96-character ASCII, alpha-numeric terminal, detached, sculptured typewriter keyboard with integral 14-key data-entry pad and 18 function keys, industry-compatible asynchronous communications interface, 20mA, EIA RS232C, direct cursor positioning and sensing, 9×6 screen, 24 lines × 80 characters, 5×8 dot matrix. Main U.K. agent Data General.

Dasher D100 and D200 — *from £1,141*

Operator-orientated, 96 character ASCII, alpha-numeric terminals, detached, movable, typewriter-style keyboard, industry-compatible asynchronous serial communications interface, 20mA, EIA RS232C current loop, direct cursor positioning and sensing, 9×6 screen, 24 lines × 80 characters, 7×11 dot matrix. Main U.K. agent Data General.

DIGITAL EQUIPMENT

VT-100 — *£1,100*

Separate numeric, standard keyboard with 12in. screen, 132 or 80 characters wide, 14 or 24 characters high, full cursor controls with special character sets, RS232C and 20mA interfaces, unintelligent. Main U.K. agent Rair Ltd.

VT103 LSI-II — *£1,971*

CRT monitor, detachable keyboard, alpha-numeric plus separate numeric keypad, up to 132 columns × 24 line display and 7×9 dot matrix, includes operator-selectable double-height/double-width characters, double-intensity, normal and reverse video, blinking, underlining and variable tabulation, parallel and serial, EIA, 20mA, current loop, RS232C, RS423 and RS422 interfaces. Main U.K. agent Rapid Recall.

FACIT

Integral and separate keyboards with numeric pads, some models intelligent, 14in. screen, 80/132×40. Main U.K. agent Facit U.K. Ltd. — *from £600*

GENERAL TERMINAL CORPORATION

GT-100A — *£610*

Intelligent Z-80-based VDU with integral keyboard with separate numeric pad, 12in. screen, 24×80 characters, plus 25th status line, full cursor control special character sets including line-drawing as standard, RS232C and 20mA current-loop interfaces. Main U.K. agent SEN Electronics Ltd.

GT-101 — *£690*

Intelligent VDU, includes Z-80 micro and programmable function keys, integral keyboard with separate numeric pad, 12in. screen, 24×80 characters plus 25th status line, full cursor control, line drawing as standard, RS232C and 20mA current-loop interfaces. Main U.K. agent SEN Electronics Ltd.

GT-110 — *£770*

Intelligent VDU, Z-80-based and includes user-programmable function keys, integral keyboard with separate numeric pad, 12in. screen, 24×80 characters plus 25th status line, full cursor control, with U.K./foreign and line-drawing character sets, RS232C and 20mA current loop interfaces. Main U.K. agent SEN Electronics Ltd.

GT-400 — *£947*

Intelligent Z-80-based VDU, separate keyboard with separate numeric pad, 12in. screen, 25×80 characters includes full editing facilities, full cursor control, RS232C and 20mA current loop interfaces. Main U.K. agent SEN Electronics Ltd.

HAZELTINE

1520 — *£1,050*

Intelligent VDU with separate standard numeric keypad, 12in. screen, 80 characters wide, 24 characters high, full cursor controls with buffered editing and printing and special character sets, RS232C and 20mA interfaces. Main U.K. agent Rair Ltd.

1510 *£890*
Intelligent VDU with separate standard numeric keypad, 12in. screen, 80 characters wide, 24 characters high, full cursor controls with buffered editing and special character sets, RS232C and 20mA interfaces. Main U.K. agent Rair Ltd.

1500 *£785*
Separate standard numeric keypad, 12in. screen, 80 characters wide, 24 characters high, full cursor controls and special character sets, RS232C or 20mA interfaces, unintelligent. Main U.K. agent Rair Ltd.

1420 *£675*
Separate standard numeric keypad, 12in. screen, 80 characters wide, 24 characters high, full cursor controls, with special character sets, RS232C interface, unintelligentg. Main U.K. agent Rair Ltd.

1410 *£590*
Separate standard numeric keypad, 12in. screen, 80 characters wide, 24 characters high, full cursor controls with special character sets, RS232C interface, unintelligent. Main U.K. agent Rair Ltd.

IBM

3101/20 *£994*
Intelligent VDU with separate standard numeric keypad 12in. screen, 80 characters wide, 24 characters high, full cursor controls with buffered editing, RS232C and 20mA interfaces. Main U.K. agent Rair Ltd.

3101/10 *£922*
Separate standard numeric keypad, 12in. screen, 80 characters wide, 24 characters high, full cursor controls, RS232C or 20mA interfaces, unintelligent. Main U.K. agent Rair Ltd.

INCOTERM U.S.

VTU 5106 *P.O.A.*
Intelligent VDU with clustered-terminals and terminal-processing unit which is programmable and supports up to 16 VDUs, separate keyboard with integral numeric pad, 12in. screen 80 characters × 12 or 25 lines, includes cursor control and character sets and keyboards for compatibility with IBM, ICL, Honeywell, Burroughs, Univac or to customers' specification, Incoterm current loop and standard RS232C interfaces. Main U.K. agent Incoterm Ltd.

VTU 5102 teller terminal *P.O.A.*
Intelligent VDU, includes cluster teller stations with the Series 7000. Intelligent Transaction Controller, which supports up to 12 teller terminals and four executive terminals. Separate alpha-numeric keypad. Can be upgraded to support Series 7500 receipt/journal printers, bankcard readers and personal identification number keypads, 5in. screen 40 characters × six or 12 lines, cursor control 30 programmable keys can be customised to any application, Incoterm current loop and standard RS232C interfaces. Main U.K. agent Incoterm Ltd.

ITT COURIER, U.S.A.

3280 Visual display system *P.O.A.*
Separate numeric pad keyboard, 80 characters wide × 24 characters high, cursor control, non-intelligent but has own intelligence for self-checking diagnostics, languages for all countries and 'APL', V24 interface. Main U.K. agent ITT Business Systems.

NEWBURY LABORATORIES

7000 £495
Non-intelligent VDU, integral keyboard, no numeric pad, 12in. screen, 24×80 characters, block cursor, V24, 20-60mA, current loop interfaces. Main U.K. agent Newbury Laboratories Ltd.

760C5
Non-intelligent VDU, integral keyboard, no numeric pad, 12in. screen 24×80 characters, block cursor with cursor addressing, V24 or 20mA current loop interfaces. Main U.K. agent Newbury Laboratories.

7009 £795
Intelligent VDU, integral or separate keyboard option, with numeric pad, 12in. screen 24×80 characters, block cursor, includes full editing facilities, block transmision, highlighting features, cursor addressing and seven pages of memory, also includes special character sets, V24, 20-60mA, and current loop interfaces. Main U.K. agent Newbury Laboratories Ltd.

7007 £745
Intelligent VDU with integral or separate keyboard options and numeric pad, 12in. screen 24×80 characters, block cursor, includes full editing facilities, block transmission, highlighting fatures and cursor addressing, also includes special character sets, V24, 20-60mA and current loop interfaces. Main U.K. agent Newbury Laboratories Ltd.

7002C £645
Non-intelligent VDU, integral or separate keyboard options, with numeric pad, 12in. screen, 24×80 characters block cursor with cursor addressing, includes hard copy printer output and connection for external monitor, V24 or 20mA current loop interfaces. Main U.K. agent Newbury Laboratories Ltd.

7002 £595
Non-intelligent VDU, integral or separate keyboard option, with numeric pad, 12in. screen 24×80 characters, block cursor, includes hard copy printer output and connection for external monitor, V24 or 20mA current loop interfaces. Main U.K. agent Newbury Laboratories Ltd.

E1904 £775
Intelligent VDU, integral numeric keyboard, 12in. screen, 80 cpl, 24 lines per screen, cursor controls, full edit features, block transmission by line or page, XY cursor address, protected field format, two-page memory, roll or page mode. Serial interface CCTTT, V24, RS232C and 20/60mA current loop. Main U.K. agent Extel.

E1204 £595
Integral numeric keyboard, 12in. screen, 80 cpl, 24 lines per screen, V24 and 20mA interfaces, unintelligent. Main U.K. agent Extel.

PERICOM DATA SYSTEMS

6801 £985
Semi-intelligent VDU, separate keyboard with numeric pad, 15in. screen, 24×80 characters, underlining, blinking cursor, includes special character sets, RS232C, current loop interfaces, fully Post Office approved. Main U.K. agent Pericom Ltd.

6803 £1,285
Semi-intelligent VDU, separate keyboard with numeric pad, 15in. screen, 24×80 or 24×132 characters, switch-selectable or software-selectable, underlining, blinking cursor, includes special character sets, RS232C, current loop interfaces, fully Post Office approved. Main U.K. agent Pericom Ltd.

MICRO ADS

are accepted from private readers only, pre-paid and in writing, 20p per word, minimum charge £2.

SOROC TECHNOLOGY INC

IQ140 *£860*
Intelligent VDU, 12in. screen, 80 character wide × 24 characters high, non-destructive block, blinking or non-blinking cursor, includes protect mode, edit features and 25th line for status and mode display, 128 ASCII character set, upper/lower-case and alpha-numeric control characters, RS232C and current loop interfaces. Main U.K. agent Sigma U.K.

IQ120 *£576*
Intelligent VDU, integral keyboard, separate numeric pad, 12in. screen, 80 characters wide × 24 characters high, non-destructive block cursor, includes protect mode, 96 ASCII character displayable, RS232 interface. Main U.K. agent Sigma U.K.

TELEVIDEO INC

TVI-920 *from £623*
Intelligent VDU, integral keyboard, separate numeric pad, 12in. screen, 80 characters wide × 24 characters high, blinking block cursor, includes block mode, protect mode, tabbing, programmable reverse video, special programmable function keys, 96 ASCII displayable character sets, RS232C and current loop interfaces. Main U.K. agents Sigma U.K. and Data Design Techniques Ltd.

TVI-912 *from £549*
Intelligent VDU, integral keyboard, separate numeric pad, 12in. screen, 80 characters wide × 24 characters high, blinking block cursor, includes block mode, protect mode, tabbing, and programmable reverse video, 96 ASCII character set, RS232C and current loop interfaces. Main U.K. agents Sigma U.K. and Data Design Techniques Ltd.

VISUAL TECHNOLOGY INC

Visual 200 *£698*
Intelligent VDU, separate keyboard and numeric pad, 12in. screen, 80 characters wide × 24 characters high, non-destructive block cursor, switch-selectable emulation of: Hazeltine 1500, Lear Siegler ADM3A, DEC VT52 and ADDS520, full range of cursor control functions, memory test on power-upa, 95 ASCII characters upper/lower-case plus 31 character line-drawing set, RS232C and current loop interfaces. Main U.K. agent Sigma U.K.

Visual 100 *£1,213*
Intelligent VDU, separate keyboard and numeric pad, size of screen is 24 lines × 80 columns or 24 lines × 132 columns, blinking block or blinking underscore, user-selectable cursor, DEC VT-100- and DEC VT-52-compatible, advanced video package standard, 95ASCII US/UK plus 32 character graphics, RS232C and current loop interfaces. Main U.K. agent Sigma U.K.

VOLKER CRAIG

VC-400 series *from £595-£850*
Non-intelligent, separate keyboard with either standard numeric pad or optional numeric pad, 12in. screen, optional green or amber, 80×24/24 characters, flash, steady, blinking or underscore cursor, addressable, special character sets — natural, APL, custom design facilities, i.e., Wordstar, RS232/current loop interfaces. Main U.K. agents Volker Craig, Fortronic Ltd.

VC-4152 VT-52 emulator *£675*
Non-intelligent, separate keyboard with standard numeric pad, 12in. screen, 80×25 characters, flash, steady, blinking or underscore

cursor, addressable, special character sets — VT-52 Graphics, APL, national and custom design facilities, i.e., Wordstar, RS232/current loop interfaces. Main U.K. agents Volker Craig (U.K.) Ltd., Fortronic Ltd.

Teleprinter *£1,500*
Non-intelligent, separate keyboard with standard numeric pad, 12in. screen, 80×25 characters, flash, steady, blink or underscore cursor, addressable, special character sets — national, APL, custom design facilities, i.e., Wordstar, VT-24 and 5-bit interfaces. Main U.K. agent Volker Craig (U.K.) Ltd. Fortronic Ltd.

VC-2100 VT-100 emulator plus *£995*
Non-intelligent, separate keyboard with standard numeric pad, 12in. screen, 132×25 characters, flash, steady, blink or underscore cursor, addressable, special character sets — double height, double width, national, APL, custom design facilities, i.e., Wordstar, RS449, RS232/current-loop interfaces. Main U.K. agents Volker Craig (U.K.) Ltd, Fortronic Ltd.

Alphabetical list of suppliers

Supplier	Address
Access Data Communications Ltd, 0895-30831	228 High Street, Uxbridge, Middlesex UB8 1LD
Almarc Data Systems Ltd, 0602-625035	906 Woodborough Road, Nottingham NG3 5QS
Anadex Ltd 09905-6333	Dorna House, Guildford Road, West End, Woking, Surrey
Aviquipo of Britain Ltd, 0628-34555	St. Peter's Road, Maidenhead, Berkshire SL6 7QU
Brospa Data Ltd, 0734-589393	87 Castle Street, Reading, Berkshire
Cable and Wireless 01-928 0261	83 Blackfriars Road, London SE1 8HQ
Cifer Systems Ltd, 0225-704502	Avro Way, Bowerhill, Melksham, Wiltshire SN12 6TP
Clary Ltd, 01-680 2222	12-14 Lower Addiscombe Road, Croydon, Surrey CR9 6AG
Comma Computers, 0277-811 131	West Horndon Ind Park, West Horndon, Essex CM13 3MJ
CPU Computers Ltd, 04862-73883	Copse Road, St. John's, Woking, Surrey GU21 6TP
Dacoll Engineering Services Ltd, 0438-4381/0506-56565	Gardners Lane, Bathgate, West Lothian
Datac Ltd, 061-941 236/2	Tudor Road, Broadheath, Altringham WA14 5TN
Data Design Techniques Ltd, 01-207 1717	12 Leeming Road, Borehamwood, Hertfordshire WD6 4DU
Data Dynamics, 01-848 9781	Data House, Springfield Road, Hayes, Middlesex
Data General Ltd, 01-572 7455	3rd and 4th Floors, Hounslow House, 724-734 London Road, Hounslow, Middlesex TW3 1PD
Dataplus Ltd, 0242-30030/37373	39-49 Roman Road, Cheltenham GL51 8QQ
Davinci Computers Ltd, 01-952 0526	65 High Street, Edgware
Diablo Systems Ltd, 04862-71991	Regent House, 20 The Broadway, Woking, Surrey GU21 5AP
Electrographic AV Ltd, 01-573 1826	Printinghouse Lane, Hayes, Middlesex UB3 1AP
Extel, 01-739 2041	Engineering Division, The Exchange Telegraph Company Ltd, 73-75 Scrutton Street, London EC2 4TA
Facit Ltd, 0634-401721/7	Maidstone Road, Rochester, Kent

SHOPWINDOW

ZX80 SOFTWARE — Four listings for 1K. ZX80. Moonlander (graphics), Pontoon, Calendar, Maths-test. Send £2 to — P. Pickering, 56 Lennox Road, Todmorden, Lancs. OL14 8QD.

'Sharp' MZ80K. 24K RAM. New inc. Basic tape, manual, 55 progs, User Club membership and warranty. £450 o.n.o.' S. Fisher, 21 Balmoral., Adlington, Nr Chorley, Lancs.

UK101, fully built and tested, 5K RAM, Compukit Case, £210. Phone Deeside (0244) 810245.

TRS-80 Level I Software Space Attack, Earth Invaders, Rogue Invaders M/C. Biorhythm, 3 Dox, Drawstore, Stockmarket. All Programs on cassette with documentation £4.00 each/£15.00 all. A. D. Twigg, 25 Hick Close, Woodloes Park, Warwick CV34 5ND.

ASSEMBLED 2×80 adaptor and practical computing subscription to June 1981. £90 o.n.o. to Chris Forrest, 5 Castle Park, North Circular Road, Belfast BT15 5FF.

PET 8K OR., Expandamem, Toolkit £500. Computhink 400K Disks £600. Keyboard £50. Buy complete system, 250 programs FREE! Phone 01-894 7149/ 01-948 2847.

ZX80 BREAKOUT — One of the first genuine CONTINUOUS NON-FLICKER games for the ZX80. A simplified version of the famous computer game 'BREAKOUT'. With the paddle under your control, try to knock all bricks out of the wall before your final ball's lost. Written in machine code, a truly superb achievement for 1K memory using 4K ROM. Listing and details for only £4.00 inclusive or send S.A.E. for list of other ZX80 Specials to: K. Macdonald, 26 Spiers Close, Knowle, Solihull, B93 9ES.

CRICKET 1 — interactive cricket scoring program for 16K PET. Ball by ball or updating modes — easy error recovery. Prints scorecards and analyses. Cassette, Manual and listing £10. Send SAE for details and orders to: Sportsoft, Thatched Cottage, Crundale, Canterbury, Kent.

CHEAP ADD-ONS for Superboard/Compukit. SAE B. Mistry, 75 St. Margaret's Road, Bradford, W. Yorks.

S-100 IMSAI Mainframe, 8080 CPU,F/Panel (kit) £310 (split); N/Star disk controller/software (s/density) £140; SA400 drive (new) £180. Other items Telephone Crawley 515201.

PET 8K. Large keyboard. As new. £395. Manuals £5 each. Phone Fareham 45578.

IMPROVED MK14 Monitor: Alphanumeric keyboard, C.O.S., VDU routines. SAE: P. Trevellick, Queens College, Oxford.

CHEAP Printer — Fully reconditioned, Teletype KSR33 with RS232 interface £275. Receive only Teletype £100. Phone 01-894 3761.

NANOCOMPUTER. Plus Power Supply. Unused. £240 o.n.o. Tel: John Reid on Aylesbury 86500 (work Hours).

UK101 Owners Look! 48 × 32 characters. Send us your working UK101 for us to convert. £50 incl. p&p. M.P. Electronics, 33 Penton Lane, Minehead, Somerset.

EXPERIENCED Prof. Eng. interested in Dealerships; Sales, Hardware/Software Support, 30 miles radius Preston. Probable retail outlet. Tel: 0253 (866464).

TRANSAM Triton — Full 8K RAM and documentation. Hitachi tape, leads and programs. £250. Bewdley (0299) 403418.

PET 16K, New ROMS, Books, Mags. and £500 worth of Software. £900 o.n.o. Phone Oxford 93351 Ext. 215 between 2pm - 6am.

NEWBURY 7000 80×24 video (metal). Year old. As new £195. MPI 44T 132col 120cps printer cost £525 three months ago, practically unused £350. Ex-ICL teletype KSR newly serviced £50. New S-100 11 stot mainframe with 10amp psu, fan and drive mountings in dual pedestal desk £95. Brentwood 823378 evenings.

PET 2001-8K Soundbox, Programs. Used privately, £395. Phone Erith 31934.

WISH TO GO SHARP From S100. For Sale or Part Ex. 3×16K Static Boards — £130 Each. 1 × Expanda PET — £225 (24K Memory Add-on for PET). Phone W'ton (0902) 338964 After 7 p.m. or weekends.

SHOPWINDOW

SORCERER 32K Basic, development pac. Extra handbooks, much software. £620. Tel. Rugby 846220.

PET 3032 ... 32K, Computhink 800k drive, Printerm 879 Printer. Demonstration if required. £1900 complete or would split. T. Newman. Tel. Watford 24253.

TRS80 4K LEVEL II CPU For Sale, includes manuals, T-Bug, TV Modulator, Tapes etc. 6 months old, perfect. Offers over £275. 080428-654 Evenings (Devon).

IBM 731 Selectric Golfball Computer Terminal (reconditioned). Paper feed by adjustable width tractors or pressure. Ideal for high quality output. £250. Suffolk 0787 76785.

SUPERBOARD EPROM programmer £20. Light pen £10. For more information SAE. B Harat, 75 St. Margaret's Road, Bradford, W.Yorks.

NASCOM SOFTWARE!! Golf — Nightmare Park, Amazing Programs in Basic on cassette. Require 16K + NAS-GRA + NAS-SYS. £5.25 each to Simon Gillican, 9 Ely Road, Littleport, Ely CB6 1H6.

NASCOM 2. p.s.u., 32k, Graphics. Professionally built. Verocased, £450. 0245-441828 (Chelmsford).

BARGAIN! Action games for the 8K Pet. Dawn Patrol, X-Wing, Gaming Machine and Dam Busters supplied on one cassette for £12. N. Robinson, 49 Links Avenue, Felixstowe, Suffolk.

NASCOM 1 buffer board built not tested selling because upgrading to a II. Price £20. Tel. 0242 67 2742 after 6.00pm.

T.T.L. LOGIC Probe kit, find out how T.T.L. logic works!! £14.90p. R. Allen, Southview, Forncett End, Norwich. Tel. (095389) 420.

WANTED — teenage computer freak to get (and keep) our accounts (and anything else they can) on to our TRS 80 II. Keen, reliable, trustworthy person required. London W3. Phone 01-993-2111.

SWTPC 6800 SYSTEM comprising 6800 Processor with parallel and serial interface; SWT Bug; 40K Ram; CT64 terminal; AC30 Cassette interface; MF68 Twin mini floppy drive unit (170K); PR40 40 col printer. System may be seen operating. £1350. Phone Ware 2864 (Day) or Ware 870300 (evenings).

APPLE II plus 48k Disc and Controller many progs worth hundreds of pounds. £1050. Also Z-80 Softward £195. 01-450 5049.

GET LOST!! ... Super Multistorey 3D Maze, for 16K Pet, Video Genie. Up to 10 stacked, interconnected, 10 × 10 mazes, Superb Graphics. Bargain £5. K. Weatherburn, 15 Sharp Road, Huddersfield HD5 8SW.

IMSAI VDP80 64K memory £2,500 o.n.o. + VAT. Ideal for use in a small business. Tel. Norwich 617361.

NASCOM 2. 32k RAM, 8k Basic, 4k Leap in EPROM. 4k Toolkit. 2400 baud cassette interface. Keyboard case. Manuals, tapes and programs. £470. Tel. 0326 62207 evenings/weekends. Can deliver West Country and London.

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Son of Hexadecimal Kid

A parable in eight virtual pages by Richard Forsyth

Page 3 — page boy

The world has been utterly changed by the destruction of the System, which has been devastated by gigosis, a kind of computational catatonia which afflicts artificial — and sometimes natural — intelligences. Our human heroine Cleo has settled down at Sprocket's Hole with her cybernated sister Lambda — one of the few androids to survive the Great System Crash — to await the birth of the child she is expecting. Its father, now dead, was the Hexadecimal Kid, the rebel android more than anyone else responsible for the ruin of the System.

One of the most remarkable features of the demise of the System was how quickly things returned to normal — normal, that is, for human beings. Towns started re-appearing everywhere, like grass growing-up through an abandoned pavement. Soon, it was almost as though there had never been a System. An event as momentous and final as the extinction of the dinosaurs had left virtually no trace. Truly, the meek shall re-inherit the earth.

The resilience of the humans was astonishing in view of the fact that for 50 years, they had been little more than android fodder — raw material for the cybernation process. They had been herded like animals into cybernation camps, and their population had been culled from a peak of nearly 10,000 million worldwide to around 250 million.

The main source of their resilience was undoubtedly the spiritual strength they drew from the new, and fanatically un-systematic, religion that sprang up during their time of oppression.

To understand the Nullards we have to go back to the English nobleman who was their founder. He was Anthony Bonehead-China — or Tony Bony as he preferred to be called — the charismatic former viscount who renounced his peerage to become Minister of High Technology during the upheaval in Britain which later became known as the white-hot cultural revolution. This aristocratic tea-addict pioneered a great British invention which was exploited more successfully by other countries — the nil-day week.

That conquered unemployment at a stroke, but he was far from satisfied. He aspired to be a national leader but was impeded by certain primeval traditions concerning majority voting which clung to his party as relics of its inauspicious past.

So he set up his own sect, a quasi-religious brotherhood called NULL — the National Union of Latterday Luddites. It was a potent mixture of high technology and low cunning, a heady brew which caught the mood of the times because it aimed to restore declining human prestige in a world increasingly dominated by machines and cybernated androids.

He became an international figure, and it was when he arrived in California for a lecture tour that the movement really took off as a world religion. Hundreds of thousands swarmed to his meetings. There were chip-frying riots — though he advocated non-violence — there was looting in the streets and wild scenes of mass adulation.

At the height of his popularity he was assassinated, at an open-air rally in the Santa Clara Valley, by a crazed gunman who was found to be working for a splinter group of the Red Army Ensemble. His martyrdom was complete. The CIA, Cybernetic Integration Authority, was immediately suspected of complicity in his murder, and no-one believed their vehement denials.

From then on, the polarisation of society into Nullards — nicknamed Boneheads by their opponents — and the hard-core of dp experts who eventually became androids was irreversible.

With the growing power of the System, the Nullards were driven underground, but their cult flourished. Their faith was the inspiration behind the human rights movement, sustaining the hard-pressed biological partisans in their guerrilla campaigns after the great popular risings of the forties New Calendar, had been suppressed with bloody violence.

In the Nullard pantheon, two legendary figures stood out, only slightly below the revered Tony Bony. One was Igor Gigotski, whose mathematical theory of gigosis offered hope that the System could one day be beaten. The other was Abraham Synapse, Hex's father, who not only extended Gigotski's researches but also, when compelled to become an outlaw, played an active part in the fight to preserve natural life forms from the depradations of the System. Many myths were woven round his deeds in the persona of Dr Null — until it became hard to distinguish fact from fiction.

In the eight months between the destruction of the System and the birth of Cleo's child, many changes took place, of which the most significant was the establishment of Nullardy as a ruling theocracy. For Johnny McNull, the failed electronic whizz-kid turned goatherd who had long been a devout Nullard, it was the opportunity of a lifetime.

His curious speech impediment — which meant that he could only talk in archaic phrases that sounded like quotations from the Bible — was no longer laughed at. He left Sprocket's Hole to become an itinerant preacher — his true vocation — and a hugely respected one.

People flocked from miles around to hear him tell of the death throes of the System. He held audiences spellbound recounting Hex's incredible exploits and moralising weightily on their consequences. Indeed, McNull was mainly responsible for elevating Hex to the status of a minor folk hero in the role of a prodigal made good.

Cleo and Lambda stayed at Sprocket's Hole with the impassive, and at times inscrutable, Piltdown 2 to assist them. Despite Lambda's antipathy towards Bill Bootstrap, Cleo persuaded her sister that he could remain with them. Lambda assented essentially because he was no longer a threat.

He was a spent force, having never really recovered his wits after the Great Crash.

Cleo nursed him back to some semblance of health, but his high-level index had been corrupted. Now that there was no source of spare parts, his condition could never greatly improve. Pitiful indeed is the fate of the android who has had large chunks of brain tissue gouged out to make room for micro-electronic circuitry which no longer works.

Bootstrap doddered about harmlessly, giving a new meaning to the term absent-minded, his few bouts of lucidity cut painfully short by intermittent memory parity failures, amusing himself by scratching words whose import he no longer fully grasped like GOSUB and RETURN in the sand with a stick. He was lucky in as much as, unlike so

(continued on next page)

(continued from previous page)
many of his kind, he was still alive and kicking.

So their rustic existence took its tranquil course until the day that Cleo suddenly stopped in her tracks and called out: "Lambda. Quick. I think it's starting".

Now it so happened that on that very day McNull had strayed from his customary by-ways and was close at hand. He had been led in the direction of Sprocket's Hole by a strange sign which he had seen in the sky the night before. While lying on his back out in the open gazing up at the stars and pondering the infinite void, something had caught his eye.

At first, he took it for a comet, but it moved too fast. Soon it became clear that he was looking at a long stream of binary digits written in the night sky, as he presumed, by the hand of God himself to guide him towards some wonderous event.

What had in fact happened was that the star freighter Green Tangerine on its journey from Zargon 7 to Omega Solaris had strayed slightly from its course due to a rounding error in its navigational computer and was passing unusually close to the earth.

McNull had seen the jetstream of digits spewed out at nearly the velocity of light by the huge integer multipliers of its factorial drive motors which hurled it across space by calculating the factorial of factorial 10,000 in binary. All that night he followed the celestial trail, and by morning when it faded he was so near Sprocket's Hole that he decided to pay his friends there a visit.

As he rode up on his donkey he heard moans from one of the huts. Suspecting foul play — for he too had never trusted Bill Bootstrap — he dismounted and ran inside, just in time to witness the first breath of the last Synapse.

"Look", said Lambda proudly, relieved that nothing had gone wrong with the delivery. "It's a boy, a bonny bouncing boy". She held the little creature up for him to admire.

"And so mine eyes have seen it come to pass, even as it was encoded prophetically in the ancient storage media", replied McNull gnostically.

The baby started to howl.

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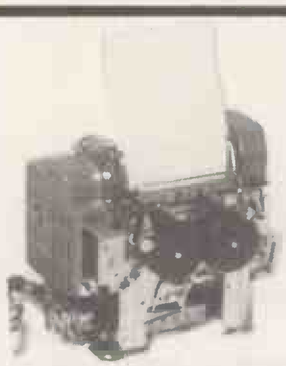

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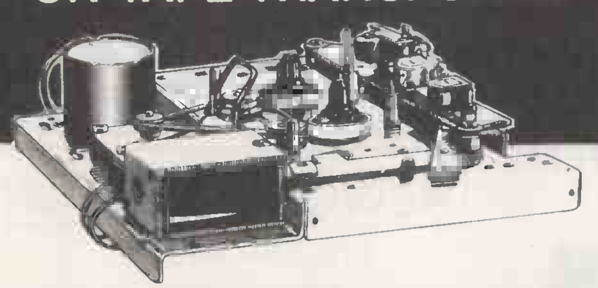

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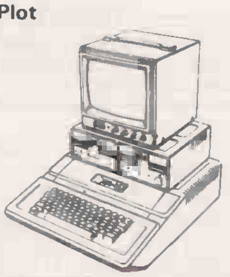

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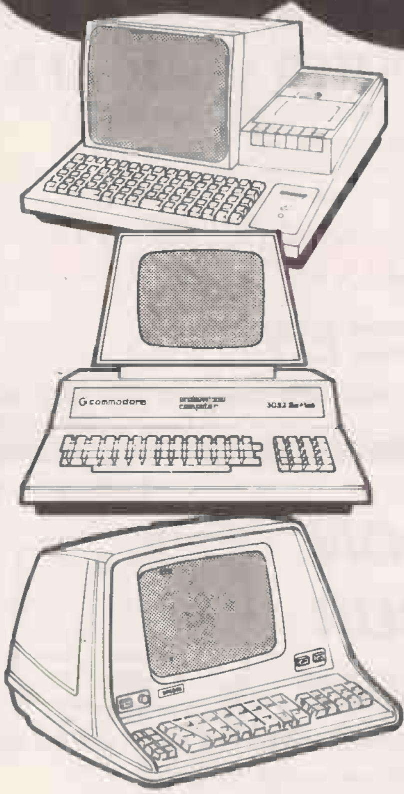

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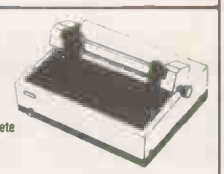

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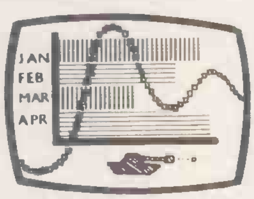

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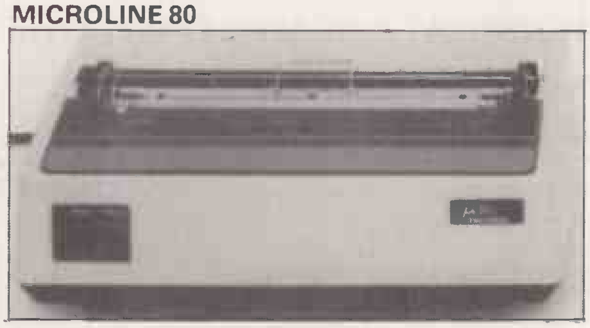

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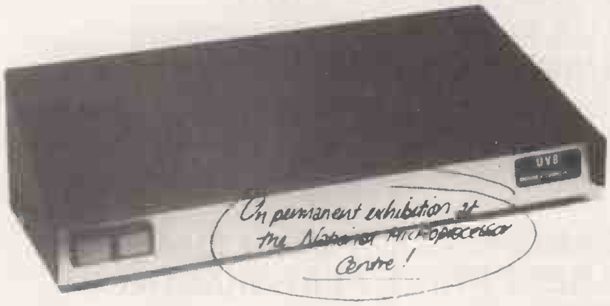

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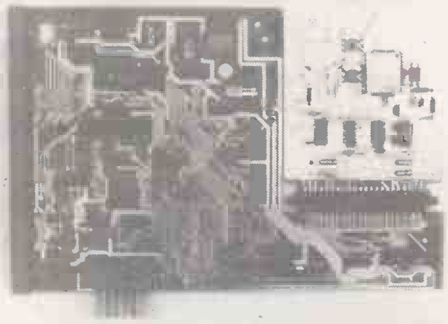

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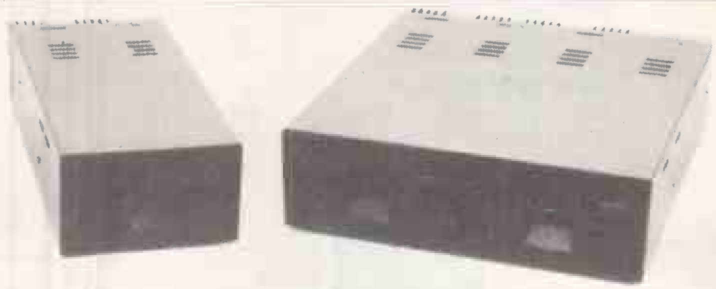

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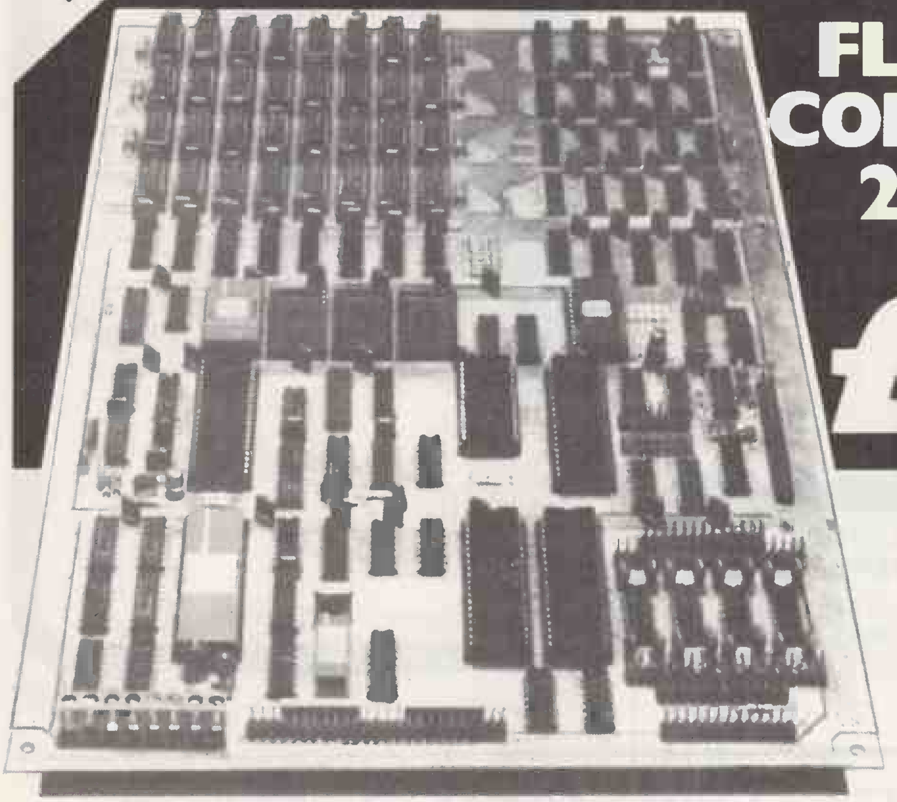

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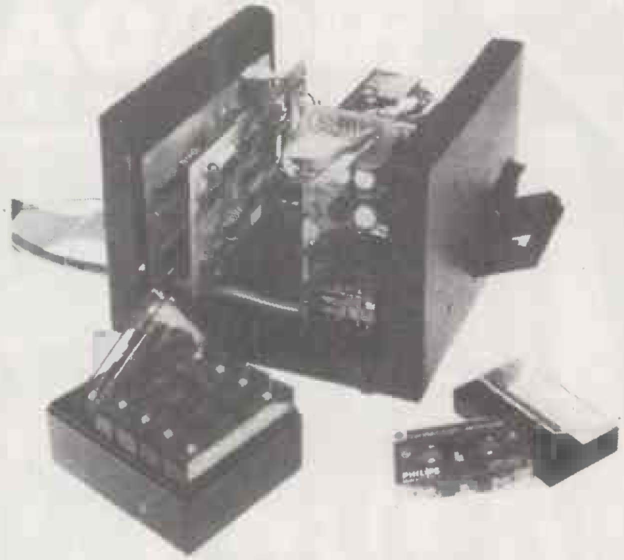

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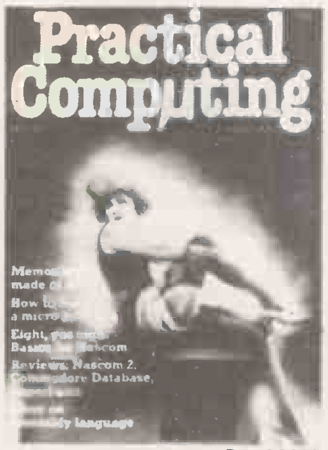

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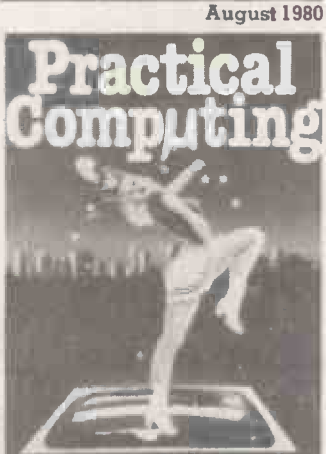

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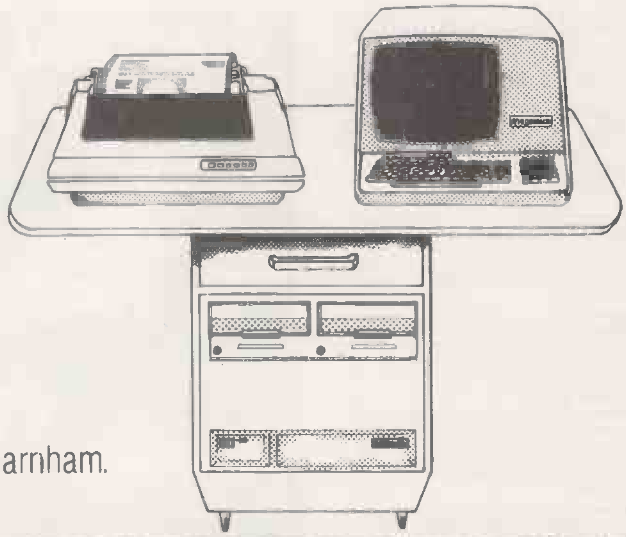

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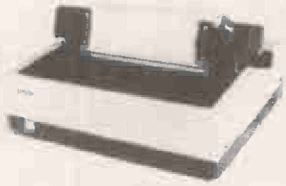

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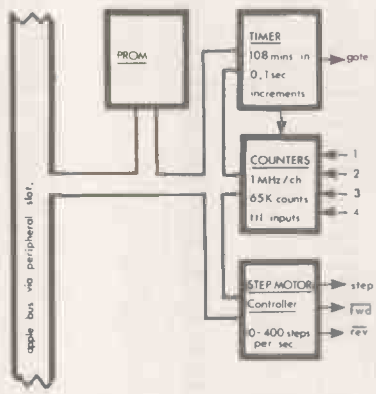

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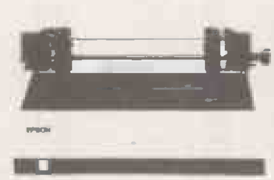

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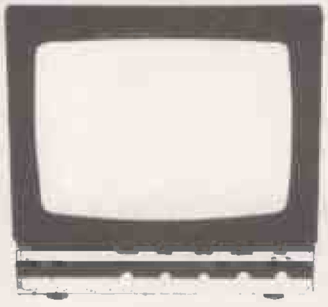

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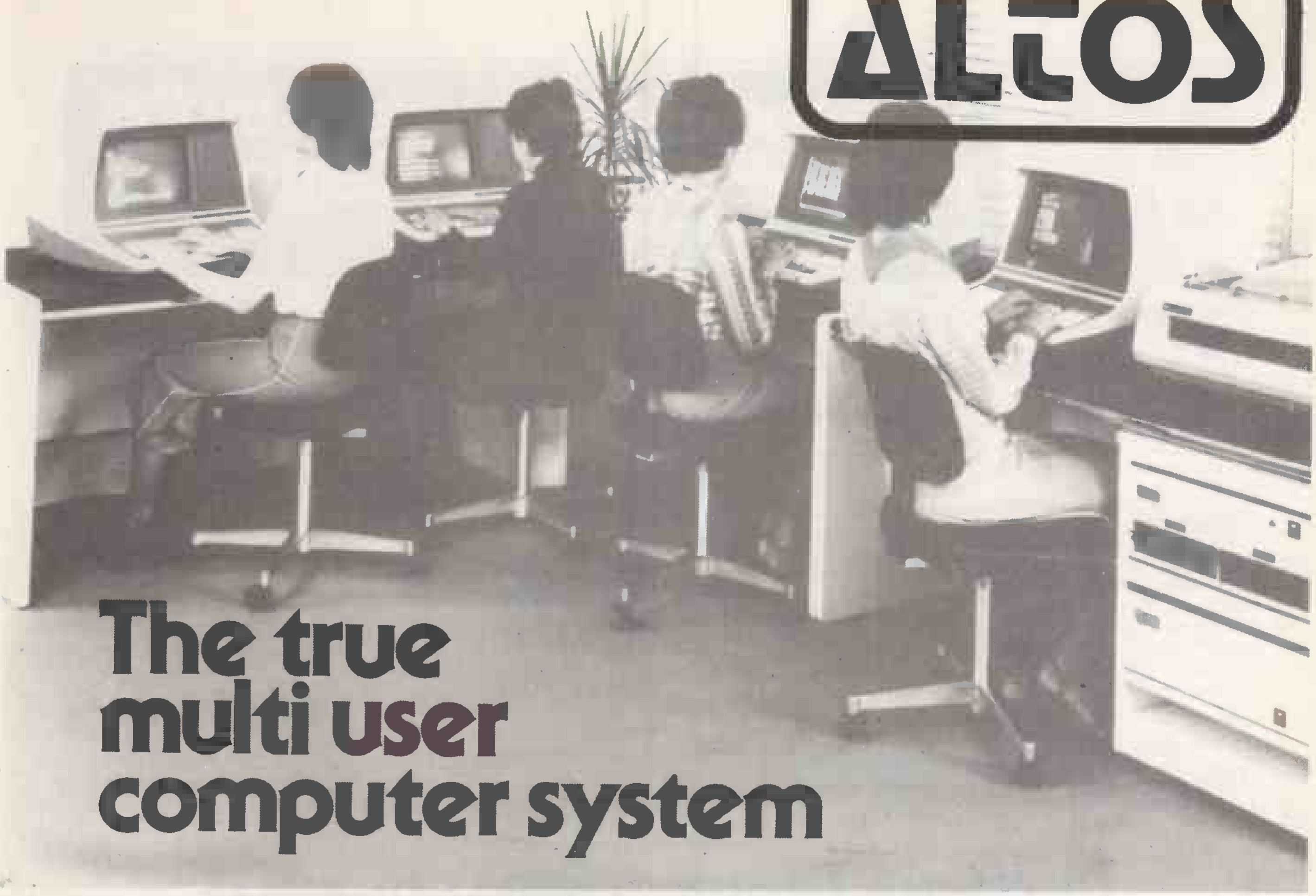

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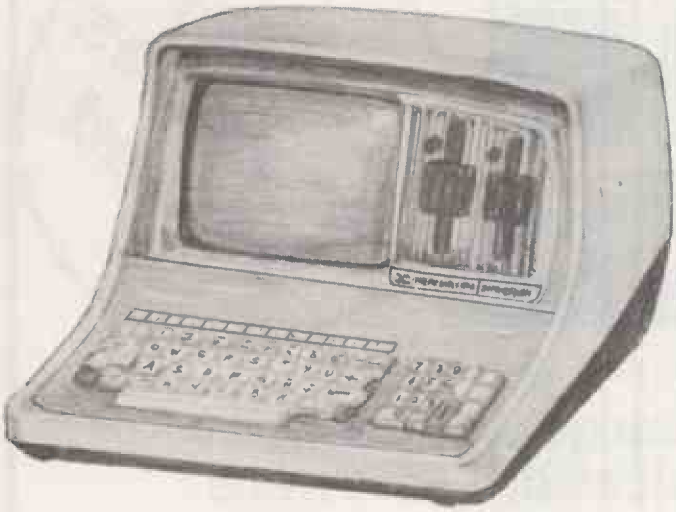

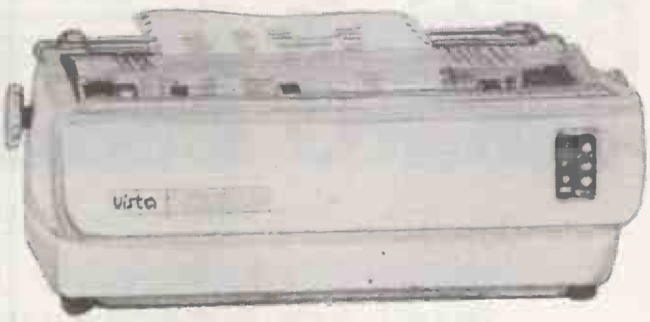

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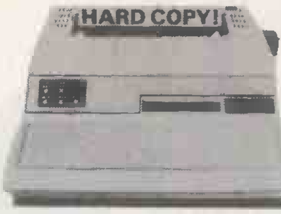

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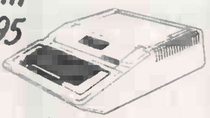

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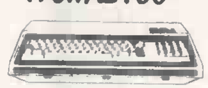

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2 year warranty. Price **£545 + VAT:**

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MODEL UV140 EPROM ERASER
Similar to model UV141 but without timer. Low price at **£61.50 + VAT, postage paid.**

MODEL UV141 EPROM ERASER
EX-STOCK

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- Safety interlocked to prevent eye and skin damage
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SOFTY Kit of parts **£100 + VAT**
SOFTY Built & tested **£120 + VAT**
SOFTY Built power supply **£20 + VAT**

P&P IS INCLUDED IN ALL PRICES
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SOFTY CONVERSION CARD
Enables SOFTY to program the single rail EPROMs, 2508/2758/2516/2532. Selection of device type and 1K block are by pcb slide switches. Programming socket is zero insertion force. Easy connection to SOFTY with the DEP Jumper supplied. Built and tested: **£40 + VAT**, postage paid.

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EX-STOCK EPROMS

	1-9	10-24	25 up
2716 (single rail)	9-00	8-00	7-35
2708	4-80	4-30	3-90

ADD VAT AT 15% — POSTAGE PAID

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Alive... well... and very healthy

As a Nascom user I had enormous satisfaction and sensed an excitement about the future when told that I had Nascom.

I have been determined from the start of the troubles that Nascom would be revived and with several colleagues formed an association with sufficient finance to purchase and expand the new company.

Being a customer I am only too well aware of the frustrations caused by Nascom's supply problems. The root of these was cash and, as we will not have that problem, I am very confident that Nascom International can progress quickly and professionally into a normal supply situation.

While immediately supporting our traditional marketplace we intend to expand the company rapidly into the manufacturing of industrial Nascom products. The design of certain products is already under way and the first of these will be a Prestel users receiver which will be available at the start of 1981. This is a separate, stand alone unit having no connection with previous Nascom products. We have several other projects under design or investigation that will give the new industrial division a good start next year.

We have the finance and facilities to exploit new ideas and would be very pleased to hear from any designer who has an idea based around Nascom products. Anyone with hardware or software please write to me at Pall Mall.

Nascom announced many products in the last year few of which arrived. Luckily during receivership many of these designs were completed and we will immediately be purchasing supplies to make these available a.s.a.p.

There are also other Nascom 2 products defined that we will quickly engineer and produce in the next few months.

The future for micros is undeniable and Nascom International intends to retain its rightful place at the head of European microcomputing.

Peter Mathews Chairman

Competition-best caption 1.

To allow the frustrated to vent their ire and the imaginative to vent their flair we invite your captions to the four cartoons that appear this month. A prize for each and the winners published. You can't win if you are too rude as we can't publish. Send to Chesham marked "Cartoon".

New Start With 20,000 users and a good deal of frustration and uncertainty mixed into the enthusiasm we invite everyone to write with their ideas and needs. The new home division will not be able to answer all the letters but policy decisions on direction can best be made on research into user needs.

Dealers We intend to continue the policy of sales through dealers and Nascom International will not be selling products direct to the public. Stocks we know are depleted and we would ask you to allow us time to restock our dealer network.

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new company... new people... new start...

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Five S100 boards on one single board—just for starters. Plus five extra slots for future expansion.

What a combination! Z80 and S100 with the TRANSAM total package of system and applications software.

THE PRICE RANGE

From £235 for complete main board kit to £1481 for 48K assembled with 2 × 5¼ drives.

THE HARDWARE

The first Z80 single board computer with integral S100 expansion. British designed to the new IEEE (8 BIT) S100 specification, the TUSCAN offers total system flexibility. A flexibility available now.

The board holds the equivalent of a Z80 cpu card, 8k ram, 8k rom video and I/O cards with 5 spare S100 expansion slots and offers a price/performance ratio which is hard to beat.

Just compare our price with a commercial S100 ten slot motherboard with this specification.

THE SOFTWARE

TUSCAN offers the user the choice of system monitor, editor, resident 8k basic, resident Pascal compiler or full CP/M disk operating system. All options are upwards compatible and fully supported with applications software. Both 5¼" and 8" drives are supported in double density.

THE PACKAGE

TUSCAN is available in kit form or assembled. With several hardware and software options to suit your requirements and budget. Attractive desk top case also available holds 2 x 5¼" Drives.

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I am interested in the TUSCAN Z80 based single board computer
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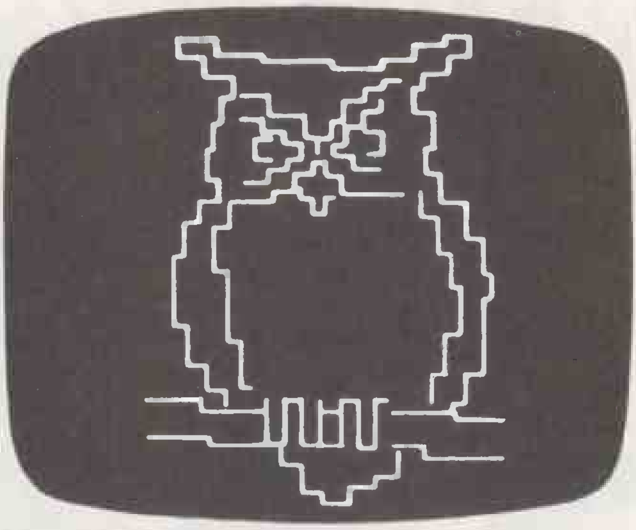

You lucky Apple II owners– by adding appletel you can have the only PO approved computer connection

With Appletel you can link your present Apple II computer direct to Prestel for just £595 plus VAT - which is a major cost saving for a start. Add in these other major advantages and you'll really appreciate what the complete Owl Computer package can do for you!

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★ Write your own BASIC programs to process Prestel data as well as send commands to Prestel.

★ The full keyboard means you can use Prestel to maximum advantage for sending messages.

★ **Appletel is now available in colour**

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You can now buy the entire range of Tandon Magnetics high quality, market leading, mini flexible disc drives direct from the exclusive U.K. Distributor.

Tandon drives are available as either the OEM product or as complete packaged units in single or dual drive British manufactured cabinets with high reliability power supply. Complete pre-test and burn in ensures reliability and all drives carry a full 6 months parts and labour warranty.

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BOXED DRIVE PRICES

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Single Sided 40 track	£250.00	£430.00
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So reliable we give you 365 days warranty.
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125 cps. 70 lines/minute.
96 characters, upper/lower case.
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Interface cables for Apple, TRS-80 etc.

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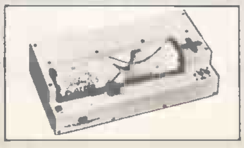

The Strobe drum plotter uses low cost colour pens to draw graphs, charts and pictures with .004" resolution.

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Interfaces and software for TRS-80, Apple, PET, Horizon, S-100 on 5" and 8" diskettes.

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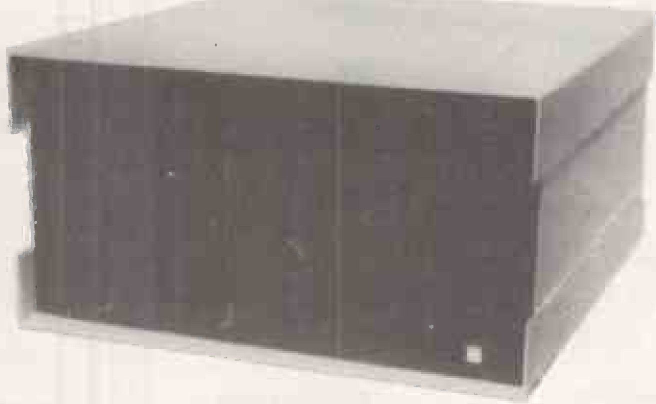
MIDAS S.100 SYSTEMS



MIDAS 1: From £750
MIDAS 2: From £1580
MIDAS 3: From £2150
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ITHACA-DPS 1: From £1075

- Our versatile Z80 Microcomputers are available as standard units or custom configured to your exact specification from a comprehensive range of stocked S100 boards.
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- MIDAS runs CP/M and MP/M is also available. Other Software includes M-BASIC, C-BASIC, FORTRAN, COBOL, CIS-COBOL, PASCAL and Word Processing.
- **A MIDAS 3, with 64K RAM and 2M Bytes storage on two 8" drives with two Serial I/O Ports and CP/M 2 only £2600.**
- Printers, VDUs and other peripherals stocked to give complete package systems at keen prices.
- Business Packages include Accounts, Stock Control, Purchase Ledger etc etc.
- OEM and Dealer enquiries welcome.

Boards stocked from Ithaca, Godbout, SSM, S D Systems, Vector, Micromation, Mullen, Mountain Hardware, Hi-Tech, Video Vector, Pickles & Trout, Central Data, Cromemco, Thinker Toys — Send for full Price List (many available in kit form).

Processor		
Z80 Starter Kit		**£188**
SBC100		**£208**
SBC200		**£237**
Z80 CPU 4 MHz	from	**£130**
EPROM		
2708 EPROM (16K)		**£60**
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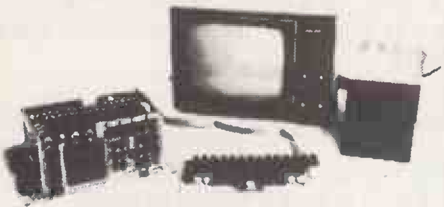
From Newtronics

THE NEW EXPLORER/85 SYSTEM

EXPLORER/85 PROFESSIONAL COMPUTER KIT



NOW AVAILABLE with 8" Floppy Disc System. An inexpensive 8085S Based S-100 Computer system designed for maximum flexibility.

An inexpensive 8085, S100 Based Computer System designed for maximum flexibility Now available with 8" Floppies

The EXPLORER/85 offers you real design flexibility — you can build the exact system you require. EXPLORER/85 can be your Beginners System, OEM Controller or IBM formatted 8" Disc System. You don't buy more than you need. Prices start from £85.

Here's the line up:

Intel 8085 microprocessor. 8355 as a really powerful 2K Monitor system. 8155 RAM I/O all on one single Mother board with room for RAM/ROM/PROM/EPROM and two S-100 pads (expands to six), plus plenty of prototype space.

The 8085 is 100% compatible with the 8080 but 50% faster. The 8355 ROM 2K monitor system includes cassette interface with tape control. Two 8-bit programmable I/O ports, automatic baud rate selection, labelling of cassette files, etc. 8155 RAM I/O features ¼K 'scratch pad'. Two programmable 8-bit and One programmable 6-bit I/O ports plus progammable 14-bit binary counter-timer. Plus many other features which cannot be included due to lack of space.

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Compare these prices carefully and you'll find you are actually getting more for your money.

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★LSI Controller ★Write protect ★Single or Double density ★Capacity 400K Bytes (SD) 800K Bytes (DD) unformatted ★Access time 25ns. Price £350.

DISC CONTROLLER I/O BOARD
Controls up to 4 Drives ★1771 ALSI (SD) floppy disc controller ★On board data separator (IBM compatible) ★**2716 PROM socket included for use in custom applications** ★On board crystal controlled ★On board I/O baud rate ★Two serial I/O ports ★Autoboot to disc system when system reset ★Generators to 9600 baud ★Double-sided PC board (glass epoxy). Price £150.

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De Luxe steel cabinet to house single drive with power supply unit to ensure maximum reliability and stability. Price £79.

DRIVE CABLE SET-UP FOR TWO DRIVES
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SAVE £30 by purchasing complete single drive system. One 8" drive, F.D.C. board, cabinet/PS.U. and cables. Regular price £598. Special price £568.
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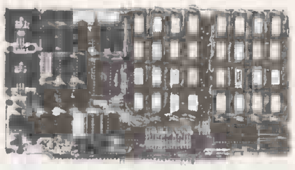
64K 'JAWS' S100 DYNAMIC RAM BOARD



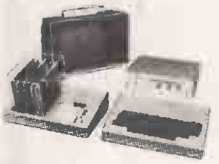
Newtronics solves the problems of Dynamic RAM with a state-of-the-Art chip from Intel that does it all. Intel's 8202 64K dynamic RAM controller eliminates high logic pans . . . delay lines . . . massive heat sinks . . . unreliable trick circuits.

We offer you — Hidden refresh . . . fast performance . . . lower power consumption . . . latched data outputs . . . 200ns 4116 RAM's . . . on board crystal . . . 8K bank selectable . . . fully socketed . . . solder mask on both side of the board

Designed for 8080, 8085 and Z80 bus signals . . . works in Explorer/85, Tuscan, Horizon, Sol, as well as all other well-designed S100 computers.

16K kits	£149	Wired and tested	£169
32K kits	£194	Wired and tested	£214
48K kits	£239	Wired and tested	£259
64K kits	£284	Wired and tested	£304
16K expansion kits	£45		

ELF II



SPECIFICATION
'RCA 1802 8-bit microprocessor with 256 byte RAM expandable to 64K bytes.
'RCA 1861 video IC to display program on TV screen via the RF Modulator Single Board with Professional hex keyboard — fully decoded to eliminate the waste of memory for keyboard decoding circuits. Load, run and memory protect switches. 16 Registers. Interrupt, DMA and ALU. Stable crystal clock. Built-in power regulator 5-slot plug in expansion bus (less connectors).

STARTS AT £59.95

ELF II BOARD WITH VIDEO OUTPUT

FEATURING THE RCA COSMAC 1802 cpu
STOP reading about computers and get your "hands on" an ELF II and Tom Pitman's short course. ELF II demonstrates all the 91 commands which an RCA 1902 can execute, and the short course speedily instructs you how to use them.

ELF II's VIDEO OUTPUT makes it unique among computers selling at such a modest price. The expanded ELF II is perfect for engineers, business, industry, scientific and educational purposes.

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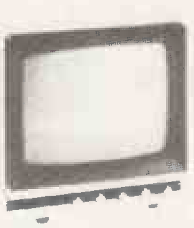
NOW AVAILABLE BASIC LEVEL III with R.P.N. Maths package. Both cassette and EPROM versions.



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DOUBLE SIDED, DOUBLE DENSITY. 5¼" DISCS CONTROLLER CARD (NAS BUS COMPATIBLE) PSU + CP/M. AVAILABLE MID. NOV. POA.

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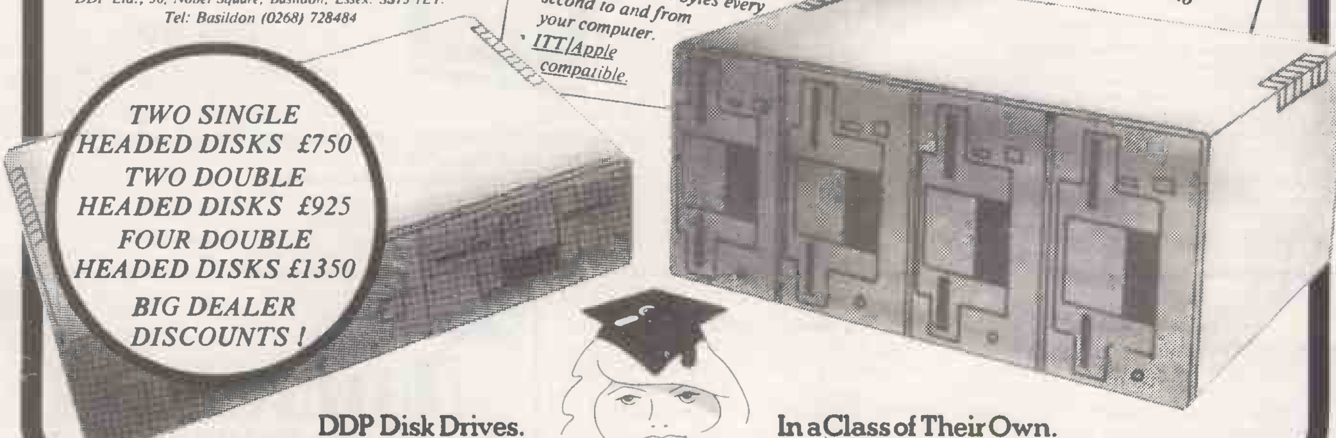

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BIG DEALER DISCOUNTS !

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From as little as £20 per week for your own business system with video screen, keyboard twin floppy disk unit and printer. Choose any of the software programs available i.e.:

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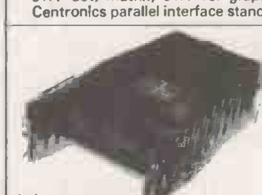

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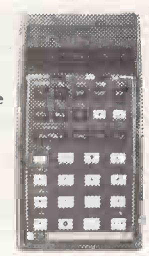

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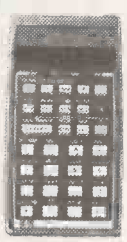

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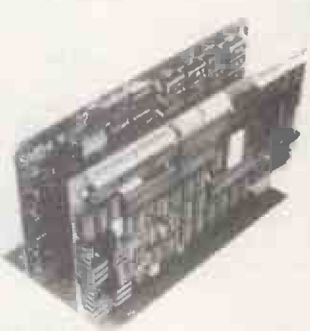

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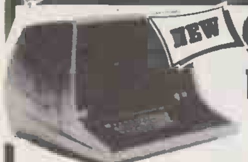

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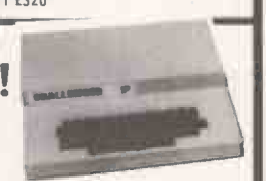

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- ETCHED NON-GLARE FACEPLATE
  Your operator will appreciate viewing characters through an etched non-glare faceplate. This feature assures crisp, sharp character resolution even in the brightest office environments. Further, the tilt screen feature allows an adjustable viewing angle, 10° to 15°, for optimal viewing comfort.
- ADVANCED VIDEO PACKAGE IS STANDARD
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  A 20mA current loop interface as well as an EIA RS232C interface.
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- Detachable Keyboard
- Smooth Scroll
- Tilt Screen (10° to 15° viewing angle)
- Large 7 × 9 Dot Matrix Characters

Perhaps the most distinctive feature of the VISUAL 200 is the Switchable Emulation capability. A switch on the rear panel programs the terminal for code-for-code emulation of a Hazeltine 1500, ADDS 520, Lear Siegler ADM-3A or DEC VT-52. To an O.E.M. customer it means no change in software to displace the older, less powerful terminals in his product line with the new, reliable and low cost VISUAL 200. To a Distributor it means offering a single modern terminal which is compatible with all the software his customers have written for the older terminals. And you're not limited to merely emulating these older terminals; you can outperform them at the same time by taking advantage of the additional features of the VISUAL 200.

Reliability designed into the VISUAL 200 is evidenced by its solid state keyboard, single P.C. Board and self test diagnostics on power up.

Seeing is believing, so see for yourself. For a demonstration and a pleasant surprise on quantity pricing of the powerful, easy to use and reliable VISUAL 200, call or write us today.

Standard Features

- 24 × 80 Screen Format
- 7 × 9 Dot Matrix
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- Blink Line
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- Set/Clear Tab
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- Clear End Line, Field & Page
- Clear Line
- Clear Screen
- Line Drawing
- Current Loop or RS-232 Interface
- Secondary Channel
- Composite Video
- Serial Copy Port
- Hold Screen
- Baud Rates to 19,200
- Self Test
- Cursor Addressing
- Cursor Control Keys
- Read Cursor Address
- Typamatic Keys
- Smooth Scroll
- Microprocessor
- Detachable Keyboard
- Solid State Keyboard
- Read Terminal Status
- Tilt Screen
- Switchable Emulations

• Circle No. 371

DATASOUTH DS180

HIGH SPEED MATRIX PRINTER

£1490 + VAT

The Datasouth DS180 is a dot-matrix serial impact printer designed for high performance at an economical price. Application flexibility and a long list of standard features make the DS180 an ideal device for small business systems, distributed communications networks and intelligent terminals.

HIGH SPEED PRINTING

Utilizing 180 cps optimized bidirectional printing, the DS180 offers higher throughput than any printer in its class. Its 9-wire printhead produces highly legible 9x7 characters with decenders for lower case letters and true underlining. All 96 ASCII characters may be printed across a 132 column line at 10 characters per inch. Expanded characters (5 cpi) may be selected for highlighting portions of the text.

USER PROGRAMMABLE

The DS180 offers a large number of user programmable features, yet is easy to operate. A unique programming keypad with a non-volatile memory makes printer set-up quick and simple. Top of form, horizontal and vertical tabs, perforation skip-over and auto line feed are just a few of the features the user may select. Communications status may also be programmed and monitored using the indicator panel lights and LED display.

ATTRACTIVE DESIGN

Compact, desk-top packaging allows the DS180 to fit into almost any installation. Its noise dampening cover makes it suitable for use in a quiet office environment. The cartridge ribbon makes routine changes clean, fast and convenient.

MICROPROCESSOR ELECTRONICS

Through the use of state-of-the-art microprocessor electronics, reliability and maintainability have been greatly improved. The simple modular design of the DS180 provides easy access to all major components. A single printed circuit board contains both the power supply electronics and digital controller for the printer. A self-test feature and diagnostic display panel help the user verify proper operation of the unit and isolate problems should they occur.

COMMUNICATIONS

Interfaces on the DS180 include RS232 and 20mA current loop serial interfaces and a Centronics compatible parallel interface. Baud rates from 110-9600 and parity selection may be keyed in by the user for his specific application.

FORMS HANDLING

Adjustable tractors accomodate forms from 3-15 inches wide. A head-to-platen gap adjustment ensures optimum print quality on up to 6-part forms. Fanfold paper may be fed from the front or bottom of the DS180. A paper out sensor may be programmed to send a stop transmission character and sound an audible alarm.

QUALITY MANUFACTURING

Reliable performance is ensured by a stringent quality control program. Datasouth uses pretested, high reliability parts from leading manufacturers. Multiple tests are performed on sub-assemblies during each stage of production, with each completed unit undergoing a final 24 hour print test and burn-in. The DS180 carries a 90 day warranty on materials and workmanship.

• Circle No. 372

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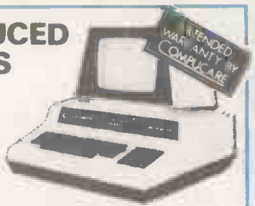
16K £499 + VAT
32K £599
RRP £795 for 32K



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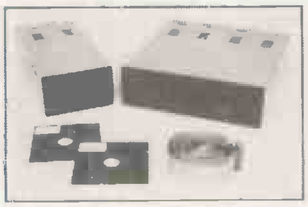

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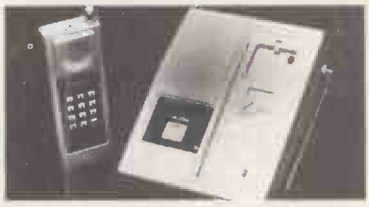

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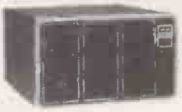
1 DISK EXPANSION Room for 3



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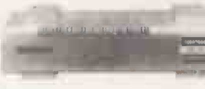

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