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YOUR COMPUTER

OCTOBER 1981

Vol.1 No.3

ZX programs tested

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Microtan 65

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Although primarily designed for the Sinclair ZX81, many of the cassettes are suitable for running on a Sinclair ZX80 – if fitted with a replacement 8K BASIC ROM.

Some of the more elaborate programs can be run only on a Sinclair ZX Personal Computer augmented by a 16K-byte add-on RAM pack.

This RAM pack and the replacement ROM are described below. And the description of each cassette makes it clear what hardware is required.

8K BASIC ROM

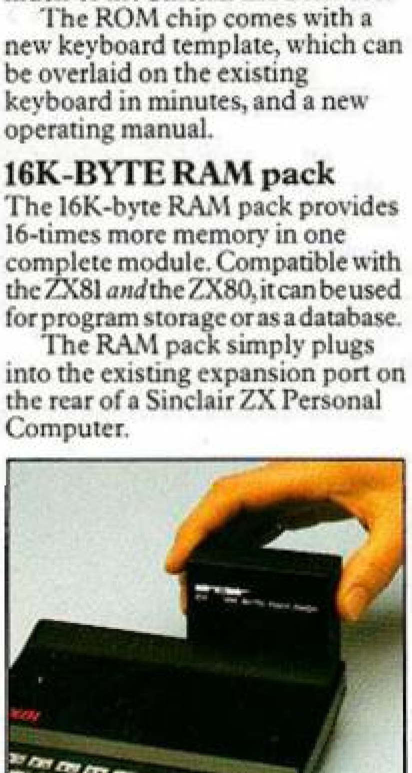
The 8K BASIC ROM used in the ZX81 is available to ZX80 owners as a drop-in replacement chip. With the exception of animated graphics, all the advanced features of the ZX81 are now available on a ZX80 – including the ability to run much of the Sinclair ZX Software.

The ROM chip comes with a new keyboard template, which can be overlaid on the existing keyboard in minutes, and a new operating manual.

16K-BYTE RAM pack

The 16K-byte RAM pack provides 16-times more memory in one complete module. Compatible with the ZX81 *and* the ZX80, it can be used for program storage or as a database.

The RAM pack simply plugs into the existing expansion port on the rear of a Sinclair ZX Personal Computer.



Cassette 1 – Games

For ZX81 (and ZX80 with 8K BASIC ROM)

ORBIT – your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

NOTE PAD – a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

BANK ACCOUNT – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

AVERAGES – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

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YOUR COMPUTER

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EDITORIAL

BUYING COMPUTERS mail-order is occasionally risky. That reassuring phrase "please allow 28 days for delivery" is no guarantee that the eager entrepreneur advertising the goods will make any special effort to deliver within 28 days.

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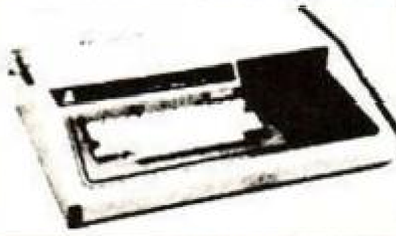

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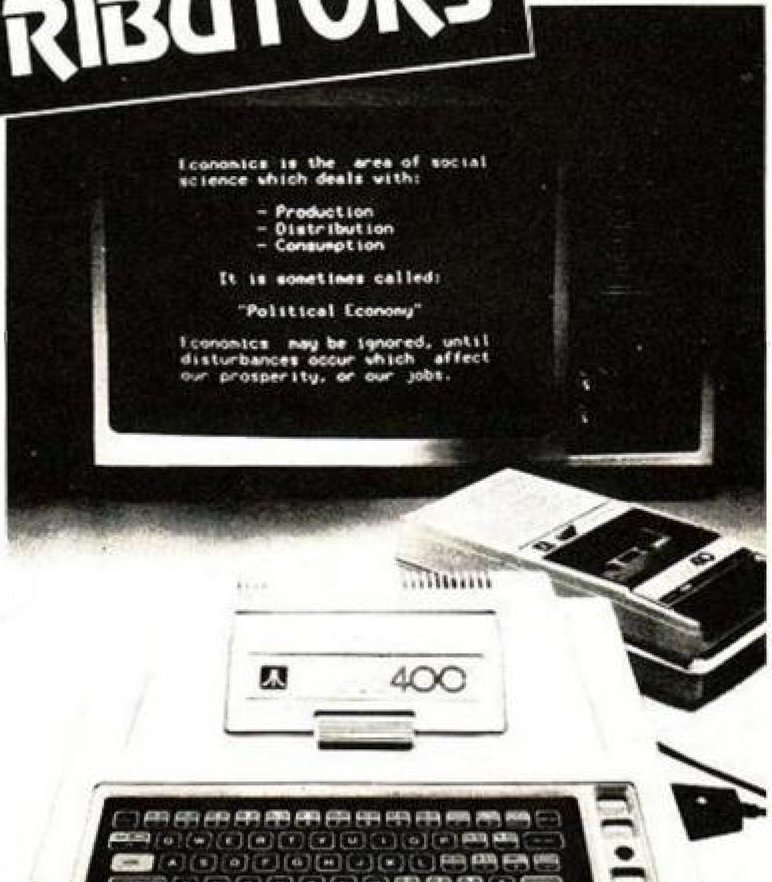

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YOUR LETTERS

RADIO CONTROLS

As micro users and radio-controlled model aircraft enthusiasts, we are a little concerned at the possible effect of your article "Beyond games into micro applications", in the August/September issue.

In the article reference is made to the use of an Acoms AP-435 35 MHz proportional radio-control system. In view of all the recent controversy relating to the 27 MHz band and the illegal use of citizens' band radio, representatives on behalf of model aircraft enthusiasts have been to great lengths to negotiate for an exclusive clean band for model aircraft use.

The Home Office has responded by allocating the 35 MHz band solely for this purpose. It would appear, therefore, that the implications and conclusions from your article are in direct contrast to the safe use of model aircraft on this newly acquired 35 MHz band.

Although we do not wish to discourage innovatory thinking in the use of microcomputer systems, it should be pointed out that if a system, developed as suggested by your article, were operating within range of a flying radio-controlled model, the results could be devastating.

The chances of this occurring are, we appreciate, quite low, but the risk will still exist. Bear in mind that the average model aircraft weighs between 5 and 10 pounds and can travel at speeds approaching 100mph. In an uncontrollable state, it becomes a potentially lethal projectile.

We feel, therefore, that any such practice of using 35 MHz radio control equipment for anything other than controlling model aircraft, should be strongly discouraged and that your readership be advised to this effect before considering computer-control projects involving telemetry.

P J Morrell,
A V O'Malley,
Stockport, Cheshire.

■Mr Morrell and Mr O'Malley confuse two ideas in order to make a point in their letter. The analogue input to the radio control transmitter mimics manual movement of the joystick and the signal radiating from the transmitter is entirely different to that from the citizens' band voice transmitter. At worst, the computer control transmitter could appear to be another aircraft control system in the neighbourhood. This is a common problem at the open locations where model aircraft are flown and its importance is reduced still further by the geographical separation between sites for flying model aircraft and the predominantly urban or sub-urban locations in which microcomputers are used.

Nevertheless, I agree that if a band has been allocated solely for model aircraft users, this should be respected. There are many excellent digital proportional radio control systems available operating on 27 MHz which would be preferable for the control applications described in the series.

John Dawson

CHESS CHALLENGE

I have several points to make about the two chess articles by John White in the August/September issue of *Your Computer*. I am an author of chess books and magazine articles and have an international rating of 2,250.

Before my criticisms of his review of chess machines, I should like to point out an error in the second article concerning the British Chess Federation grading system. The anomaly whereby you could, in theory, increase your rating by playing and losing many games against people much stronger than yourself has long ago been eliminated.

If Joe Bloggs, with a rating of 100, plays Grandmaster Tony Miles, with a rating of 240+, and loses every game, his rating for those games is his present rating. If by some chance he draws a game, his rating for that game is 150. If Miles has a brainstorm and loses, Bloggs gains 200 for that game, and Miles' rating for losing that game is not 50 — as John White implies — but 140 as the 50-point cut-off works in both directions.

In his conclusion, he says that: "Sargon 2.5 remains the strongest and fastest chess computer". He appears unaware that the Morphy cartridge he mentions in passing has been available since March this year from the Great Game Machine — along with an openings' cartridge to play the early phase of the game, and with an end-games' cartridge due for release soon — and is also available in stand-alone form as the Morphy Encore.

This computer, playing on its level 8, can make 40 moves in two hours and I estimate its rating at around 1,800 — 150 on the BCF scale. With the two extra cartridges, that rating may possibly reach 1,900.

Other strong and fast computers available shortly are the Chess Champion Mark V from Philidor Software and SciSys with a rating estimated around 1,900, the Champion Sensory Challenger, the Novag Savant and probably before long from West Germany, a new version of Mephisto.

Intelligent Chess is recommended by White but to be frank, it costs two or three times as much as other computers which play as well, it is bulky and hard to use without a TV set and it is slow — it starts to play well only on level six in my opinion.

Super System III is obsolete by now and the Sensory 8 Challenger and Challenger 7 are threatened because computers which play as well can be bought at a fraction of the price and by Christmas, there will be two or three at least for £80 or less with sensory boards or other aids to communication with the computer which will make the keying of moves a thing of the past.

T D Harding,
Firhouse, County Dublin.

■First, all the machines surveyed are still available, according to the latest catalogues, obsolescent or not. Harding seems to think that I know little of Morphy; I have owned one since the U.K. launch in March. I fail to understand why Harding brings in the Philidor program — Chess Champion or Mark V — or the Chess Champion Challenger or the others named. I made it clear that I was reviewing only machines I had tested myself and which were available commercially. These machines are still unavailable in the U.K.

Harding estimates the Morphy Level 8 rating as about 1,800. I flatly reject this assessment — I would say about 1,650. To turn to his other criticism, the cut-off rating which Harding mentions is, indeed, correct — an oversight on my part — but this does not affect the substance of the article. Harding must be aware of criticism in the chess magazines, to the effect that some players have stronger ratings than others because they avoid weaker players. My article was aimed to test this theory. I should be interested to know whether Harding himself plays in any of the British or Irish leagues, or whether he confines his games to strong tournaments.

John White

MACHINE CODE

On page 36 of the August/September issue, Trevor Sharples assumes that USR on the ZX-80 is the same as ZX-81 whereas Sinclair states that USR gives the resultant value in "HL", of n if it does not alter HL when using the ZX-80.

However, when using the ZX-81 the result of using USR is the value in the "bo" register pair. Thus the short routine to reduce 17000 to 16999 if carried out on the ZX-81 should be:

```
10 POKE 170000, 11      dec bo
20 POKE 17001, 201      ret
30 Print USR (17000)
```

As a beginner in machine code, I rely on magazines such as yours — which I find to be excellent apart from this error.

Peter Push,
Ramsgate, Kent.

■The routines listed in the August/September issue of *Your Computer* will not work on the ZX-81 because the ZX-81 USR function refers to the BC register rather than the HL register.

However, the following routines can be substituted for those given in the article so you can run them on your ZX-81.

DECREMENT BC BY ONE:

```
10   POKE 17250, 11
20   POKE 17251, 201
30   PRINT USR 17250
```

TEST FOR NO. OF AVAILABLE BYTES:

```
10   POKE 17250, 33
20   POKE 17251, 0
30   POKE 17252, 0
40   POKE 17253, 57
50   POKE 17254, 68
60   POKE 17255, 77
70   POKE 17256, 201
80   PRINT USR 17250-16366
```

HEX LOADER:

```
10   LET A = 17250
20   LET B = A
30   LET A$ =
     "21000039444DC9"
40   POKE A, 16*CODE A$ +
     CODE A$(2) - 476
50   LET A$ = A$(3 TO)
60   LET A = A + 1
70   IF A$ <> "" THEN
     GOTO 40
80   PRINT USR(B) - 16366
```

TO FIND THE ADDRESS OF ANY GIVEN POINT IN THE BASIC PROGRAM:

```
17300  21
17301  7B
17302  40
17303  3E
17304  08
17305  23
17306  BE
17307  28
17308  02
17309  20
17310  FA
17311  23
17312  3E
17313  09
17314  BE
17315  44
17316  4D
17317  C8
17318  20
17319  F1
```

Because line numbers are stored in a completely different manner in the ZX-80 and ZX-81, the line renumber program can be modified to run on a ZX-81.

Trevor Sharples ■

Database for Sharp MZ-80K

THE SHARP MZ-80K is a versatile and useful home computer. Not only does it make a good machine for playing games, but there is also a range of useful software available for the machine. One such item is a database designed to work with the MZ-80K cassette unit.

The database is a useful method of keeping records. In this particular case, the program allows the user to consider each record as a card in an index file. The program can accommodate up to 255 cards each of 10 lines.

Records are created containing one to 25 cards. The search, browse and print facilities are standard. A special report, say, a mailing list, can be printed. The data resides in the memory and is transferred to cassette for storage.

The possible uses for the database are legion — that is, there are many items which could be filed on such a system. For further details contact Jon Day of Newbear Computing Store Ltd, 40 Bartholomew Street, Newbury, Berkshire. Telephone: 0635 30505.

Latest computer chess games

ELECTRONIC chess-playing games are becoming increasingly popular these days. That is hardly surprising — it is the marriage of one of the oldest and most respected games to the newest technology which appeals to so many. Others just like to have an opponent who is available 24 hours a day.

Vulcan Electronics is a leading company in the marketing of chess-playing machines and has recently introduced three more machines into a range which now totals six. The machines are among the most advanced ever seen in the U.K. and are of British design. Manufactured by SciSys, the machines bear the emblem of FIDE, the world chess federation, showing that they are endorsed by that organisation.

The three new machines cover the spectrum from the hand-held Executive Chess up to the sophisticated Chess Champion Mark V. The machine most likely to be filling the stockings of businessmen this Christmas is the Executive Chess. Incorporating the state-of-the-art microprocessor technology, the machine features a LCD chessboard display.

Vulcan's Chess Champion Mark V — £249 projected retail price.

Electronic chess pieces move across the display by a cursor control system as if the pieces were real pieces on a real chessboard. There are eight levels of play from beginner to expert and the machine can be operated either from batteries or from the mains. It even plays against itself. Vulcan's Executive Chess costs £89.95 including VAT.

The other two chess machines are further upmarket and are very sophisticated. Chess Champion Mark V is claimed to be the "Rolls Royce of chess machines", and retails for £249. The Super System IV retails at £119, and has add-ons available: it is likely to appeal to a wide audience.

Vulcan Electronics is located at 45 South Street, Bishop's Stortford, Hertfordshire.

Hand-held NewBrain sold to Grundy

AFTER SPENDING more than two years trying to make the hand-held NewBrain computer work, Newbury Laboratories has sold it to Grundy Business Systems. The NewBrain was originally conceived by Clive Sinclair's company Sinclair Radionics and was passed to Newbury Laboratories during his involvement with the National Enterprise Board.

The sale was negotiated by the new British Technology Group — formed by the recent merger of the National Enterprise Board and the National Research and Development Corporation. The British Technology Group, which now owns Newbury Laboratories, is to invest £235,000 in Grundy Business Systems in return for a 30 percent shareholding.

When the plans for the NewBrain were first announced, it sounded both novel and competitive but the endless delays in its development mean that it has now lagged behind a new generation of personal computers. It is now almost certain that the NewBrain will never repay its development costs.

Criticism of the Government's involvement in new technology products and companies has been steadily mounting in recent months. There is a growing suspicion that the Whitehall involvement in any product is a guarantee not only of failure but also of a good deal of irretrievably-wasted public money.

Tory MP Michael Grylls has been trying to find out how much money has been spent by the Government on surveys of the market. Grylls suspects that effort and money have been wasted in four overlapping studies, but so far he has received only evasive replies to his questioning of the Department of Industry.

Utility ROM for Atom

A UTILITY ROM has just been released for the Acorn Atom. This adds new commands to the Atom, some of which can be used within Basic programs. The ROM plugs straight into the spare slot on the Atom; no hardware changes are required. The commands are available for use as soon as the machine is switched on and it will work with an unexpanded Atom.

The 17 commands allow Atom users to re-number programs, delete a range of statements, do a string search, line-number automatically, keyboard scan, zero all Basic variables, print all non-zero Basic variables, remove Rems and spaces from programs, give a short sound on each keystroke, print size of program, and a full-feature disassembler.

The utility ROM is supplied with a full instruction manual for an all inclusive price of £35. For further details, Willow Software, PO Box 6, Crediton, Devon EX17 1DL.

Acornsoft launches plug-in WP pack

ACORNSOFT — the software company dealing in programs for the Acorn Atom, seems to be very busy these days. The range of software developed by Acornsoft and that written by outsiders and approved is ever increasing.

Of the software to date the most important must be the Acornsoft Wordpack. The Wordpack is supplied in the form of a ROM, which is inserted into the spare socket on the Atom board. The pack provides a number of facilities which convert the humble Atom into a text editor or simple word processor. By connecting the Acorn GP-80 printer, a unsophisticated but effective word processor can be yours for around £300.

The price tag of the Atom word processor is enough to tell you that it has a limited application but, nevertheless, none of the Atom's features are lost by the addition of this ROM. The package is ideal for the preparation of leaflets, letters, booklets and documents. Text may be saved on cassette and printed in a number of formats. The Wordpack is complete with a manual giving full instructions.

The Wordpack costs around £30 and is available from Acornsoft. Other Acornsoft software packages for the Atom computer include games, mathematics and simple business software. A database program, Atom Forth Mathspacks 2 and 3, Peeko-processor and Games Pack 8 all cost £11.50. Acornsoft, 4a Market Hill, Cambridge. Telephone: 316039.

Interface produced for ZX-80/81

BOLTON Electronics has produced an interface unit for the Sinclair ZX-80 and 81 computers. It consists of a printed-circuit board which plugs on to the rear of the computer and provides eight TTL output lines and eight TTL input lines.

The state of the output lines can be set by a simple Poke command and the input lines are read by Peeks. The addition of suitable drivers, e.g., relays, allows the control of systems from model railways to central heating to disco lights.

The unit is priced at £15.90 plus £1.00 postage and packing. Bolton Electronics, 44 Newland Drive, Bolton, Lancashire. Telephone: Bolton 64772.

Prestel TVs go public

FORTY PUBLIC-access Prestel TV sets are to be placed for a year in places such as post offices, information and advice centres, shops and other places used by the public in Gateshead, Kingston-on-Thames and Brighton.

The ways in which the sets are used will be monitored and the results will be fed back to Prestel information providers. All the sets will be attended by staff whose job it is to give information to the public, so that people will see how to use Prestel effectively.

The experiment was devised by the Social Information Providers' Group which wants to encourage the use of social information on Prestel — about people's legal rights and so on.

The cost of the scheme has not been disclosed but the Department of Industry is providing £65,000 towards the project. Assuming that the Department has provided less than half the cost, this means that rather than installing 40 sets for a year the group could have bought more than 800 Prestel adaptors.

Microtan add-ons developed by Tangerine user group

THE TANGERINE users' group has developed a range of add-ons for the Microtan 65 system. The devices are all developed by members of the user group and are available to both members and non-members.

The first package to become available from the group is an EPROM programming package. The package is in the form of a kit and provides Tangerine users with an inexpensive alternative to those higher cost units already on the market. Another factor is that this programmer has been designed for Tangerine users by fellow users.

The kit provides the PCB together with construction notes, instructions on use and programming tips along with a powerful software program which allows automatic programming of the 2716 EPROM directly from the memory contents. The programmer requires three PP3 batteries to eliminate the need for a purpose-built power supply.

The price is £21 to non-members and £17 to members of the Tangerine users' group. Membership of the users' group can be doubly beneficial because the newsletter contains programs and routines which may be programmed into the EPROM for use.

The newsletter has been revamped with more pages and more information. The main reason for this has been the "thirst for information" which Tangerine fans seem to have.

The group hopes to soon become an information provider on British Telecom's Prestel system. There is a close affinity between Tangerine users and Prestel — largely due to the success of the Tantel adaptor.

Maplin, the electronics and hardware mail order company, is to take to the road. The Maplin Roadshow will feature the Atari personal computers, and customers will be able to gain hands-on experience with these machines and see the colour graphics for themselves. The show is completely free. Five cities are on the Maplin itinerary: Birmingham, Edinburgh, Manchester, Newcastle-upon-Tyne and Norwich. The venues chosen are all in the centre of the respective cities. Shows will last from 6pm until 10pm and all the family is welcome. For details of when the whole circus arrives in your town etc., telephone Maplin on 0702-554155.

The New University of Ulster has produced a special keyboard for the physically handicapped to be used in conjunction with the Acorn Atom. On the special keyboard, which has only eight large keys, two presses are used to select a character. When a key is pressed, its number appears at the top of the VDU, and when the second key is pressed the character is printed on a line below. Normal Edit facilities are retained, so mistakes can be easily corrected. The auxiliary and the normal keyboard can operate totally independently, and at all times — it is not a switched arrangement, thus giving maximum flexibility. The University has donated a unit to Fleming Fulton Special School, Belfast where it is very much in demand by students. The Acorn computer was donated by CEM Microcomputer Services and a printer was provided by the Lady Hoare Trust. The keyboard and program are being marketed by CEM, Belfast.

ZX-80/81 chess program

ANOTHER chess game for the ZX-80 and ZX-81 computers has been released. The company, Artic Computing, says that the program is written entirely in machine code, is 9K long and has six levels of difficulty. According to Artic: "It easily beats Z-Chess and annihilated Phillip Joy's chess program".

The program also allows the user to set positions on the board and then play from there. The pieces are represented graphically on a board which occupies most of the screen. The program is available for both the ZX-80 and ZX-81 for £10 from Artic Computing, 396 James Reckett Avenue, Hull, North Humberside HU8 0JA.

New viewdata adaptors

TANGERINE is still setting the pace in the Prestel market not only with sales of its Tantel adaptor, with which it claims to have captured 78 per cent of the market, but also with its new products. The company is now aiming to capture the personal computer/Prestel market as well by converting the Tantel adaptor so that it can interface with almost all popular personal computers.

This adaptor costs the same, £170, as the existing Tantel unit. One of the advantages of the adaptor is that it can convert a personal computer into a colour computer and might eventually replace many colour boards. Its other new product is an alphanumeric Tantel unit costing £200. Details from Tangerine, Telephone: Ely 3633.

BBC computer goes to ICL

ACORN, which makes the Atom computer and designed the new BBC computer, has announced that the BBC computers will be built by Cleartone of Gwent and ICL, the loss-making, Government-backed computer company.

The first 1,000 will be built by Cleartone and ICL will start production in early October. It will have produced 2,000 BBC computers by the end of the month. By November, the combined output from both companies will be 5,000 per month. A third assembly contract may be awarded for 1982.

It has been reported that ICL should make £250,000 on the first 5,000 units it makes, with Acorn supplying the components. If ICL makes the components for the next 7,000 computers the company would make £3.4 million.

Green Paper on copyright

ONE OF the problems with selling software for personal computers is that it is very difficult to stop other people making copies and selling it themselves. The law of copyright for software has always been confused.

In response to all the fuss about computer software privacy, the Government has after years of delay published a Green Paper discussion document inviting ideas from anyone and everyone on the best way to provide protection for computer programs. If you have ideas, write to the Patent Office, 25 Southampton Buildings, London WC2A 1AY.

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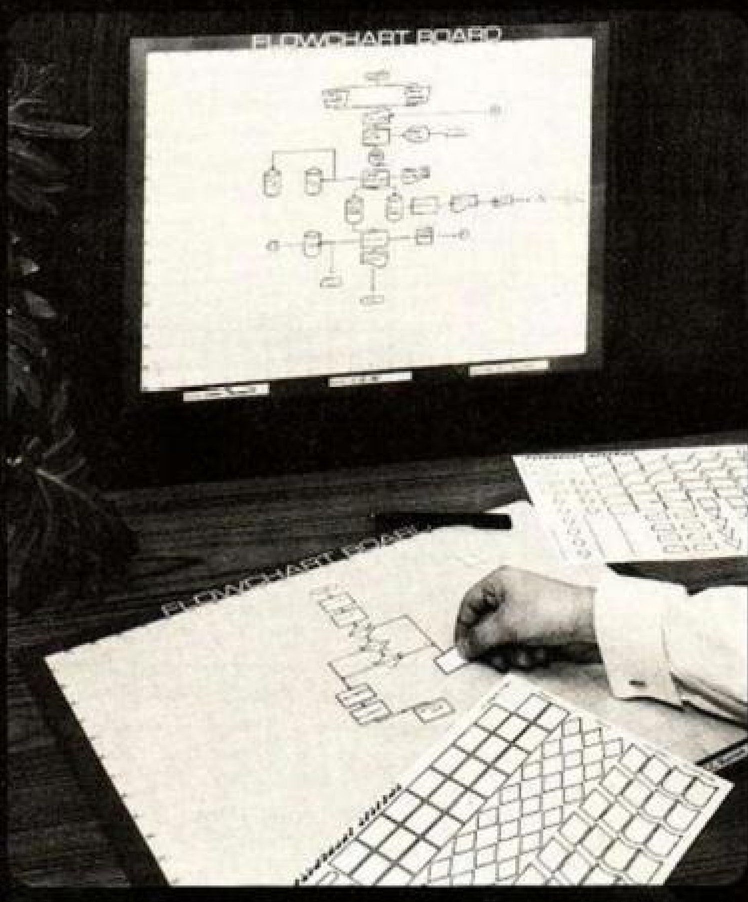

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Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. Each month we will devote the page to new ideas from local clubs. We would like to hear of anything which has made a club a success, or of any projects or programs you are developing.

Liverpool tries computers in youth centre

Liverpool is hardly famous for its computer clubs; in recent months it has been brought to our attention more as a centre of rioting and social deprivation. Our report this month is not on a Liverpool computer club as such, but on an interesting new experiment in community computing, writes Duncan Scot.

A COMPUTER SHOP and mail-order company in Liverpool, Microdigital, has decided, very generously, to give more than £5,000's worth of computer equipment to a local Liverpool charity called the Victoria Settlement. The Settlement is run on Manpower Services Commission, MSC, grants to offer some kind of retraining for unemployed school-leavers.

To date, the courses have included electrical fitting, plumbing, woodwork, brickwork and bricklaying, painting and decorating, refurbishing and printing. At any one time, there are about 200 people in the Settlement.

"Many people talk about the effects of the new technologies", says Settlement director Gordon Rudd: "I decided that we needed to work at minimising the damaged caused by new technology and to maximise the advantages and social benefits. I was worried that people here in Liverpool were going to miss the computer bandwagon.

"We have to react to the needs not being met by society", says Rudd, and so 18 months ago the Settlement bought its first Pet. One of the problems they have faced is that no-one at the Settlement had any experience of programming. When Rudd applied to the MSC for a grant to hire a programmer, to train the youngsters, he was told that "it would serve no functional purpose".

According to Rudd: "At the local level at least they were not interested".

The possibility that Microdigital would supply some computer equipment was first raised some months ago. The company was running down its computer-hire operation and decided that much of the equipment had become difficult to sell. Bruce Everiss, Microdigital's General Manager, approached Gordon Rudd and offered him the equipment.

It includes two ITT 2020s, four Video Genies, three Atoms, two 8K Pets, and two floppy disc drives for the ITT systems. As Gordon Rudd says: "Industry is often reluctant to get involved in a scheme like ours. Yet business can do a great deal for the community at no great expense to itself".

Bruce Everiss has also given the scheme a good deal of support by lending Rudd one of his technical staff and giving away a selection of computer books, programs and games. Only one of the supervisors at the Settlement has any experience on computers. Terry McDonnell qualified with an HND in computing in the summer of 1980 and after many months of fruitless job-hunting in Liverpool was recruited by the Settlement in March. He now plays a key part in running the computer room.

"At the moment the computers are regarded as extra-curriculum activity", says McDonnell. "There is give and take, though. The kids can be given permission to be released from one of their courses to do computing; they can arrange it with their supervisor".

The children are allowed to stay at the Settlement only for a year, so there is a constant turnover. Newcomers arrive every Wednesday and now that the computers have been installed, the newcomers are introduced to them on their first day.

"I bring them in, show them how to use and load programs and games", says McDonnell. "Mostly they write their name and address on the screen at first and then learn to use the delete and insert keys".

Few of the youngsters will have the time to become expert at using the systems — at the moment, the hope is that the short experience they can gain at the Settlement will encourage them to pursue their interest further outside — perhaps by trying for an HND course at one of the local colleges.

Gordon Rudd is now hoping that more local companies will become interested in the project and help with donations of equipment.

▲ *Terry McDonnell in the computer room demonstrating the use of the 8K Pet.*

◀ *Gordon Rudd, Victoria Settlement director, now plans to launch a community computing centre in Liverpool.*

They need to upgrade the Pets, floppy disc drives, books, television sets — some of the computers cannot be used yet because they have no television — and software.

Rudd's next plan is to take over the local Methodist Hall and convert it into a community computing centre. Anyone will be able to visit and discover for themselves that one does not need a degree in computer science to enjoy playing with computers.

If anyone would like to start a similar scheme elsewhere in the country, let Computer Club know and we will do what we can to help. We would also be extremely interested to hear from any community computer centres which are already up and running. ■

REVIEW

TANDY'S COLOUR COMP

The TRS-80 Colour Computer is Tandy's answer to the Commodore Vic-20. Tim Hartnell runs through its key features including its game-playing ability and its potential for expansion. Prices start at £349 for a basic system with 4K of memory.

THE MANUFACTURER of the Tandy Colour Computer has not, in my opinion, made any major design errors. The computer is housed in a standard alpha-numeric keyboard, about the size of the TRS-80, but slightly thicker. The only design problem I found was that a push-button switch at the back, which is an on/off switch, did not appear to turn off the internal transformer, so although the machine appeared to be turned off, the transformer continued to operate.

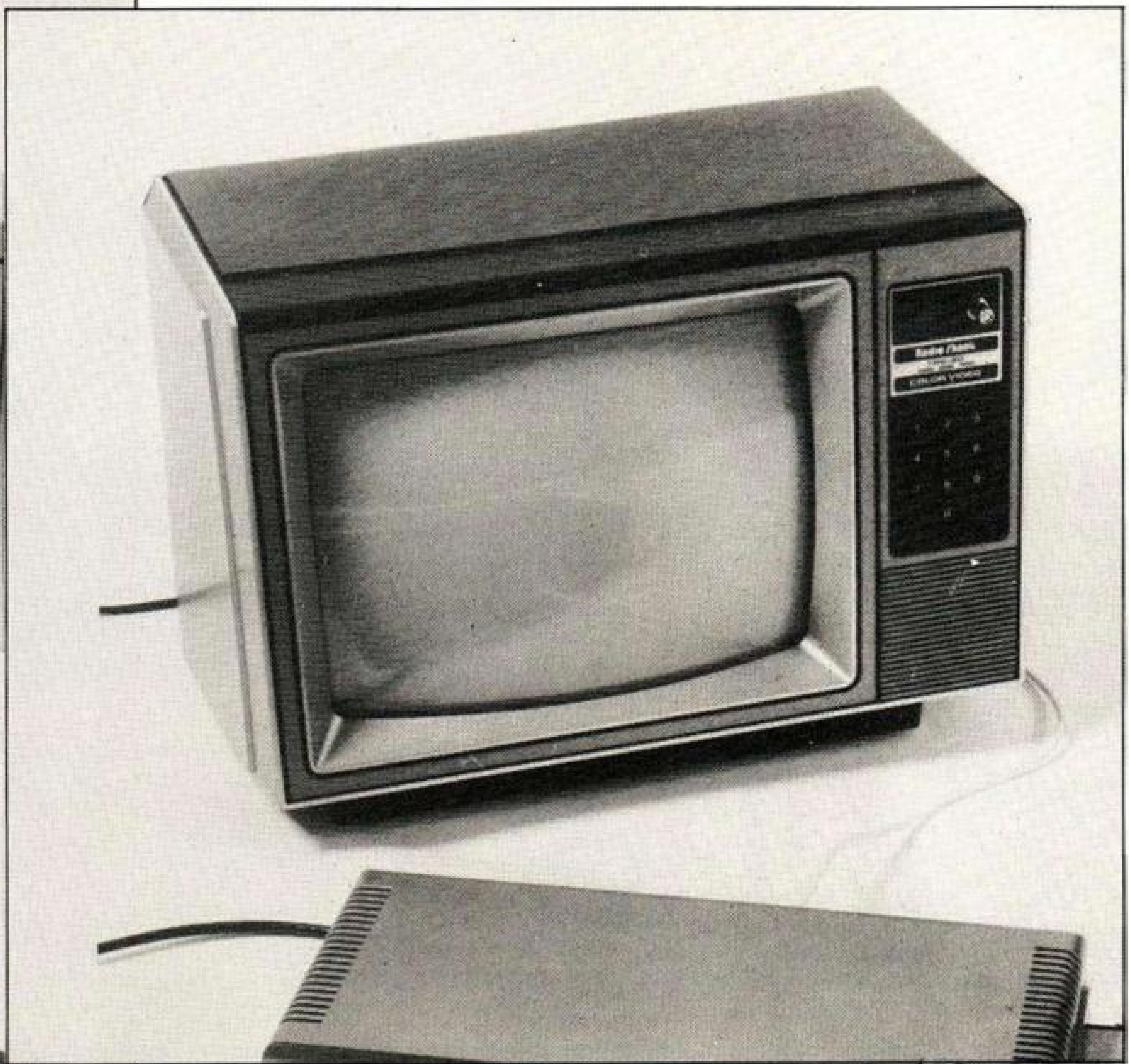
After a few hours of being "off", the computer grew very hot. This, coupled with the fact that it was impossible to tell if it was off or on without turning on the television display, meant the push button was, literally, a complete waste of energy — you still have to turn the computer off at the power point.

Apart from this, the computer was a joy to use. The keyboard is full-size, the Basic almost completely standard Microsoft and its only non-standard features were some very useful extra commands and statements.

An oblong cursor, which cycles through the eight available colours, appears when you turn the computer on. If you do not specify a colour-graphic mode, you obtain black letters on a pale-green background. The text on the screen is clear and easy to read. There are no graphical characters obtainable directly from the keyboard — you need to use CHR$n for them.

Although there are eight colours available — green, yellow, blue, red, buff, cyan, magenta and orange — only black on green is available when using text. The command CLS clears the screen to green for text, or if a graphic mode has been previously selected, CLSn clears to the colour specified by n.

If you do not want to use the colour immediately, and you have had some experience using other Basic computers, you will find you can probably use the Tandy Colour



UTER

Computer from the moment you first turn it on, without even referring to the manual.

The standard Basic supplied on the machine — the review machine had *Extended Colour Basic* — is such a common subset of Microsoft you should find you can use it without any problems at all — a very big plus for the machine.

The only slightly non-standard feature is the generation of random numbers. To obtain a random number in the range 1 to 10, for example, you enter RND(10) rather than the more usual

INT(RND*10) + 1

Tandy Colour Basic and Extended Colour Basic require the use of the word Then in an If statement, but do not need Let, as in

IF A = 6 THEN LET B = 7

the Let is not needed, whereas the Then is required. The extended Basic will allow the word Let to be in a listing, and will ignore it, while the standard Basic will hang up on the word.

I predict that Tandy will find a ready market among the ex-ZX-80 fraternity, because the standard Basic is almost exactly the same as ZX-80 Basic. Apart, that is, from the character set; Tandy uses ASCII, Sinclair uses its own. The vast majority of ZX-80 programs I tried — except those using screen Peeking and Poking — worked perfectly, when entered without modification on the Tandy.

A simple arithmetic modification allowed even many Peek/Poke programs to run. The address in the first line of a program after the word Rem on the Tandy is 7686, on the ZX-80 it is 16427.

It is in the special features of the Tandy extended Basic that the computer really moves into its own. Here are a few of the unusual commands and functions available:

Audio: This connects or disconnects the cassette output to the TV speaker.

Circle: Draws a circle at a specified location, of specified radius and colour, with a height/width ratio of your choice — so ellipses can be plotted. All the required information can be entered in a single program line.

Color: Sets foreground and background colour.

Defuser: This command defines the entry point for the USR function.

Draw: This draws a line beginning at a specified starting point, of specified length and colour. As with circle, all the information is entered as a single line.

Joystr: A splendid command, it functions somewhat like an Inkey$ command, returning the horizontal or vertical co-ordinates of the left or right joystick.

Paint: Another useful command which fills an area from a specified point with a chosen colour, and stops at a border of a specified colour.

Play: This triggers the sound output, heard through the TV speaker, and plays music of a specified note, A to G over five octaves. The note duration and volume can be set with the same line. The music played is held in a string.

Pos: Returns current cursor position.

Renum: An apparently instantaneous re-number function, used in the direct mode, which also re-numbers Gotos and Gosubs.

Timer: Cycles from zero, or from a number specified, to 65535.

This is a selection of some of the most interesting commands available in the Extended Colour Basic. As you can see, it is highly flexible. You can also program and output in decimal, hexadecimal or octal without any problems. There is also a

PRINT AT (PRINT @)

function, plus Set and Re-set — called ambiguously PSet and Preset. They make dramatic graphic displays relatively easy to achieve.

(continued from previous page)

The only real complaint I have about the Basic is the Edit function. I was unable to understand the instructions in the manual for using Edit — there seem to be about four different procedures which have to be followed, depending on what and where you wish to edit. So I was reduced to re-typing lines whenever I wanted to change them.

I also feel brickbats should be awarded to the supplied software. You can save and load your own programs through the DIN-jack at the back of the computer, but can use commercial software supplied as firmware, plug-in cartridges. The general standard of the supplied software was very low.

The space attack game Quasar Commander and Pinball use PSet and Preset and were apparently written in Basic, so they were slow, jerky and unimpressive. The Football program is incomprehensible without a detailed knowledge of Grid-Iron. Music is a reasonably impressive machine-code program, but entering a melody was slow and laborious, although it played well once entered.

The three most interesting games included Dinowars, which features two dinosaurs moving in three dimensions — that is, towards and away from the players, as well as right to left on the screen. There was a most impressive death howl when one of the beasts was injured.

Backgammon had good graphics and a rapid response, but I could not help feeling the computer was cheating, throwing itself good dice. When I confided this feeling to the distributor of the Tandy, he said he had had the same impression.

Checkers has eight levels of play, an auto-play facility and good graphics. As I have long been interested in computer draughts and have studied many of the game algorithms, I was impressed to be beaten by this Checkers program on level four. My pride would not let me attempt a complete game at level eight.

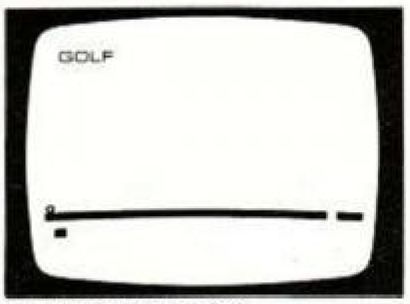
The colour was bright and vivid from the review computer, although the one supplied was of U.S. origin, running off 110 volts and producing a picture on an American TV. I will be most interested to see if the colours are as well-defined and intense on a U.K. set.

The colours are relatively easy to access from the keyboard, although they are a rather unusual selection. You are never quite sure, as the manual frankly points out, exactly which colour will be produced. Despite this, I managed to produce some splended, high-resolution designs with short programs. ■

CONCLUSIONS

- Although it is a splendid computer which I found almost impossible to crash, with a good range of standard Basic functions and an imaginative set of additional features, it could well be overshadowed by the Vic, simply because Commodore started to market the Vic aggressively long before it was available here, and may well have better back-up in terms of software, literature and dealer distribution.
- I would think, however, that the Tandy Colour Computer, which has proved very popular in the U.S., should be considered very carefully — especially if you are more interested in writing your own programs than buying commercial software.
- Although the colours are easier to access than are the Vic's, there are fewer of them and they are slightly less predictable.
- There are a number of useful commands to make using machine-code simple on the Tandy, including Cloadm which loads a machine-language program from the cassette; Defuser; Dload which loads a machine-language program at a choice of baud rates, 300 or 1,200; and Exec, which transfers control to machine-language programs at a specified address.
- Also, you can work in decimal, octal or hexadecimal as you choose — or even mix them.
- In short, I feel the Tandy Colour Computer is a flexible and impressive machine which, despite having limited Edit facilities and an unconventional colour system, features a good range of extended Basic commands.
- The close similarity between the Tandy standard Basic and ZX-80 Basic may well make it an attractive next computer for Sinclair users who outgrow their first machine.

What would I do with a computer?



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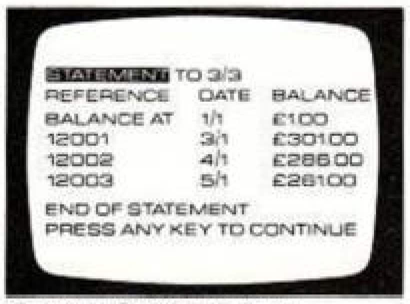

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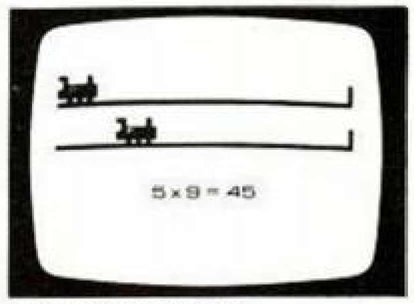
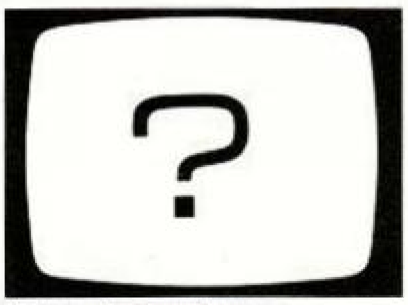


*Teach the children multiplication and play trains at the same time.



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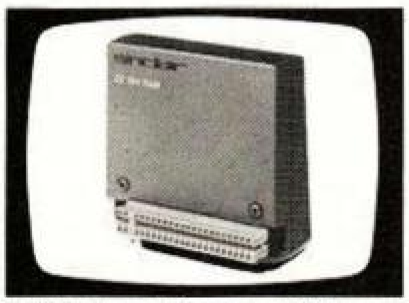

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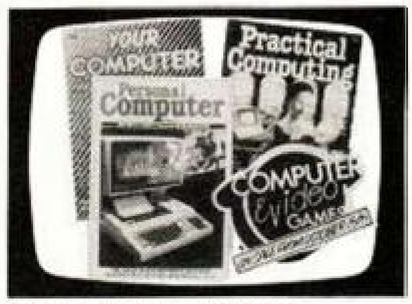

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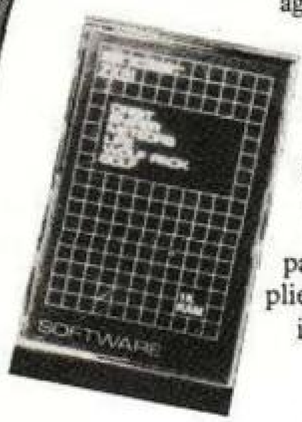
Varied standards in ZX

The ZX range of computers is, arguably, the world's most popular. But not all the software for the ZX computers is of the highest standard. In this article Eric Deeson takes a sample of ZX programs on sale and devises his own methods for rating their quality.



ONE EFFECT of the vast number of Sinclair micros in Britain has been the rapid appearance of a remarkable range of software, user groups and publications. In each case, the market leaders have been enthusiastic amateurs operating in back rooms — one cassette reviewed had the happy sound of children playing in the distance. This back-room phenomenon has not been observed before — certainly never in the U.K. — and it has produced the obvious problem of uneven quality.

To give each cassette a fair hearing, we shall develop some criteria for assessment. These guide-lines should help you to evaluate any other material you may encounter. First, any supplier worth dealing with should be prepared to give a refund for software returned as inadequate. When making initial enquiries to suppliers, include this point in your letter. Also send a stamped, addressed envelope with initial enquiries — back-room initiative operates on a shoe-string and needs every support.

If you are buying a book, you can browse before buying — with software, you have no chance to spend a few minutes in assessing competing cassettes. This obstacle is made more difficult in the case of Sinclair software by loading barriers. ZX-81 programs cause fewer problems than those for the ZX-80, but few of the review cassettes loaded first time in either case. Some, indeed, failed to load at all — despite a minimum of three attempts with different volume settings in the optimum circumstances. As many have discovered the programs bearing the Sinclair label are not paragons of virtue.

Since loading is at the mercy of many factors — the individual cassette and the quality of saving/copying, the player, the computer, cable lay-out, temperature, and so on, my success does not guarantee yours — and my failure must not mean that the material should be rejected out of hand. Try for yourself, but, as I have already suggested, do so in the security of a money-back agreement.

When one meets an unloadable cassette, another temptation arises. This is to judge the product by its cover. I would give high marks for documentation/presentation/packaging to only one supplier of those reviewed — and it is not Sinclair Research. The norm is to have an unmarked cassette — perhaps without a library case — accompanied with a confused explanatory sheet. Some of the best ZX programs I have ever used have been like that — the packaging must not be a major criterion.

Of course, cassette labels, index cards and thoughtful documentation cost money. Of course, the programmer wants to program rather than bother with entrepreneurial necessities — but for market success, good presentation is a necessity.

Sinclair seems to have realised this. To consolidate the scant notes in its ZX-81 cassettes, there is now an excellent booklet. It has operating instructions, notes and illustrations of sample output. It is a definite improvement — and a clear example to most other suppliers.

ZX-80 cassettes

We shall first deal with ZX-80 software and then ZX-81 packages. The addresses of the suppliers are to be found at the end.

Linsac was one of the first groups to supply meaningful ZX-80 programs, and has done well within the limits set by 1K. There are two education cassettes, 10 programs in all, easy to load and provided with good clear, though brief, documentation for the teacher. The first cassette has primary material; the second is for secondary use. Between them, they cover mathematics, music, languages, statistics and general subjects, in an interesting way.

Linsac is well-known for its ZX resources in general — a wide range of programs and the excellent *ZX-80 companion* have originated from its stable. A cassette of software to accompany the book contains 10 of the *ZX-80 companion's* 30 or so programs to save your tired fingers. Three of the 10 appear on the education cassettes as well.

The book is very good; so too, no doubt, is its ZX-81 successor. The programs are good as well, though it is not easy to understand why these particular ones were chosen for the cassette. Only the last two are outstanding — programs which can keep you glued to your chair. That is true of Maze only until you realise how to crash through to the treasure.

Much newer on the scene is Hassoft — software from the delightfully-named Sussex village of Hassocks. The company's one review program is also delightfully-named — Liz, Locking Information in the ZX-80. It is a highly-sophisticated file-handling system. The user defines his/her record/field structure and is then able to develop, edit, save, and use it in the up-market way.

Up-market, too, is the 16-page manual, the most detailed of all the ZX ones seen and easy to follow as well. A ZX-81 version of Liz is due for release soon, but Hassoft observes that this will probably be slower. There was one problem, however — neither of my two copies of Liz would load. Heartbreaking, as Liz seems to be really invaluable material.

JRS Software, which we shall meet again in the ZX-81 section, provided a tantalising package called Programmable moving display. This is a five-program cassette backed with an eight-page manual and most valuable coding sheets. Usable in 1K or more RAM, this is really more of a teaching package than a program or two on cassette. The examples are simple but entirely flicker-free and versatile; the documentation is clear and comprehensive; the fill-it-yourself skeleton is reasonably straightforward.

Rose Cassettes has been in existence a long time — in ZX software terms. It publishes a cassette of solid and unadventurous educational material for 4K RAM and an unambitious 16K telephone index. The loadability is poor as is the documentation which consists of the program titles and half a page of loading instructions in the case of the first cassette and not much more for the second. Rose Cottage industry is developing ZX-81 material.

Time-data has left me with much more mixed feelings. I count its *ZX-80 magic book* as one of the three best publications on that micro — but I was unable to load the professional-looking arcade games cassette. Unhelpful documentation just added to my frustration.

After several attempts, I was able to load Usherwood's animated Breakout. Even then, surely the ZX-80 can provide smoother animation than this? Though the program works well enough as a Breakout variant, the jumping display threatened my epilepsy and my TV's horizontal sanity.

program survey

This supplier offers a good range of ZX-80 programs, on cassette for a few pounds and on paper for even less. Usherwood, too, has a book on the ZX-80; no doubt the '81 version will be available soon.

Let us turn to the ZX-81 — a much better machine, with easier loading and clever new functions, features and facilities.

The first commercial software for the ZX-81 was developed, of course, by Sinclair. A number of people had been given development chips and a reasonable amount of time to produce material. One should expect, for this reason alone, the results to be first-class.

Sinclair's ZX-81 programs are neatly packaged, with smart library cards and brief but adequate instructions in tiny print. As I mentioned, there is now also a little glossy booklet with more information and some listings.

Alas, I cannot back up Tim Hartnell's comment — *Your Computer*, June/July, page 14 — that the software is pretty too.

The first problem one meets is that the Sinclair programs are not easy to load. In fact, with some, I have to report total failure. That was despite having several copies and making indomitable attempts to succeed over several weeks.

There is no excuse for Sinclair, with a high-volume market in its net, to produce unreliable cassettes. One supplier has managed to provide us with perfection in this context — Sinclair does its excellent hardware a disservice in failing us here.

Secondly, the programs themselves fall on average only just on the plus side of mediocrity. There are some excellently novel ideas, and some excellent implementations, but there is plenty of poor-quality stuff on the other arm of the balance.

The five cassettes so far launched cover education — 1K and 16K — games — 1K and 16K — and household — 16K. That gives a total of 28 programs for slightly less than £20. The standard Sinclair cassette price of £3.95 is certain to have a major influence on the cost of commercial ZX software.

The educational material is patchy in quality. Some of the programs are novel, but as a teacher, I would not be happy to use them all with pupils. In particular, the question of educational level has received inadequate attention — but also the formatting and graphics tend to be uninspiring, so that users are likely to start to yawn very quickly. Still, some of the 16K material is definitely worthwhile.

The games are not bad — as long as one has never tried Atari or watched the displays in the railway buffet. ZX-81 games can never approach the excellence of the modern dedicated video material — the machine lacks colour and sound and the programmers still need to gain considerable animation experience. If one wants to spend much time gaming with a micro, the Atari and Vic are the machines to choose, even if they are significantly more costly.

Sinclair's business and household pack satisfies the company's need to offer something for the serious commercial user — even if only the very small business in the first instance. I doubt if many small businessmen will have the patience I had in trying to load this excellent-sounding software. The program promises to be so good that I spent considerably more than an hour on my three copies of the set — and I failed to load even one.

Telephone gives storage of up to 50 personal records, with search allowed in seven fields. Notepad seems to be similar but the fields are user-definable. Bank Account is "a sophisticated financial-recording system with comprehensive documentation". I could not test the first part of that statement, but agree that the documentation is, for Sinclair, unusually comprehensive. It should not be long before Sinclair extends its range of software; it is no secret that more material is in the pipe-line. It is crucial, however, that the company solves the loading problem first.

Perhaps Sinclair should contact Bobker. I have two versions of Bobker's 1K ZX-81 cassette. Both programs loaded perfectly each time I tried. In fact, I frequently used a Bobker cassette as a check when an offering from some other supplier failed to appear on the screen.

The Bobker material presents a good contrast to that from Sinclair in other ways, too. The cassettes are poorly presented, scribbled on and without a library case, let alone a card. The accompanying documentation sheet is unappealing, too — providing inadequate detail on a cramped duplicated page with plenty of hand-written corrections.

Bobker runs a kind of underground User Group, ZX Guaranteed, which welcomes ZX users dissatisfied with the conventional organisations. The boast is that all Bobker programs work — they do: they all load first time and they all run. All the same, they are not fabulous programs.

They fit easily into 1K — and yet make little attempt to use those remaining bytes to maximum efficiency. Why not a few more lines to improve the action, bug-trapping, graphics, variation and formatting? Bobker makes great play of the fact that its graphics are totally flicker-free. Flicker freedom is not, however, the only criterion of good graphics.

Here are brief details of the six programs.

Pools: Gives you a set of random numbers. As I do not do the pools I am unable to tell whether they are winners. They are different every time, though.

Draw: About one-quarter of the screen can be drawn on by a neat combination of Inkeys, the Edit arrows, and draw and erase codes. Sadly, the result of your effort does not appear to be saveable.

Alien: A simple and slow, rapidly-boring, two-player reflex game.

UFO: Shoot it down as it moves overhead. That is not hard — the UFO even stops when you fire.

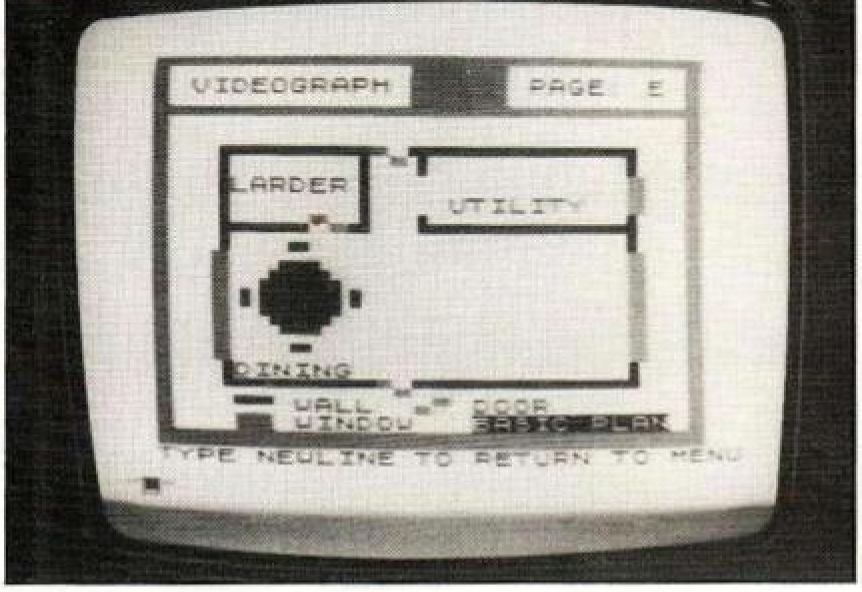
Decision: "Shows that the machine can make intelligent decisions". All it showed me was what I knew already — that even a six-year-old can program the ZX-81.

Simon: The usual game, with Simon saying up up to 12 digits. I suppose it is not bad for 1K — at least it loads.

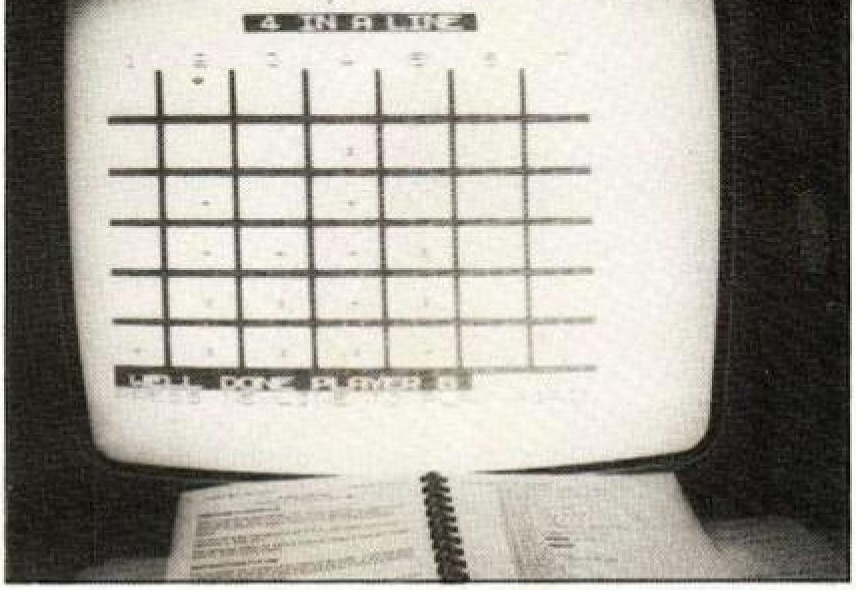
However, I cannot say the same for the products of JRS Software, one of the few runners in the ZX-80 race who has so far also entered for the ZX-81. JRS gives us two short, but more than 1K, games for the rather high price of £2.95 each, or £4.95 the pair. The price could, arguably, be reasonable if the programs are good — I could not load either one.

(continued on next page)

A page from Video Software's Videograph — ZX-81 16K



The end of a game from the Linsac Companion pack — 1K ZX-80



Supplier	Program name	Program type	Description	A	B	C	D	E	F	G	H
				Assessment							
ZX-80											
2	Liz	D*	Full file-handling	4	0	—	—	—	—	—	—
3	Moving Display	U	DIY animation and examples	4	5	4	2	5	5	5	5
4	Maths Drill	E	Simple four-rule tests	5	5	2	3	3	3	—	1
	Dot Recognition	E	Guess dot number	5	5	3	3	3	3	2	1
	Musical Notes	E	Identify note on staff	4	5	2	4	2	3	4	3
	Spelling Quiz	E	Spell teacher-set words	5	5	3	3	2	2	2	2
	Day Finder	M	Day of given date	3	5	2	2	2	2	1	2
	Graph Plotter	E	Quadratics from a,b,c	2	3	2	1	2	2	1	2
	Prime Factors	E	Prime, or factors	2	4	2	2	4	3	—	1
	Number Bases	E	Convert or four rules	2	4	1	2	4	4	—	2
	Bar Charts	E	Up to eight by 10	2	4	2	3	4	3	2	2
	Statistics	E	Standard values	2	4	3	3	4	4	—	2
	Number Guess	G	Standard — 100 high/low	2	4	3	4	2	2	—	2
	Bigprint	M	Standard	1	4	3	3	2	3	3	3
	Moving Display	U	Standard	1	3	—	0	—	2	—	3
	Dot Recognition		Guess dot number								
	Memory Display	U	Hex or dec	4	0	—	—	—	3	—	—
	Spelling Quiz		Spell teacher-set words								
	Graph Plotter		Quadratics from a,b,c								
	Hurkle	G	15 by 15	3	4	4	3	2	3	3	2
	Four-in-a-Line	G*	Standard	3	4	4	3	4	4	4	3
	Maze	G	Maze changes with time	4	5	3	3	4	4	3	3
5	Multibase Arith	E*	+/- in bases	1	1	2	3	3	2	1	1
	Quadratics	E*	Solving	1	1	2	3	3	3	—	2
	Matrices	E*	×/- 1	1	1	2	3	3	2	—	2
	Revision	E*	Hotchpotch test	1	1	3	3	3	3	—	1
	Phone Index	A*	Simple index	1	2	3	1	2	2	—	1
7	Brkout	G	Two arcade games	1	0	—	—	—	—	—	—
8	Breakout	G	Arcade variant	3	4	2	3	3	3	3	4
ZX-81											
1	Pools	G	Random coupon fill	3	5	3	3	3	2	—	1
	Draw	M	H/V design ¼ fill	3	5	3	4	4	3	4	4
	Alien	G	Two-player reflex	2	5	1	4	2	2	2	2
	UFO	G	One-player shooting	2	5	2	4	1	3	2	1
	Decision	G	For drunken parties	3	5	3	3	2	2	—	1
	Simon	G	Standard, numbers	2	5	3	3	3	3	—	1
3	Black Holes	G*	Space navigation	2	0	—	—	—	—	—	—
	Slalom	G*	Ski-slope navigation	2	0	—	—	—	—	—	—
6	Orbit	G	Fair skill	3	3	—	2	3	3	1	1
	Sniper	G	Fair skill	3	3	—	2	2	3	2	2
	Meteors	G	Good skill	3	3	3	4	3	3	2	3
	Life	EG	Standard	2	0	2	—	—	—	—	—
	Wolfpack	G	Submarine hunt	2	0	2	—	—	—	—	—
	Golf	G	Drive on random fairway	2	2	2	2	2	2	2	2
	Maths	E	Simple tests	3	4	2	3	3	3	—	3
	Balance	E	Law of torques	3	4	3	4	3	3	2	3
	Volumes	E	Oblong volumes	3	3	4	3	3	4	2	3
	Averages	E	Mean and median	3	0	—	—	—	—	—	—
	Bases	E	Convert 10 to n	3	2	3	3	4	3	—	2
	Temp	E	Mixing hot and cold	2	3	3	3	1	3	2	1
	Lunar Landing	G*	Good variant	2	0	3	—	—	—	—	—
	Twenty-One	G*	Dice blackjack	2	0	1	—	—	—	—	—
	Combat	G*	Space battle	2	0	1	—	—	—	—	—
	Substrike	G*	Frigate v. 10 submarines	2	0	3	—	—	—	—	—
	Codebreaker	G*	Integer mastermind	2	0	1	—	—	—	—	—
	Mayday	G*	3D search	2	0	—	—	—	—	—	—
	Crash	E*	Arithmetic game	2	4	2	3	4	2	2	3
	Multiply	E*	Long, with help	3	4	4	3	4	3	—	2
	Train	E*	Tables game	4	5	3	4	5	4	3	4
	Fractions	E*	Vulgar, four rules	4	5	4	4	4	4	2	2
	Addsub	E*	Long, with help	4	5	4	4	4	3	—	2
	Spelling	E*	Teachers' tests	2	5	3	3	4	4	—	4
	Telephone	D*	50 records multi-access	2	0	3	—	—	—	—	—
	Note Pad	D*	File handling	3	0	2	—	—	—	—	—
	Bank Account	D*	Accounts files and subscriptions	4	0	2	—	—	—	—	—
9	Video-graph	D*	CAD aid	5	2	5	4	5	4	4	5
	Video-map	D*	Map-reading exercises	5	0	—	—	—	—	—	—
	Video-View	D*	Mini-Prestel	5	2	5	5	5	4	4	5

Notes: **Supplier**: numbers refer to suppliers' list. **Program type**: asterisk shows 16K required; A, administration, D, data handling; E, education; G, games; M, miscellaneous; U, utilities. **Assessment** on a 0-5 scale: A, documentation or instructions; B, loading — 0 means impossible; C, format or screen lay-out; D, ease of use; E, functional value; F, programming quality; G, quality of graphics, if any; H, novelty.

(continued from previous page)

Black holes and Slalom are both guide-your-self-through-the-obstacles games using Inkeys. The touchstone must be graphics/animation in such cases and, of course, those aspects I could not test.

Video Software gains the highest marks for ZX-81 programs. I have been able to assess three of its packages; also offered are cassettes of games at £3.95 — if they are as good as their serious material, they would be outstanding. The three "serious" packages have great potential for education, the home and the small business. Each package is available either for ZX-80 or ZX-81. The ZX-81 version uses the same approach as the ZX-80 one, but with better results. Also, each package comes in a standard form at £5.95 — cassette and manual — and a beautifully boxed *de luxe* version at £7.95.

Video View is a superb example of the Prestel-type of approach to database handling. As supplied, the database concerns the village of Kinver, with 12 accessed pages of beautiful graphics describing that village. On the reverse of the cassette is an acceptable audio commentary introducing this application of Video-view and going on to describe how to prepare one's own index and data pages. The superbly-presented little manual also provides this information. It is, however, written to cover both ZX-80 and ZX-81 versions, so can be unnecessarily confusing.

Video-graph is just as good, though perhaps not of such wide potential application. Again, there is outstanding documentation on audio and in manual. The demonstration comprises a set of pictures concerning kitchen planning. The program is very similar in outline to Video-view — a set of pictures — full screen or eight by eight — can be created and amended before being stored in pages. One can display any set of pictures, or make further amendments, including adding any eight-by-eight mini design to any part of any full design.

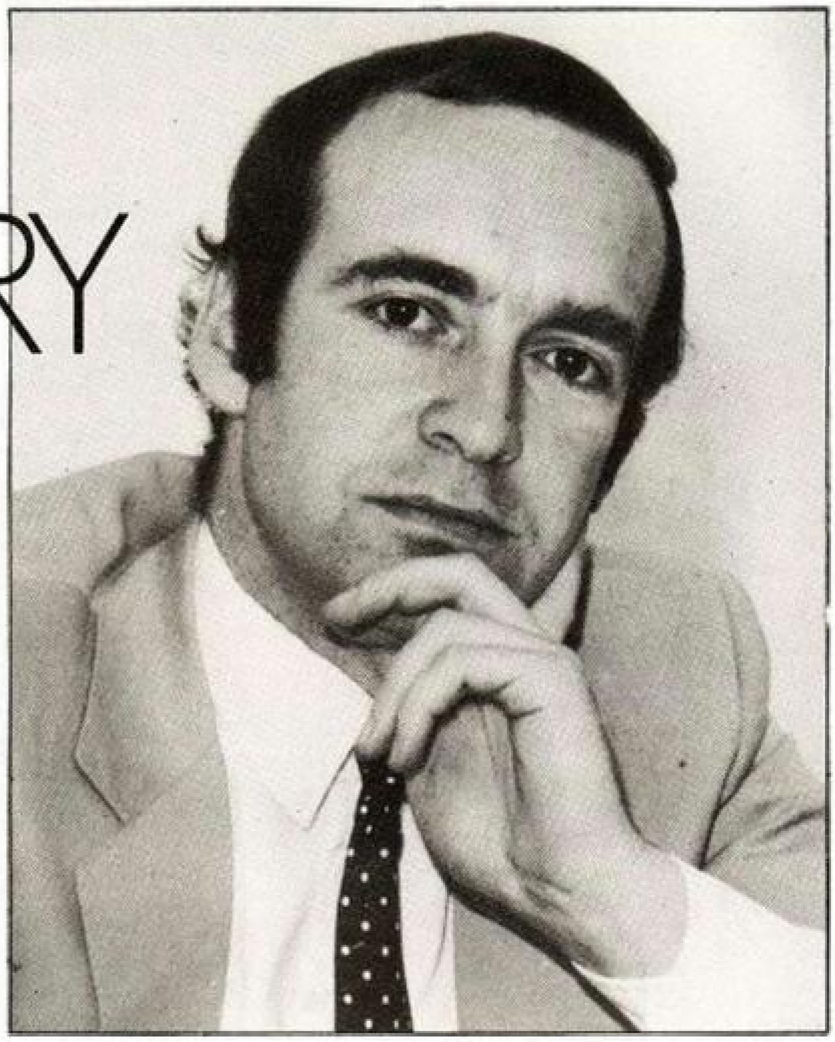
Video-map is an educational game involving map reading/using. The victim has to navigate his bomber across country without failing in various ways. The mission details and map dealing with them may be varied. ■

Suppliers and addresses

1. **Bobker** 29 Chadderton Drive, Unsworth, Bury, Lancashire. ZX-80/1: games.
2. **Hassoft** 14 North Court, Hassocks, West Sussex. ZX-80: games, utilities.
3. **JRS Software** 19 Wayside Avenue, Worthing, Sussex. ZX-80/1: games, utilities.
4. **Linsac** 68 Barker Road, Middlesbrough, Teeside. ZX-80: games, education, utilities.
5. **Rose Cassettes** 148 Widney Lane, Solihull, West Midlands. ZX-80/1: education, home administration.
6. **Sinclair Research Ltd** 6 King's Parade, Cambridge. ZX-81: education, home administration, games.
7. **Timedata** 57 Swallowdale, Basildon, Essex. ZX-80: games.
8. **Usherwood** 53 Marlborough Road, Stockton, Cleveland. ZX-80: games.
9. **Video Software** Stone Lane, Kinver, Stourbridge, West Midlands. ZX80/1: data handling, training, games.

INTERVIEW

CHRIS CURRY



Chis Curry's Cambridge company, Acorn, is beginning to emerge as one of the strongest personal computer firms in Britain. Its main product, the Acorn Atom, has proved both popular and reliable. The company won the coveted contract to design and build the computer to be marketed by the BBC and accompany the BBC's planned computer literacy series. Chris Curry talks to Duncan Scot.

THE ATOM computer is one of the few approved by the Departments of Industry and Education for purchase by other Government departments. Acorn's other products include its networking system, the Econet, which is designed to link Atoms together in a classroom.

Acorn will shortly be releasing the first of the BBC computers and a larger version of the same system which will be known as the Proton. At present, the company is quartered in four offices in Cambridge — new business accommodation is being built on the outskirts of the city. Its turnover is about £3 million per annum and a new financial controller is planning systems which will take

'The Basic is as good as anyone can make it'

the company into the £15 million to £20 million bracket.

All this has happened in the space of 18 months. Perhaps ironically it was Clive Sinclair, creator and manufacturer of the ZX-80 and ZX-81 personal computers, who led Chris Curry into the field of computing. Curry left school with some A levels and a keen enthusiasm for all things electronic — he used to spend much of his spare time trying to build amplifiers from old television valves.

After working in several different jobs, Curry answered an advertisement, placed by Clive Sinclair, for engineers. Curry was given the job just when Sinclair was starting his work on miniature radios.

"Things really took off when Clive returned from the States with the first single-chip calculator. He gave it to me with a wadge of paper and said 'get that working'. It was completely new to me.

"I built a prototype with another chap in the laboratory. We built a breadboard around the chip and built a keyboard from bent wire. After a little fiddling, the thing worked. It really was like magic to see those numbers appearing on the display; and then when you used one of the functions and the result flew across the screen — it was incredible. To see this happening with this little piece of electronics was really exciting".

By 1977, the fortunes of Sinclair Radionics, the main arm of Sinclair's operation, were waning. The company was ensnarled with the National Enterprise Board; there were technical problems with the infamous Black Watch and the first of the Microvision television sets were proving extremely expensive. Clive Sinclair decided to re-launch another company he owned, Science of Cambridge, with Chris Curry in charge.

"I had been very interested in the computer market, watching, buying the U.S. magazines and seeing what was happening. I actually tried to negotiate an import agreement with an American company which had, what they called, a computer in a book.

"We nearly went ahead with an inexpensive home computer which would have been based on the use of a calculator chip for keyboard and display. Eventually, we went away from the use of a calculator and used more conventional interfaces to provide a display and keyboard — and produced the Mk-14.

"That became a great favourite very quickly. The first arrived on the market in February 1978, but in fact it wasn't until May that we distributed them in reasonable quantities. I think we sold about 1,500 of them.

"By this time, I was thinking in terms of a better product. I had been trying to persuade Clive that we should do a low-cost personal computer which ran Basic and could be attached to a television set. At the same time, Sinclair Radionics started developing the machine now known as the NewBrain. I could see that Clive was not going to support this kind of product at Science of Cambridge if he was going to do it in Sinclair Radionics".

One of the side-effects of Chris Curry's work on the Mk-14 was that he had many enquires from people wanting to use microprocessors in various industrial applications. That led him into what was effectively a part-time consultancy and brought him into contact with Dr Herman Hauser, who later became a partner in Acorn, and a member of the Cambridge Processor Group, the university computer group. Curry decided to try and keep the team together, outside Science of Cambridge.

"We went ahead with the System 1. It was a kind of equivalent Mk-14, but based on Eurocards so that we could expand and link the system. When the advertising appeared, Clive spotted the trademark".

Chris Curry stayed at Science of Cambridge for a few months while Clive Sinclair found someone else who could run the operation. In the meantime, Acorn had already set up offices in Market Hill in Cambridge and was a thriving little operation with four full-time staff.

'It's a philanthropic gesture by the BBC'

"There has always been a fairly amicable relationship between Clive and me. We always pretended that there was not much competition between us. I think it is certainly growing more intense now that Clive is obviously aiming hard at the education market.

"The System 1 appeared in January 1978 — exactly a year before the Atom. Acorn did not really take off until the Atom became available. There was a strong attitude in the laboratory at that time that we should maintain our product line as being semi-professional — that we should concentrate on the Eurocard system.

"I had to push hard for the Atom. I did the development separately with one chap. For example, to save money, the case for the Atom was designed not as a computer but as a keyboard for the Systems. We asked the industrial designer to make something which was low-key, not too flashy. He produced the Atom".

The designer of the computer was Roger Wilson of Acorn. He chose the 6502 chip because he believed and wanted to prove that the 6502 could be faster than the Z-80 chip, contrary to popular opinion. Much of the Atom Basic, however, had its origins in Acorn's early days when they were writing process-control applications.

In other words, it was written for speed, not to fall in line with common standards. Chris Curry defends the Basic as being extremely fast and that: "It has only been criticised on the grounds that it is not like Microsoft"

The big breakthrough for Acorn, however, occurred when it was awarded the contract to design and

"The BBC is not going to stop in the U.K.'

supply the computer for the BBC's forthcoming computer-literacy series, the details of which were published in the June/July issue of *Your Computer*. The fact that the BBC is to use its marketing powers to sell a BBC-branded computer is still a matter of some controversy.

"I think I read a report in a paper somewhere that the BBC was to market its own computer. It gave some brief specification of the computer. I went to see Clive and he had not heard of it. We both did some research and discovered that it was almost certainly the NewBrain". By this time, the NewBrain had been passed from the National Enterprise

'We showed a record of managing to produce things quickly with a reasonably good design'

Board to the company Newbury Laboratories.

"We were all very cross and both of us wrote letters complaining about the choice, at not having heard about it and at not even being given the chance to tender for it. We also questioned whether, in principle, it was reasonable for the BBC to do such a thing.

"I've done a little word-eating since then. After the letter, I had a meeting with John Radcliffe, the producer, and showed him the Atom. He obviously discussed it with his advisors and then said that it would not do the job. We then told him about the Proton". (The Proton was being developed by Acorn at the time as a contender for the office microcomputer market): "They said the Proton would do the job. We had more meetings, a presentation at the laboratories, they examined our production facilities and our record of production ability.

"I think that the main thing which went against Newbury was that it had spent nearly two years developing its computer and it still had not got off the ground. We showed a record of managing to produce things quickly with a reasonably good design.

"The BBC was very worried about upsetting the rest of the industry, but for the purposes of its educational course it could not base it on any computer. The BBC had to have one computer and so it had to be chosen or specifically built. In the end, the Proton is effectively a machine built specifically for the BBC.

"The BBC is being pilloried about it but really it's a kind of philanthropic gesture on its part; all it wants to do is give computer knowledge to the people".

Before the BBC contract arrived Roger Wilson at Acorn was writing a development of the Atom Basic which would have brought it more into line with languages such as Pascal and Comal. In the end, however, the BBC contract forced them to move back towards a Basic compatible with Microsoft.

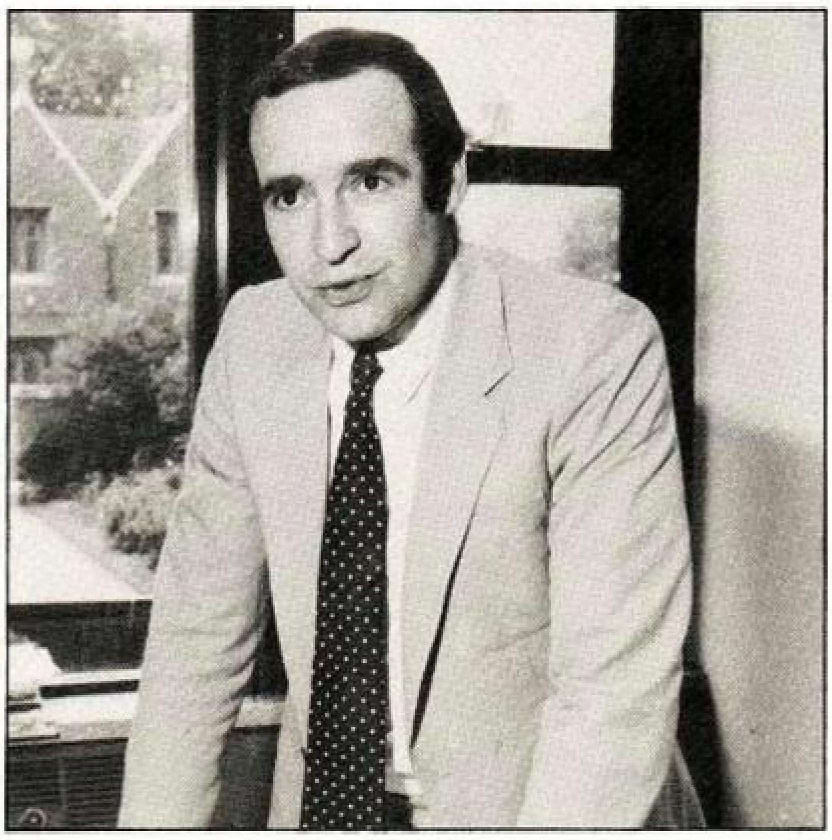
"We have ended up with a compromise that doesn't actually lose the features of Roger's original ideas. We are confident that the Basic we are using for the BBC is as good as anyone can make it. It covers all of the Microsoft and all the good points of Roger's original Basic. It meets just about everyone's criteria of what they need out of Basic. It meets Microsoft 5; it does what Comal does; it is a structured Basic; it's fast and it has upward-compatibility from the Atom Basic.

"I see it becoming a world standard. Whereas most of the other languages have retained their

'I see it becoming a world standard'

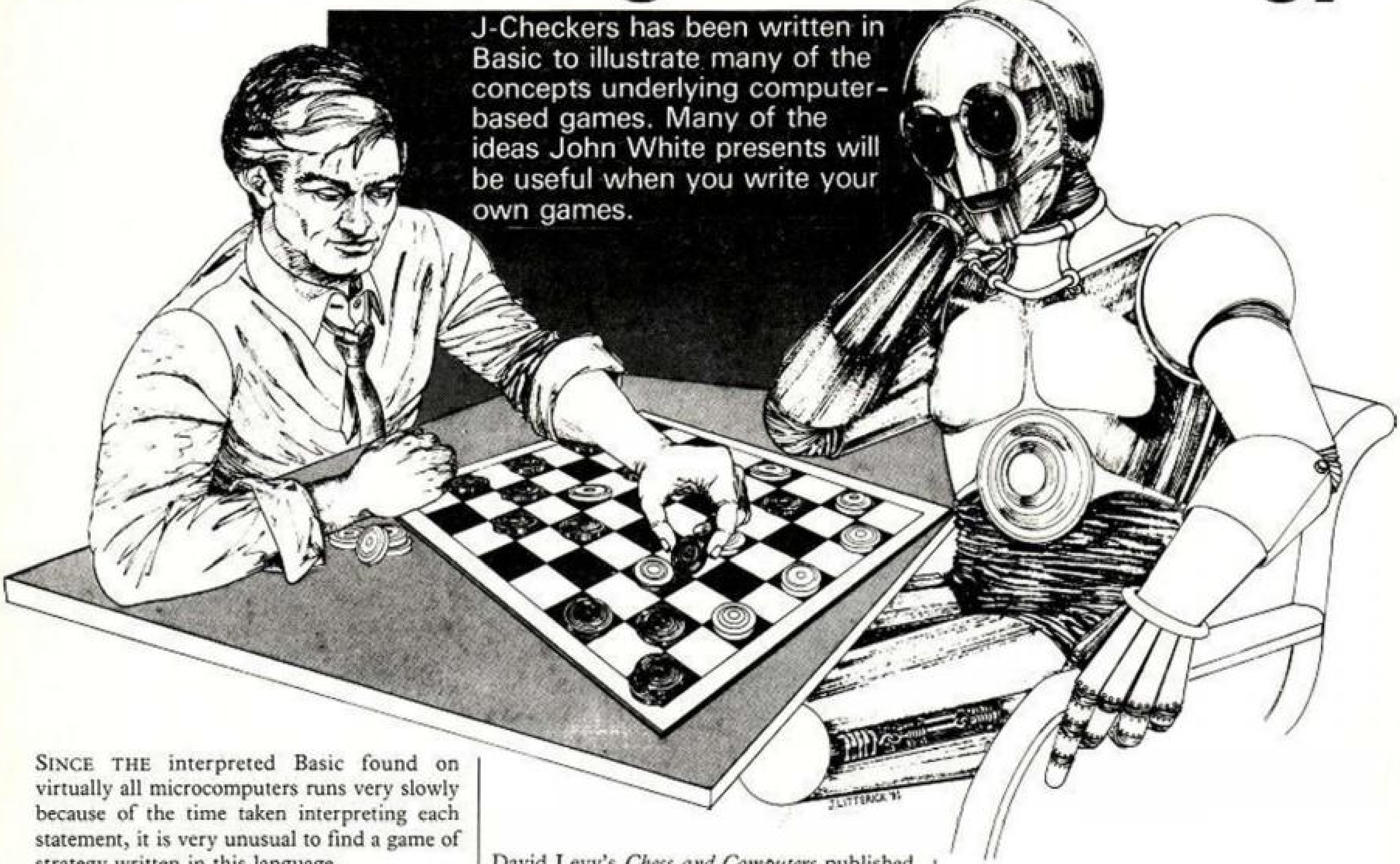
identity, Basic has been drifting around according to manufacturers' and designers' whims. I think that this is the first time that everyone will pull together and adopt a standard. The specifications have been distributed to everybody — all the manufacturers and distributors in the U.K. — for comments and so any company can build a similar machine if it wants to.

"The BBC is not going to stop in the U.K. It will be selling the programs in all English-speaking countries. Already non-English speaking countries are showing great interest". ■



J-Checkers — game of strategy

J-Checkers has been written in Basic to illustrate many of the concepts underlying computer-based games. Many of the ideas John White presents will be useful when you write your own games.



SINCE THE interpreted Basic found on virtually all microcomputers runs very slowly because of the time taken interpreting each statement, it is very unusual to find a game of strategy written in this language.

Compiled languages — including the rare compiled Basic — run about 100 times faster, while machine language, the choice for commercial games programs, is faster still. It is customary for most programs to estimate the value of moving a piece by assessing the position which then arises. For Checkers, this would mean an assessment for each possible move of all 64 squares of the board by two For-Next loops. This is prohibitively slow in interpreted Basic.

An alternative approach is used in Checkers, a 3.5K checkers program described in that famous and inspirational book *101 Basic computer games* by *Creative Computing*. I gratefully acknowledge the permission of *Creative Computing's* David Ahl to reproduce and adapt the original Checkers for this article.

Checkers evaluates the merit of each move, instead of the position arising after the move. The evaluation table used for this is shown in table 1.

The major problem with this approach is the program's poor strategic vision. A piece threatened with capture will not be moved unless the move itself achieves something — other than saving the piece. The evaluation function can be built to recognise such threats to a limited extent, but the best protection is a look-ahead facility which evaluates the opponent's moves. Then the program can see that a capture by the opponent can be averted only by moving the threatened piece.

I do not have the space to consider the theoretical background behind look-ahead facilities. The interested reader is referred to David Levy's *Chess and Computers* published by Batsford. However, it is not easy to implement recursive programming in Basic — a subroutine calling itself — and this leads to an unavoidable amount of duplication of program statements at each level of search in J-Checkers.

J-Checkers was written for a Sharp MZ-80K computer. I have used standard Microsoft Basic, but could not resist using the programmable music generator to give an audible prompt — these are the lines or subroutines with Tempo and Music statements. The use of a real-time clock is essential for the feature called iterative deepening.

Sharp owners will require a Toolkit or Expanded Basic for the string inequalities, e.g.,

A$<>"Y"

in some lines, and for the logical operators And and Or. I also used Newbear's *Basic Extensions*. Print "C" is a clear-screen command.

J-Checkers occupies 9K as written, or 8.3K without the instructions. Removal of all program spaces and Rem statements should reduce memory requirements to less than 8K. You will be invited to select a search method from simple one-move look-ahead — one-ply — iterative deepening from one-ply or, at two-ply search, between pruned search, minimax or alpha-beta search.

Here is a list of the features of computerised games of strategy simulated in J-Checkers:

Evaluation function: The evaluation function for J-Checkers is held in its own subroutine, and is summarised in table 2; compare it to table 1. A score is assigned to each projected move: by convention, a positive score is taken as good for the program and a negative score as bad.

I make no claim to be a good checkers player. Table 2 represents my idea of how to play — many readers will undoubtedly wish to change the values.

Evaluation of captures: Most programs evaluate captures until no more can be made. J-Checkers evaluates all captures to a depth of three-ply only. This is included solely for illustration and is a waste of time for J-Checkers. Note that double jumps are only seen by the program as a particularly favourable single jump, and it may assume that the opponent's best reply is to use the second, captured, piece to retake the machine's. It would take a great deal of extra programming to avoid this.

Mini-max search: It is obvious that a program's moves can be influenced by the opponent's reply. J-Checkers contains two levels of calculation — two-ply: machine move-man move — with a third level for evaluation of captures only. At the second level, all of the opponent's replies are evaluated for each of the machine's moves.

This is a slow business. The best opponent move is deducted from the machine's move to give the score for that move; obviously, the lower the opponent's score, the better for the program.

The best backed-up score is stored in location R(O) together with the moves which led to it. This avoids the necessity of storing all the moves. Finally, when all the moves have been considered, the best move is displayed together with the best response it considers you have at your disposal.

This method of minimising the best opponent's move to maximise the program's score is the famous Mini-max search.

Alpha-beta search: It is not necessary to search all of the opponent's replies to see if a machine move is viable. If any opponent move makes the machine move worse than the one already stored as best, the machine need not consider any further opponent moves in response to that one machine move. This is the principle underlying the modern Alpha-beta search, which gives identical results to Mini-max search but in a shorter time since fewer moves are considered.

If you want to check this, be sure to remove the randomising lines 730 and 1760 first. Similar considerations would apply at higher levels — the machine does not need to consider any further responses to opponent moves after finding one which is worse for the opponent.

To be really fast, the first moves generated would normally be sorted into order before applying the alpha-beta search, but this takes so much time in Basic as to be counter-productive for J-Checkers. The opponent's best response is not printed, unlike the Mini-max search, since only a good response has been found — not the best one.

Iterative deepening: A very modern way of assessing moves is that of iterative deepening. A time is pre-set — for J-Checkers, use 20-150 seconds — and the machine evaluates its best move at the first, one-ply level. These moves are sorted and subjected to alpha-beta search until there is no more time: then the best move so far discovered is displayed.

Move-sorting wastes too much time for J-Checkers, but the best move at level one is examined first at level two if iterative deepening has been selected. As is customary with this type of search, the move being considered by the machine is constantly displayed.

Iterative deepening is only available for microcomputers with a real-time clock. Otherwise, this function will operate as a slightly slow alpha-beta, two-ply search.

Pruned search: Another popular way of searching moves in depth, without spending an excessive period of time, is by cutting all moves which fail to meet a pre-determined criterion. J-Checkers can be selected to prune all first-level moves which do not achieve a positive score.

This accelerates execution tremendously — see table 3 — and can give results similar to those derived by other means of searching — provided that the evaluation function is a good one. The great playing strength of the older Chess Challenger models, which used pruning, provides an excellent example.

Material evaluation: The screen display of J-Checkers provides the opportunity to count the number of pieces on each side — one for a man, three for a king. This serves to tell whether one side has won — the piece count is zero for opponent — and can also be used as in lines 1100 and 1110 to measure which side is ahead and to provide a parameter P3 which encourages exchange of material if the program is ahead, or discourages exchanges if the program is losing. The use of P3 can be found in the third search level, in line 1970. This is a commonly-used algorithm found in many games programs.

End-game: For a variety of reasons, the end-game play of most computer programs — especially chess — is weaker than in the mid-game. The best chess programs use extra evaluation functions when a pre-determined level has been reached. Using the material

(continued on next page)

Table 1

Evaluation function used by original Checkers

Projected move	Score
Capture of opponent	+5
Advance of man to eight rank — promotion to king	+2
Move to side of board	+1
Back-up own piece from behind	+1
Do not approach enemy piece	−2
Do not move off first rank	−2

Table 2

Evaluation function used by J-Checkers

Projected move	Score
Capture of opponent	+10 or +30
Ability to make a second capture after first	+9, +10 or +11
Advance man to eighth rank — promotion to king	+2

```
100 PRINT"@"
110 PRINTTAB(16);"J-CHECKERS"
120 PRINTTAB(5);" by Creative Computing\ J.F.White"
130 DIM R(4),T(4),S(8,8)
140 FORX=1TO8:FORY=1TO8:READJ:IFJ=15 THEN 160
150 S(X,Y)= J:GOTO170
160 RESTORE: READS(X,Y)
170 NEXT Y: NEXT X
180 DATA 1,0,1,0,0,0,-1,0,0,1,0,0,0,-1,0,-1,15
190 FORZ=1TO2000:NEXT:PRINT:PRINT:PRINT
200 PRINT"THIS IS THE GAME OF CHECKERS. BLACK IS 'X' AND WHITE IS 'O'"
210 PRINT"SQUARES ARE REFERRED TO BY A COORDINATE SYSTEM"
220 PRINT"(1,1) IS THE LOWER LEFT CORNER"
230 PRINT"(1,8) IS THE UPPER LEFT CORNER"
240 PRINT"(8,1) IS THE LOWER RIGHT CORNER"
250 PRINT"(8,8) IS THE UPPER RIGHT CORNER"
260 PRINT:PRINT"THE COMPUTER WILL TYPE '+ TO' WHEN YOU  HAVE ANOTHER JUMP"
270 PRINT:   PRINT    "TYPE '0,0' IF YOU CANNOT JUMP."
280 PRINT:PRINT"YOU WILL BE ASKED WHICH TYPE OF COMPUTER SEARCH YOU WANT"
290 PRINT"PRUNED SEARCH IS FASTER"
300 PRINT:PRINT:INPUT"SEARCH LEVEL(1-2)?";L
310 IFL=1 THEN 330
320 GOTO 360
330 INPUT"DO YOU WANT ITERATIVE DEEPENING(Y\N)?";ID$
340 IFID$="Y"THEN INPUT"SET TIME FOR SEARCH (SECS)"; ST:AE$="Y":GOTO410
350 GOTO 410
360 INPUT"DO YOU WANT PRUNED SEARCH(Y\N)?";FA$
370 IF FA$="Y"THEN 410
380 INPUT"DO YOU WANT ALPHA-BETA SEARCH (Y\N)?";AB$
390 IF AB$="Y"THEN 410
400 PRINT"DEFAULT TO MINIMAX SEARCH"
410 INPUT"DO YOU WANT TO GO FIRST(Y\N)?";C$
420 GOSUB2000:TB=TA
430 R(0)= - 99: G= -1:P1= 12:P2=12
440 IF C$="Y" THEN C1$="X":C2$="O":C3$="O+":C4$="X+":M=M+1:GOTO 910
450 C1$="O":C2$= "X": C3$ = "X+": C4$="O+"
460 M=M+1
470 IFID$="Y"ANDL=2THENX=R(1):Y=R(2):B=G:FORA=-1TO1STEP2:GOSUB570:NEXT
480 IFM=2 ANDS(2,6)=0THENR(1)=3:R(2)=7:R(3)=2:R(4)=6:GOTO790
490 FOR X = 1TO 8:FOR Y = 1 TO 8:IF S(X,Y))-1 THEN520
500 IFS(X,Y)=-1 THEN B=G:FORA=-1 TO 1 STEP2:GOSUB570:NEXT
510 IFS(X,Y)=-2 THEN FORB=-1TO1 STEP2:FORA=-1 TO 1 STEP2:GOSUB570:NEXT:NEXT
520 NEXT Y : NEXTX
530 IFID$="Y" AND ID=0 AND L<2 THEN L=L+1:GOTO 470
540 ID = 0:IF ID$="Y" THEN L=1
550 GOTO 780
560 REM FIRST MOVE GENERATOR
570 IF ID=1 THEN RETURN
580 U=X+A:V=Y+B:IFU<1 OR U>8 ORV<1 OR V>8 THEN RETURN
590 IFS(U,V)=0 THEN GOSUB640:RETURN
600 IFS(U,V)<0 THEN RETURN
610 U=U+A: V=V+B: IFU<1 ORU>8 ORV<1 OR V>8 THEN RETURN
620 IFS(U,V) = 0 THEN GOSUB640
630 RETURN
640 UA=U:VA=V:XA=X:YA=Y:ED=1:GA=G
650 GOSUB 2040:OO=O
660 IF ID$="Y"THEN 700
670 IFOO>8 THEN GOSUB 1480:GOTO720
680 IF FA$="Y" AND OO   >0THEN GOSUB 1480:GOTO 720
690 IF FA$="Y" THEN 720
700 IF AB$="Y" AND L=2 THEN GOSUB 1480:GOTO720
710 IFL=2THEN GOSUB 1480:GOTO720
720 IFOO >R(0) THENR(0)=OO:R(1)=X:R(2)=Y:R(3)=U:R(4)=V:GOTO 750
730 IFOO=R(0)AND RND(1)>.5 THEN R(0)=OO:R(1)=X:R(2)=Y:R(3)=U:R(4)=V:GOTO750
740 GOTO770
750 IFID$="Y"THENPRINT"I AM CONSIDERING ";R(1);",";R(2);" TO ";R(3);",";R(4)
760 T1=T(1):T2=T(2):T3=T(3):T4=T(4)
770 OO=0:RETURN
780 IFR(0)=-99 THEN 1420
790 PRINT"■■■FROM ";R(1);",";R(2);" TO ";R(3);",";R(4):R(0)=-99
800 IFR(4)=1THENS(R(3),R(4))=-2 :GOTO820
810 S(R(3),R(4))=S(R(1),R(2))
820 S(R(1),R(2))=0:IFABS(R(1)-R(3))<>2THEN910
830 S((R(1)+R(3))/2,(R(2)+R(4))/2)=0
840 X=R(3):Y=R(4):IFS(X,Y)=-1THENB=-2:FORA=-2TO2STEP4:GOSUB880
850 IFS(X,Y)=-2THENFORA=-2TO2STEP4:FORB=-2TO2STEP4:GOSUB880:NEXT B
860 NEXTA:IFR(0)<>-99THENPRINT" TO ";R(3);",";R(4):R(0)=-99:GOTO800
870 GOTO910
880 U=X+A:V=Y+B:IFU<1 OR U>8 OR V<1 OR V>8 THEN RETURN
890 IFS(U,V)=0 AND S(X+A/2,Y+B/2)>0THEN ID=0: GOSUB 640
900 RETURN
910 PRINT:GOSUB2000:TD=TA:TF=TF+INT((TD-TB)/60*100+.00001)/100
920 P1=0:P2=0
930 FOR Y = 9 TO 0STEP-1:FORX=0TO 9
940 IFY=9AND(X=0 OR X=9)THEN 1030
950 IFY=0 AND (X=0 OR X=9)THEN 1030
960 IFY=0 OR Y=9THEN PRINTTAB(2*X-1);X;:GOTO1030
970 IF X = 0 OR X=9 THENPRINTY;:GOTO1030
980 IFS(X,Y)=0THENPRINTTAB(2*X);".";:GOTO1030
990 IFS(X,Y)= 1THEN PRINTTAB(2*X);C1$;:P1=P1+1:GOTO1030
1000 IFS(X,Y)=-1THENPRINTTAB(2*X);C2$;:P2=P2+1:GOTO1030
1010 IFS(X,Y)=-2THENPRINTTAB(2*X);C3$;:P2=P2+3:GOTO1030
1020 IFS(X,Y)=2THENPRINTTAB(2*X);C4$;:P1=P1+3
1030 NEXTX
1040 IFY=6 THENPRINTTAB(25);"MOVE NO. ";M;
1050 IFY=4 THENPRINTTAB(23);"MY TIME= ";TF;
1060 IFY=2 THEN PRINTTAB(21);"YOUR TIME= ";TG;
1070 PRINT:NEXT Y:PRINT
1080 IF P1=0 THEN 1410
1090 IFP2=0THEN1420
1100 IFP1>P2THENP3=(P1-P2)*P1/P2
1110 IFP2>P1 THEN P3=(P1-P2)*P2/P1
1120 IF P1<7 OR P2<7 THEN PRINT"END GAME "
1130 IFL=2 AND AB$<>"Y" AND FA$<> "Y" THEN 1150
1140 GOTO 1170
1150 PRINT"I have evaluated your best move as: ";
1160 PRINTT1  ;",";T2  ;" TO ";T3  ;",";T4
1170 GOSUB 1390
1180 GOSUB 2000:TE=TA
1190 PRINT:INPUT" FROM ";E,H:E=INT(E):H=INT(H)
1200 GOSUB 1390
1210 IFE<1ORE>8 ORH<1ORH>8THENGOSUB1440:GOTO1190
1220 IFS(E,H)<=0THENGOSUB 1440: GOTO1190
1230 INPUT" TO ";A,B:A=INT(A):B=INT(B)
1240 GOSUB 1390
1250 IFA<0ORA>8 ORB<0ORB>8THEN GOSUB1440:GOTO1230
1260 IFS(A,B)=0 AND ABS(A-E)<=2 AND ABS(A-E)=ABS(B-H) THEN1280
1270 GOSUB 1440: GOTO1190
1280 IFABS(A-E)=2 AND S((A+E)/2,(B+H)/2)>-1THENGOSUB1440:GOTO1190
1290 S(A,B)=S(E,H): S(E,H)=0: IF ABS(E-A)<>2 THEN 1350
1300 S((E+A)/2,(H+B)/2)=0
1310 INPUT" + TO ";A1,B1:GOSUB1390: IF A1<1 THEN 1350
1320 IFS(A1,B1)<>0 OR ABS(A1-A)<>2 OR ABS(B1-B)<>2 THENGOSUB1440:GOTO1310
1330 E=A:H=B:A=A1:B=B1:IF B= 8 THEN S(A,B)=2
1340 GOTO1290
1350 IFB=8 THEN S(A,B)=2
1360 GOSUB2000:TB=TA:TG=TG+INT((TB-TE)/60*100+.0001)/100
1370 ID=0: GOTO 460
1380 REM BEEP-BEEP
1390 TEMPO3: MUSIC"-C0","-C0"
1400 RETURN
```

(continued on next page)

Advance man to seventh rank	+.3
Advance man to sixth rank	+.2
Move man to side of board	+1
Move king to side of board or first or eighth rank	−.5
Do not move man to eighth edge of board if it is moving to eighth rank	−1.2
Do not approach enemy piece from front	−3
Do not approach enemy king from rear	−3
Back-up own piece from behind	+1
Do not move man from first rank	−2.2
Attack enemy men from rear with king	+1
Move piece attacked from rear by enemy king	+2
Move king rather than man	+.2
Occupy centre squares with king	+.25
Bridge two enemy pieces with king	+3
Whether to exchange pieces — see text	+P3
Maintain opposition	+.5
Do not move from square 3,5 — if enemy move — or from 6,4 — if program move	−.2

End-game: Additional functions called in the end-game

Advance man with unopposed path to eighth rank	+1
If program is winning:	
Attack enemy pieces on side or edge of board with king	+2
If program is losing:	
Keep king in double corner	+1.5
Move king towards double corner	+.3
Keep king off side or edge of board	−.35

Table 3

Average time spent on a move

Level	Search	Time in minutes	Percentage of maximum time
2	Mini-max	2.24	100
2	Alpha-beta	1.35	60
2	Pruned	0.45	20
1-2	Iterative Deepening set to 45 seconds	0.71	30
1	Level 1	0.21	10
1	original Checkers	0.10	5

Facsimile of screen detail in mid-game.

```
From 6, 6 to 7, 5

  1 2 3 4 5 6 7 8
8 . X . 0 . X . . 8
7 0 . . . . . . . 7    Move number 19
6 . . . 0 . . . 0 6
5 . . . . . . X . 5    My time = 4.06
4 . . . . . . . X 4
3 . . X . . . . . 3    Your time = 8.14
2 . . . . . 0 . . 2
1 . . 0 . 0 . 0 . 1
  1 2 3 4 5 6 7 8

End-game

From?
```

(continued from previous page)

evaluation outlined, this feature has been mimicked in J-Checkers with an end-game subroutine — the program announces that it has entered its end-game.

Book openings: Book openings can be essential if the program is to avoid opening traps. J-Checkers includes just one at line 4801 to prevent the disastrous opening line:
2,6-1,5; 3,3-4,4; 1,7-2,6; 4,6-5,5; 4,6×6,4; 7,3×5,5; 6,6×4,4; 5,3×3,5×1,7
when white is a piece up.

Random moves: To prevent the machine always playing the same responses to its opponent, J-Checkers includes two randomising lines, 730 and 1760, which randomly select between moves of equal merit.

Screen display: Far too many commercial programs provide beautiful and incomprehensible graphics for their game of strategy. J-Checkers uses the barest possible display to save memory. The number of moves are displayed as are the times elapsed for each player — the elapsed times are given in minutes and hundredths.

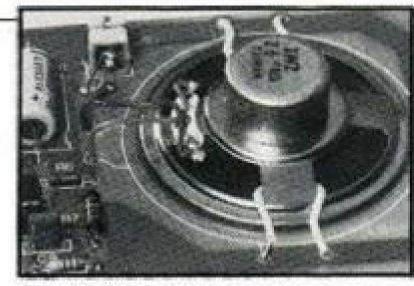
Input of moves: Several error-trapping routines have been written for J-Checkers, but the computer will not force you to make a capture — although it will force itself to do so.

In summary, J-Checkers, which uses a superior evaluation function and move searching, plays a much stronger game than the original Checkers, at the cost of 2.5 times the memory requirement and between two and 22 times the original response period. It is, of course, unlikely to play as well as any machine-code program. ■

Continued from previous page

```
1410 PRINT:PRINT:PRINT"   I WIN !":PRINT:PRINT:END
1420 PRINT:PRINT:PRINT"  YOU WIN !":PRINT:PRINT:END
1430 REM REJECT MOVE
1440 TEMPO6:MUSIC"_C5"
1450 PRINT"ILLEGAL MOVE - TRY AGAIN"
1460 RETURN
1470 REM SECOND LEVEL
1480 IFID$="Y" THEN GOSUB 2000:IF TA-TB > ST-5 THENID=1: RETURN
1490 T(0)=-98:G1=1
1500 A7=S(X,Y):A8=S(U,V):S(U,V)=S(X,Y):S(X,Y)=0
1510 IF ABS(X-U)=2 THENA3=S((X+U)/2,(Y+V)/2):S((X+U)/2,(Y+V)/2)=0
1520 FOR X1=1TO8: FOR Y1=1TO8:IFS(X1,Y1)<1 THEN 1550
1530 IFS(X1,Y1)=1 THEN B1=G1:FORA1=-1TO1STEP2:GOSUB1620:NEXT
1540 IFS(X1,Y1)=2THENFORB1=-1TO1 STEP2:FORA1=-1TO1STEP2:GOSUB1620:NEXT:NEXT
1550 NEXTY1:NEXTX1
1560 S(X,Y)=A7: S(U,V)=A8
1570 IFABS(X-U)=2 THEN S((X+U)/2,(Y+V)/2)=A3
1580 O0= O0-T(0):IF FA$="Y"THEN O0=O0+3
1590 IFID$="Y"THEN O0=O0+ 3
1600 AB=0
1610 RETURN
1620 IF ID=1 OR AB=1 THEN RETURN
1630 U1=X1+A1: V1=Y1+B1:IFU1<1 ORU1>8 ORV1<1 OR V1>8 THEN RETURN
1640 IF S(U1,V1)=0 THEN GOSUB 1700:RETURN
1650 IF S(U1,V1)>0 THEN RETURN
1660 U1=U1+A1: V1=V1+B1:IF U1<1 OR U1>8 OR V1<1 OR V1>8 THEN RETURN
1670 IF S(U1,V1)=0 THEN GOSUB 1700
1680 RETURN
1690 REM SECOND MOVE GENERATOR
1700 UA=U1:VA=V1:XA=X1:YA=Y1:ED=8:GA=G1
1710 GOSUB 2040
1720 O1=O
1730 IF ID$<>"Y" AND O1>0 THEN GOSUB 1800
1740 IFAB$="Y"AND O0-O1 < R(0) THEN AB=1
1750 IFO1>T(0) THEN T(0)=O1:T(1)=X1  :T(2)=Y1:T(3)=U1  :T(4)=V1
1760 IFO1=T(0) AND RND(1)>.5 THEN T(0)=O1:T(1)=X1:T(2)=Y1:T(3)=U1:T(4)=V1
1770 O1=0
1780 RETURN
1790 REM THIRD LEVEL
1800 IFID$="Y"THEN GOSUB2000:IFTA-TB>ST-5THEN ID=1:RETURN
1810 A4=S(X1,Y1):A5=S(U1,V1):S(U1,V1)=S(X1,Y1):S(X1,Y1)=0
1820 IFABS(X1-U1)=2 THEN A6=S((X1+U1)/2,(Y1+V1)/2):S((X1+U1)/2,(Y1+V1)/2)=0
1830 FOR X2=1TO8: FOR Y2=1TO8
1840 IFS(X2,Y2)>-1 THEN 1870
1850 IFS(X2,Y2) = -1 THEN B2=G:FORA2=-1TO1 STEP2:GOSUB 1920:NEXT
1860 IFS(X2,Y2)=-2THEN FORB2=-1TO1STEP2:FORA2=-1TO1STEP2:GOSUB1920:NEXT:NEXT
1870 NEXTY2: NEXTX2
1880 S(X1,Y1)=A4:S(U1,V1)=A5
1890 IFABS(X1-U1)=2 THEN S((X1+U1)/2,(Y1+V1)/2)=A6
1900 RETURN
1910 REM THIRD MOVE GENERATOR
1920 U2=X2+A2:V2=Y2+B2:IF U2<1 OR U2>8 OR V2<1 OR V2>8 THEN RETURN
1930 IF S(U2,V2)<=0THENRETURN
1940 U2=U2+A2:V2=V2+B2:IF U2<1 OR U2>8 OR V2<1 OR V2>8 THEN RETURN
1950 IF S(U2,V2)=0 THEN GOSUB 1970
1960 RETURN
1970 O1 = O1 + P3 -9
1980 RETURN
1990 REM TIMER
2000 TI$=TI$
2010 TA=3600*VAL(LEFT$(TI$,2))+60*VAL(MID$(TI$,3,2))+VAL(RIGHT$(TI$,2))
2020 RETURN
2030 REM EVALUATION
2040 O=0: IF ID$="Y"THENGOSUB2000: IFTA-TB>ST-5 THENID=1:RETURN
2050 IFP1<7 OR P2<7 THEN GOSUB 2530
2060 CP=0:IF ABS(YA-VA)=2 THEN O=O+10:CP=1:IF GA=-1 THENO=O+20
2070 IF GA=-1 AND XA=3 AND YA=5 THEN O=O-.2
2080 IF GA =1 AND XA=6 AND YA=4 THEN O=O-.2
2090 FOR C =-1 TO 1 STEP2:IFUA+C<1ORUA+C>8 OR VA+GA<1ORVA+GA>8THEN2250
2100 IFS(UA+C,VA+GA)=GA OR S(UA+C,VA+GA)=2*GA THENO=O+1
2110 IFUA-C<1ORUA-C>8ORVA-GA<1ORVA-GA>8THEN 2250
2120 IFS(XA,YA)=2*GA THEN 2140
2130 GOTO2170
2140 IFS(UA+C,VA-C)=0ANDS(UA-C,VA+C)=0ANDS(UA-1,VA+C)=-2*GA THEN 2160
2150 GOTO2170
2160 IFS(UA+1,VA-C)=-2*GA THEN O=O+3
2170 IF(S(UA+C,VA+GA)=-GA OR S(UA+C,VA+GA)=-2*GA)THEN 2190
2180 GOTO 2200
2190 IF S(UA-C,VA-GA)=0 OR (UA-C=XA AND VA-GA=YA)THEN O=O-3
2200 IF S(UA+C,VA-GA)=-2*GAAND(S(UA-C,VA+GA)=0OR(UA-C=XANDVA+GA=YA))THENO=O-3
2210 IF S(UA+C,VA+GA)=-2*GA AND (UA-C=XA AND VA-GA=YA) THENO=O-3
2220 IFUA+2*C<1ORUA+2*C>8 OR VA+2*GA<1OR VA+2*GA>8THEN 2250
2230 IFS(UA+C,VA+GA)=0AND S(UA+2*C,VA+2*GA)=0 AND S(UA,VA+2*GA)=-GATHENO=O+.5
2240 IFS(UA+C,VA+GA)=0ANDS(UA+2*C,VA+2*GA)=0AND S(UA,VA+2*GA)=-2*GATHENO=O+.5
2250 NEXT C
2260 IF S(XA,YA)=2*GA THENO=O+.2:GOTO 2380
2270 REM MAN ONLY
2280 IFVA=ED THENO=O+2
2290 IFCP=1THEN FC=-2:FORFC=-2TO2STEP4:GOSUB2470:NEXT
2300 IFYA=ED - GA*2 THEN O=O+.2
2310 IFYA=ED - GA THEN O=O+.3
2320 IF YA=ED - 7*GA THENO=O-2.2
2330 IFXA=1OR XA=8THEN2360
2340 IF XA+1>8OR XA-1<1 OR YA-GA<1 OR YA-GA>8 THEN 2360
2350 IFS(XA+1,YA-GA)=2*GA OR S (XA-1,YA-GA)=-2*GA THENO=O+2
2360 IF UA=1 OR UA= 8 THENO=O+1:IFVA=ED THENO=O-1.2
2370 RETURN
2380 REM KING ONLY
2390 IF CP=1 THEN FORFB=-2TO2STEP4: FOR FC=-2TO2STEP4:GOSUB2470:NEXT:NEXT
2400 IFVA=5 AND(UA=3ORUA=4ORUA=5)THENO=O+.25
2410 IFVA=4 AND (UA=3ORUA=4ORUA=5)THENO=O+.25
2420 IFUA-1<1 OR UA+1>8 OR VA-GA<1OR VA-GA>8 THEN 2440
2430 IFS(UA-1,VA-GA)=-GA AND S(UA+1,VA-GA)=-GA THENO=O+1
2440 IFUA=1 OR UA=8 THENO=O-.5
2450 IF VA=1 OR VA=8 THEN O=O-.5
2460 RETURN
2470 UC=UA+FB:VC=VA+FC
2480 IFUC<1ORUC>8 OR VC<1ORVC>8THEN RETURN
2490 IFS(UC,VC)=0AND S((UC+UA)/2,(VC+VA)/2)=-GA THEN O=O+10
2500 IF S(UC,VC)=0 AND S((UC+UA)/2,(VC+VA)/2)=-2*GA THEN O=O+11
2510 RETURN
2520 REM ENDINGS
2530 IF GA = 1 THEN RETURN
2540 IF P2<6 AND P1>P2 THEN 2610
2550 IFU=3 AND S(U,1)>0 THEN O=O+2
2560 IFS(X,Y)<>-2 THEN 2650
2570 IFU=3 AND S(1,V)>0 THENO=O+2
2580 IFU=6 AND S(8,V)>0 THEN O=O+2
2590 IFU=6 AND S(U,8)>0 THEN O=O+2
2600 GOTO 2650
2610 IF(U=7AND V=1)OR(U=8AND V=2)OR(U=1ANDV=7)OR(U=2ANDV=8)THENO=O+1.5
2620 IF8-U>U-1 AND U-1>X-1 AND 8-V>8-Y THENO=O+.3:GOTO2650
2630 IF 8-U<X-1 AND U-1<V-1 THENO=O+.3
2640 IFU=1 OR U=8 OR V=1 OR V=8 THEN O=O-.35
2650 IFS(X,Y) <> -1 THEN 2740
2660 FOR I= V TO 1 STEP -1
2670 IF S(U,I)>0 THEN 2740
2680 IF U=8 AND S(U-1,I)>0THEN 2740
2690 IF U+1 >8 THEN 2740
2700 IF U=1 AND S(U+1,I)>0 THEN 2740
2710 IF S(U-1,I)>0 OR S(U+1,I)>0 THEN 2740
2720 NEXT I
2730 O = O + 1
2740 RETURN
```

THE AM SPEECH BOARD



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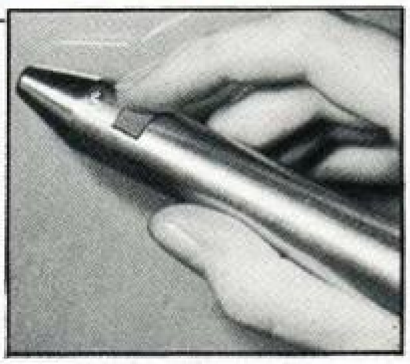

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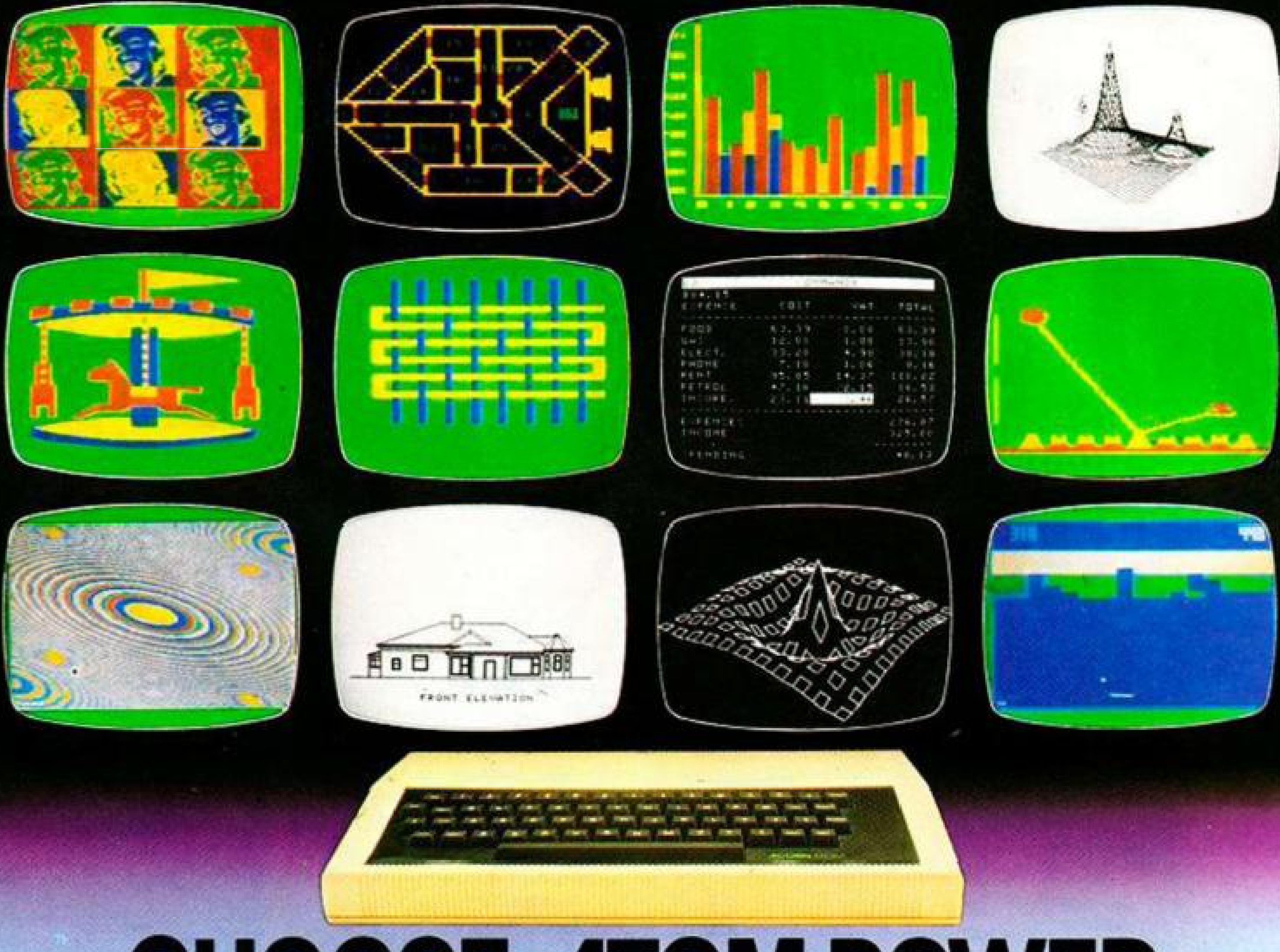

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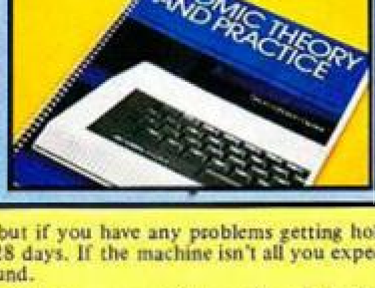

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High-resolution displays on the Vic-20

BY NICK HAMPSHIRE

The Vic-20 is a versatile machine capable of displaying normal alpha-numeric characters, user-definable characters and high-resolution point plotting. In this first of a series of articles on programming the Vic-20 Nick Hampshire explains how.

THE 255-CHARACTER alpha-numeric character set includes both upper- and lower-case characters and graphics characters. The standard character set can be displayed using Print commands or by Poking the character or ASCII code value into one of the video memory locations.

To generate user-definable characters or to plot points in high-resolution requires some special programming techniques. They are needed to change the system configuration to allow these display formats — displays which are possible only because of a very sophisticated integrated circuit, the 6561 Video Interface Chip. It is this chip which gives the Vic its name.

The Vic has three areas of memory which are utilised in displaying a character on the screen, these areas are:

- The video memory: where the code value of each character displayed on the screen is stored. Each memory location corresponds to a particular position on the screen, thus location 7680, the beginning of the 506 location video memory, corresponds to the top-left character space and 7681 is the next one to the right, and so on.
- The colour memory: this is another 506 location block of memory starting at location 38400. It contains the foreground and background colour for each character displayed. To give an example, by Poking the value 2 into location 38400, the top-left character is displayed as a red character on a white background.
- The character generator: this section of memory contains information on the appearance of each of the 255 characters in the character set. Each character uses eight memory locations to describe the pattern of dots from which the character is made. If the code value stored in a location in the video memory is 48, the pattern of dots to be displayed on the screen is stored in the 48th eight-location block of the character generator. The character generator uses 2,048 memory locations and the ROM containing information for displaying the normal character set starts at location 32768.

To use the display capabilities of the Vic to the full, it is essential that the function of each of these three memory locations is clearly understood. Part of the versatility of the 6561 integrated circuit which controls the Vic video display is that the user can change the location of either the video memory or the character generator.

If the position of the memory block used to contain the character generator is changed so that instead of a ROM with pre-defined characters it contains RAM memory, then user-definable characters can be created.

The location of the character-generator memory block is changed by altering the contents of one of the control registers of the 6561. The control registers can also be used to select whether the displayed character occupies the normal eight-by-eight dot matrix or an elongated eight-by-16 matrix.

The first stage in creating a user-definable character set is to allocate a block of RAM memory for storage of the character generator. If characters on an eight-by-eight matrix are being displayed, then 2,048 memory locations are required; if an eight-by-16 matrix is to be used, 4,096 locations are required.

Since a standard Vic only has 3,584 RAM memory locations available to the user, an eight-by-eight matrix user-definable character generator using 2,048 of these locations is the only one feasible.

The user RAM on a standard unexpanded Vic starts at memory address 4096 and goes on to address 7679. The character generator can be programmed to start at any of the following addresses within that range; 4096, 5120, 6144 or 7168. Since 2,048 locations are required for the character generator, the only possible starting location is clearly 5120.

This leaves 1,024 bytes free for user programs — which is not much; purchase of the standard 3K RAM expansion module is strongly recommended and its use will not change any of the programs or data in this article. This area of RAM chosen for use by the character generator must be protected from being overwritten by a Basic program or data. If this happened, the display would be destroyed.

The user-definable character generator can be protected from being overwritten by lowering the top of memory pointers, thus:

```
10 POKE 51,255 : POKE 52,19
11 POKE 55,255 : POKE 56,19
12 CLR
```

The next stage is to put the data about each character into the new character generator. This is done by using Poke commands to put information into the 2,048 memory locations. Before this can be done, each of the new characters must be designed which entails drawing each character on an eight-by-eight grid. See figure 1.

Once the character has been designed, it can be converted into the block of eight numerical values for storage in the character generator. Each line in the grid corresponds to a byte of data, and each of the eight bits in that byte corresponds to a dot or column position.

Information is stored in memory in binary, thus by considering each bright dot to be a logical "1" and each space a logical "0", a line of dots in each character can be converted into

(continued on next page)

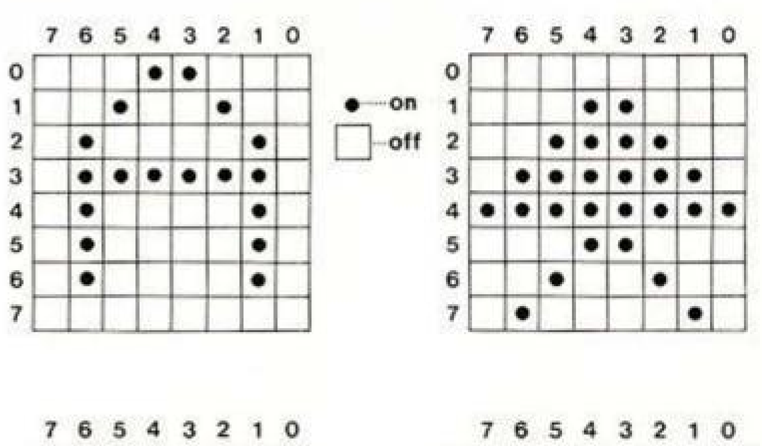


Figure 1.

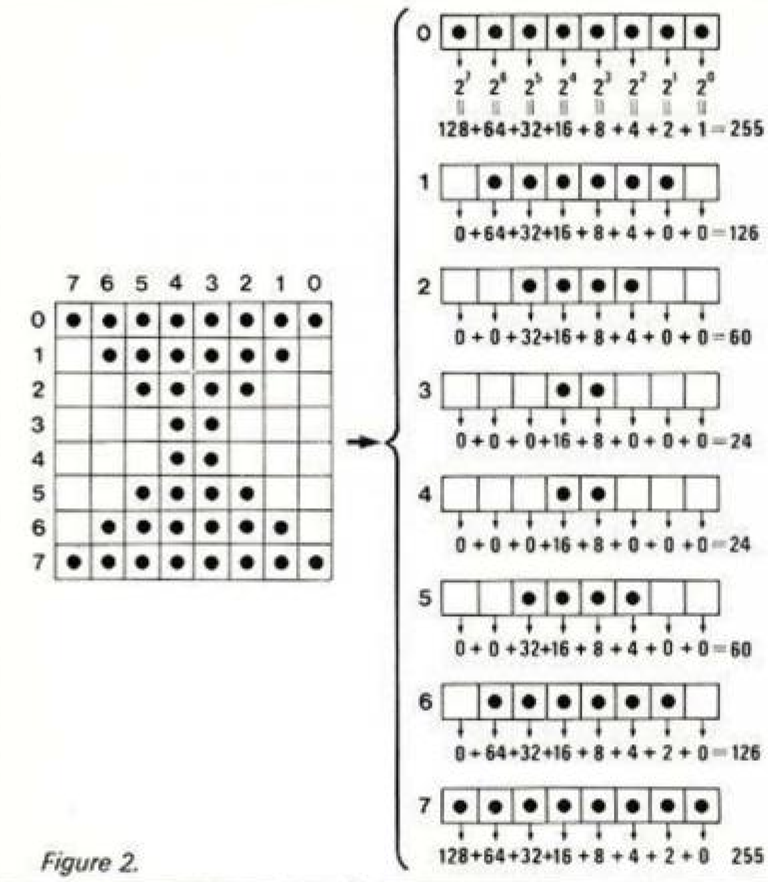


Figure 2.

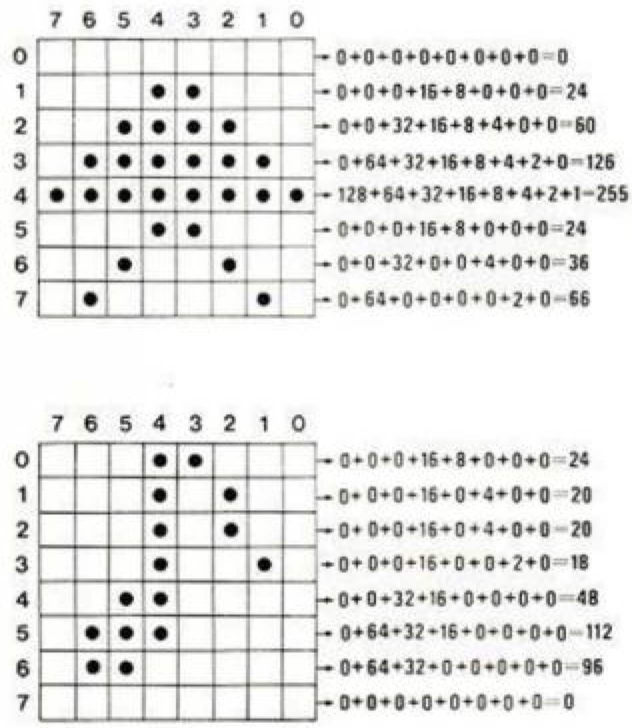


Figure 3.

(continued from previous page)

a numerical value. Figure 2 demonstrates this.

Some examples of character designs and their conversion to numerical values are shown in figure 3. From these values a table can be created. One column has the character-generator address. The corresponding entry in the second column has the value to be put into that location.

The table is divided into blocks of eight entries, each block containing the data for one character. Each of these blocks of eight entries is numbered starting at 0 and going up to 255. These numbers correspond to the ASCII or character-code number stored in the video RAM when the characters are displayed.

An example table using the character designs in figure 3, is shown in figure 4. The table need contain only the number of characters required — all 255 possible character blocks do not have to be filled. It is advisable, though, that the table starts at the first location in the character generator. Any gaps left should be filled with zeros. The values in the table are best stored as data statements. These values are then entered into memory using Poke commands, thus:

```
20 FOR 1=0 TO 2048
21 READ A
22 IF A="*" THEN 30
23 POKE 5120+I,A
24 NEXT
30 END

100 DATA 24,20,20,18,48,112,96,0
110 DATA 0,24,60,126,255,24,36,66
120 DATA 255,126,60,24,24,60,126,255
130 DATA*
```

In the majority of applications, alphanumeric characters are required in addition to user-defined graphics characters. In such cases, part of the data in the ROM-based character generator must be transferred to the new RAM character generator.

The first 128 characters of the ROM character generator are transferred to the new RAM character generator using a combination of Peek and Poke commands, thus:

```
20 FOR I=0 TO 1024
30 POKE 5120+I, PEEK(32768+I)
40 NEXTI
```

This leaves 128 possible user-definable characters starting at address 6155. These characters can be filled as described, and will have an ASCII code starting value of 128. An example of the routine to enter the character-generator data will be as follows:

```
20 FOR O=0 TO 1024
21 POKE 5120+I, PEEK(32768+I)
22 NEXT I
30 FOR I=0 TO 1024
31 READ A
32 IF A="*" THEN 200
33 POKE 6144+I,A
34 NEXT
60 REM DATA FOR ASCII CODE
   CHARACTERS 128, 129, AND 130
100 DATA 24,20,20,18,48,112,96,0
110 DATA 0,24,60,126,255,24;36,66
120 DATA 255,126,60,24,24,60,126,255
130 DATA *
```

Having loaded the user-definable character generator, it can be used. It will remain in the Vic until the machine is switched off and can thus be used by more than one program. To use the RAM character, two of the 6561 registers must be changed:

```
200 POKE 36869,253
210 POKE 36866, PEEK(36866) OR 128
```

Once the user-definable RAM character generator has been set up and the 6561 registers changed to utilise the new character generator it can be used to generate special displays. If Poke commands are used to place the characters in the video RAM memory, the ASCII code values of the new characters are used. If the new characters are incorporated into strings, it is essential to know which character in the normal character set the new character replaces.

This can be determined by using the table of Vic ASCII codes and looking for the character with the same code value as the new character. When the program is written, the normal characters are inserted into the string. When the program is run, they will be replaced by the new characters automatically.

It is important to note when using Poke commands that the colour RAM location corresponding to the location where the character is to be displayed must also be set to give the required colour — otherwise the display will be white on white and, therefore, invisible. To restore the normal function of the Vic ROM character generator, use the following two lines:

```
500 POKE 36869,240
510 POKE 36866,150
```

5120 — 24		
5121 — 20		
5122 — 20		
5123 — 18	Character code # 1 — (musical note)	
5124 — 48		
5125 — 112		
5126 — 96		
5127 — 0		
5128 — 0		
5129 — 24		
5130 — 60		
5131 — 126	Character code # 2 — (Space Invader)	
5132 — 255		
5133 — 24		
5134 — 36		
5135 — 66		
5136 — 0		
5137 — 0		
5138 — 0		

Figure 4.

High-resolution point plotting uses exactly the same principles as the generation of user-definable characters. Briefly, it entails filling the video RAM with each of the 255 character codes — only half the screen can be used with eight-by-eight characters.

The RAM character generator can then be used as a high-resolution memory-mapped display. If all bytes in the RAM character generator are set to zero, the screen is blank; set one bit in one of the characters and a single high-resolution dot will appear. ■

Flowcharting: the art of writing programs

BY COLIN WOODFORD

Drawing flowcharts before writing programs is a habit which can save many hours of debugging. It is not difficult and the symbols are easy to learn, argues Colin Woodford.

TO SOLVE a problem, we must first reduce it to a series of steps. For example, let us take the familiar problem of washing a plate in the kitchen sink. Here are the steps into which we can divide the problem:

1. Put plug into sink.
2. Open taps.
3. Squirt washing-up liquid into sink.
4. Fill sink to desired level.
5. Close taps.
6. Immerse plate in water.
7. Scrub plate with brush.
8. Rinse washing-up liquid from plate, under tap.
9. Put plate in draining rack.
10. Empty water from sink.

We could give these steps to anyone, so that they, too, could experience the exquisite sensation of washing egg stains from bone china. This series of steps, collectively, is called an algorithm.

An algorithm, like our example, is usually written in English, and is of a form which cannot be presented directly to a computer. A computer program, however, in Basic, Fortran, Algol 68 or whatever, can be fed into any suitable computer. There is, as far as I know, only one computer which can be programmed in English.

The tendency with the advent of the low-cost, personal microcomputer is for programming courses to omit algorithms and flowcharts, and to say instead: "Here is a pencil, here is some paper, write a program". The results are poor-quality programs, written in very bad Basic, on the back of telephone bills, and envelopes.

Some alumni of this school of programming claim that not writing flowcharts saves time. Others, I suspect, do not even know what a flowchart is. Another argument against flowcharts, is that if a problem seems trivial it's not worth drawing a flowchart.

In reply to the argument that flowcharts waste time, I would counter that the resulting program is desperately bad. So bad, in fact, that often many hours are spent in debugging the program. It has been said by many eminent programmers, that the more time spent in planning a program, the less time wasted on debugging it afterwards. Some programs are so bad that they cannot be debugged, and in the end, must be abandoned.

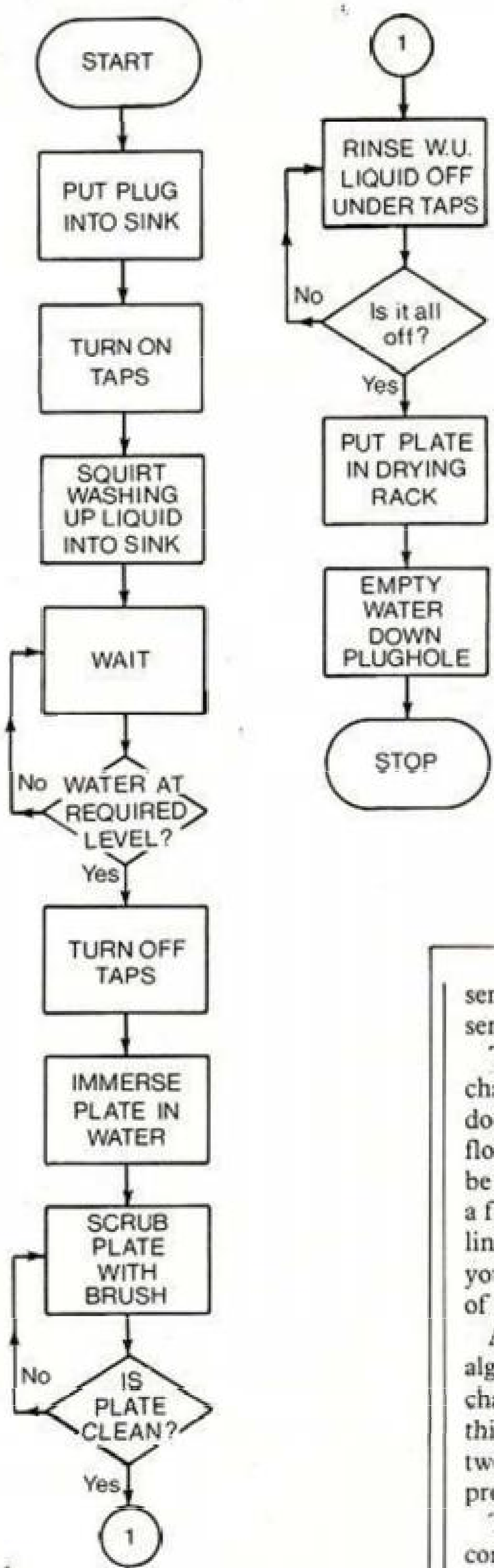


Figure 1.

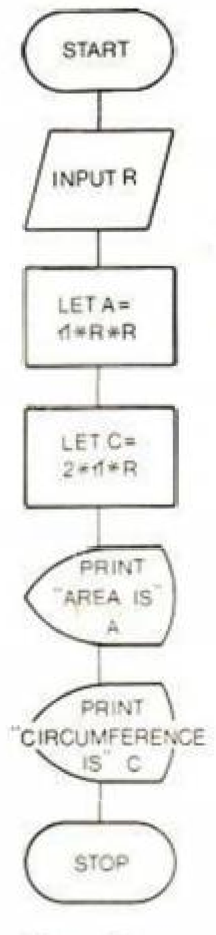


Figure 2.

The second argument that the problem does not merit a flowchart because of its triviality, can be discounted easily with a simple example. Two shepherds go to court, both charged with theft. The first shepherd, Bill, has stolen one sheep. The second shepherd, Joe, has stolen 10 sheep. Both men, however, will, and should, receive exactly the same sentence. Bill should not have a lighter sentence because he has stolen fewer sheep.

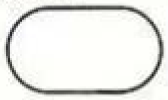
The same applies to programs and flowcharting. Just because a problem is small, it does not mean that it does not justify the use of flowcharts. Large or small, the program will be of a higher standard if it is first drawn with a flowchart. If you can write high-quality five-line programs with algorithms and flowcharts, you can write 5,000-line programs, too — and of the same high quality.

A flowchart is a kind of diagrammatical algorithm or program. Figure 1 shows a flowchart for the washing-up problem. The first thing to learn about flowcharts is that there are two kinds, the systems flowchart, and the program flowchart.

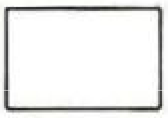
The systems flowchart shows how a computer system works, and does not concentrate on how data moves inside the computer. Figure 1 is an example of a systems flowchart. Systems flowcharts are the diagrammatical algorithms written in English.

Program flowcharts show the movement of data in a computer system, and are diagrammatical programs, written in, say, Basic or Fortran or Cobol. As you can see, from figure 1, flowcharts consist of symbols linked together with lines called flowlines. There are many symbols used to construct flowcharts, and here are some examples of them:

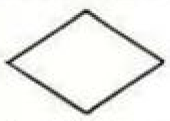
The first symbol is:



This shows a terminal point on the flowchart, for example the start or finish. Any process which changes form, location or value, is put inside this box:

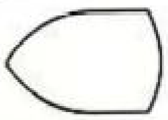


For example, the statement Let A=30 changes value and so goes inside a process symbol. A decision box is used to show conditional transfers on flowcharts:

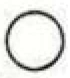


statements of the If-Then type, would fit inside it.

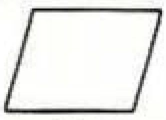
To display information on VDUs for example, using a Print statement, we would use a display symbol:



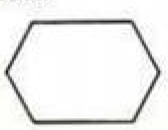
Two places on a flowchart, possibly some distance from each other, are connected by the connector symbol:



Statements pertaining to input and output fit inside the input/output symbol:



A process regarded as preparation, for example a Dim statement, would fit inside the preparation symbol:



To understand a flowchart is simplicity itself. First, start with the Start symbol and follow the flowlines in the direction of the arrowheads. Statements inside symbols are executed as you reach them.

On encountering a decision box, ask yourself the question inside the box. The answer you obtain determines which way you go next. For example, in figure 1, the first decision is "Is water at required level"? If you answer "yes", you take the path going downwards; if you answer "no", you take the right path.

The idea of the connector symbol, is to do away with long and confusing flowlines. When you reach a connector, you look at the number contained in the box and look for another connector symbol with the same number in it where the flowline continues. There, you continue to follow the flowline in the direction of the arrowhead.

One important fact to notice is that flowcharts move downwards. This makes them more understandable and is the convention.

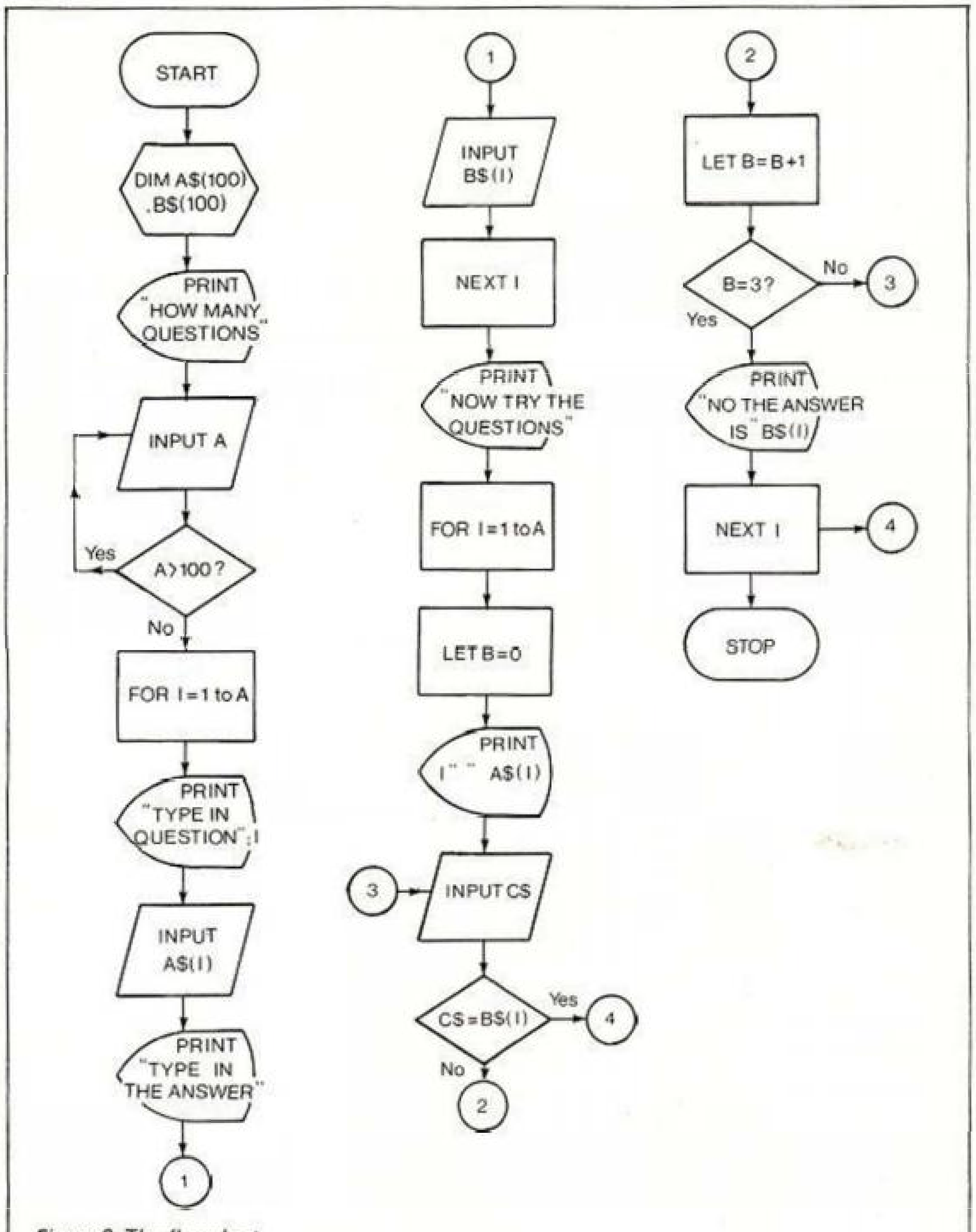


Figure 3. The flowchart.

Let us look at a program flowchart, figure 2. It is exactly the same as its counterpart, the systems flowchart, in all ways but one. This is, what is written inside the symbols.

Here is a problem, and we will see the correct way to solve it using algorithms and flowcharts. Problem 1 is to write a quiz program which allows the user to input questions and their answers, and then try to answer the questions again later. The applications for this program are mainly educational.

Figure 4. The program.

```
10 DIM A$(100),B$(100)
20 PRINT "HOW MANY QUESTIONS"
30 INPUT A
40 IF A>100 THEN 30
50 FOR I=1 TO A
60 PRINT "TYPE IN QUESTION";I
70 INPUT A$(I)
80 PRINT "TYPE IN THE ANSWER"
90 INPUT B$(I)
100 NEXT I
110 PRINT "NOW TRY THE QUESTIONS"
120 FOR I=1 TO A
130 LET B=0
140 PRINT I "." A$(I)
150 INPUT C$
160 IF C$=B$(I) THEN 200
170 LET B=B+1
180 IF B<>3 THEN 150
190 PRINT "NO, THE ANSWER IS " B$(I)
200 NEXT I
210 END
```

The program given is very rudimentary. It has been deliberately written like this so that it will run on most micros. The first stage in writing the quiz program is to write the algorithm. Algorithms, remember, are written in English, and not Basic and cannot be presented directly to a computer. The algorithm is:

1. Ask user how many questions — maximum 100.
2. Obtain questions from user.
3. Obtains answers from user.
4. Give user a question.
5. Obtain his answer.
6. If his answer is different from correct answer, go to 5.
7. Print a message.
8. If there are more questions, go to 4.
9. Stop.

This algorithm gives us a good clear idea of what the flowchart will look like.

You now know how to write algorithms, and draw flowcharts. You will notice the benefits to your programs, as you write more. One thing that is certain, your programs will be more logical and efficient and you will not spend as much time debugging. ■

A Peek and a Poke on the Acorn Atom

BY TIM HARTNELL

Even if you understand the principles of the Peek and Poke functions you might not realise how useful they can be when it comes to writing programs. Tim Hartnell works through some examples to demonstrate the main principles and then writes his own board game, making full use of the screen.

YOU HAVE probably noticed that the Atom Basic does not contain any functions called Peek and Poke. When Atom Basic was being written, it was decided not to incorporate Peek and Poke as two different functions, but to use the question mark and let the context of the use determine whether it was meant to mean Peek or Poke. For example:

```
PRINT ?#80
```

The question mark is used to represent Peek here — and the line means print the value stored at Hex address 80. If you wanted to change the number at this address, you would need to use a line like:

```
?#80=128
```

This time the question mark is used to represent Poke. Poke the address #80 with 128 — that is, change the number in address #80 to 128. The use of a question mark instead of Peek and Poke is an ingenious method. As well as being memory-saving, it is also quicker to input a "?" than Peek or Poke every time.

It was mentioned that the context of the use of the question mark determined whether it indicated Peek or Poke. Here are a few examples of typical occasions where Peek and Poke are used. First, Peek:

- PRINT ?#80 — print number in address #80
- IF ?#80=128 GOTO 10 — if the number in address #80 equals 128, go to line 10, if not, pass on to the next line of the program
- A=?#80 — let the variable A equal the number in address #80

Secondly, Poke:

- ?#80=128 — change number in address #80 to 128

You can see that the second use of Peek and the example of Poke are very similar, and it is only the prefixing by the conditional IF which determines whether

```
?#80=128
```

is a Poke or a Peek.

Now that we have discussed the theory of Peeking and Poking, let us try a few examples. We shall look at Peeking first. Address #E1 is where the value of the cursor is stored. Try typing in:

```
PRINT ?#E1
```

If all has gone well, when you pressed Return the Atom Peeked the value stored at #E1 and printed that value on the screen. It should have printed out 128, the code for an inverse space. Now try this one:

```
PRINT ?#1
```

You should obtain the answer 0. Now try it again in a slightly different form:

```
10 PRINT ?#1
```

As we have now given it a line number, you will have to use the command Run. You will now obtain the answer 10. Try running it with different line numbers which are less than 256. You can see that the answer corresponds to the line number, because address #1 — and #2 for numbers greater than 255 — contains the Basic line number of the line being executed.

Try looking at other addresses using the Peek command. If you want to look at a block of addresses you could use the following program:

```
FOR A=0TO100;PRINT A?#0;NEXT
```

Now that we have seen a little of what Peek can do, let us turn our attention to Poke. If you remember, we used the example of

```
PRINT ?#E1
```

while discussing Peeking.

We peeked the address #E1 and found it contained 128, the code for an inverse space. We can change this value using the Poke command to dramatic effect. Try this:

```
?#E1=0
```

You should find that the cursor has disappeared. We have, in effect, turned the cursor off. To turn it on again, Poke address #E1 with 128:

```
?#E1=128
```

Try Poking this address with different values up to 255 and see what you obtain.

The contents of addresses #°000 to #81FF have been set aside to hold the screen information at one character cell per address or byte. This is for the character mode only..

If you use any of the graphics modes — except for Clear 0 — you will use another specific block of memory. The address of the top left-hand cell of the screen is #8000. Try typing:

```
?#8000=1
```

The letter A should appear in the top left-hand corner of the screen.

```
?#8010=1
```

The letter A should now appear in the middle of the top line of the screen, as #10 equals 16 in decimal, which is half of 32, the number of characters along a line.

It is the value you stored in address #8010 which determines the character displayed on the screen, and 256 characters can be displayed. They are the characters with codes between 0 and 255. The complete character code can be shown on the screen by running this short routine:

```
FOR A=0 TO 222;A?#8000=A;N.
```

As well as Poking directly on to the screen, we can Peek the addresses to discover what is in a particular position on the screen. We can see which character is where on the screen, but the Atom can only tell what is on the screen by Peeking the addresses. Try entering, and running:

```
?#8010=1;PRINT ?#8010
```

The first half of the line Pokes the character 1 — the letter A — into the middle of the top line of the screen. The second half Peeks address #8010 and prints the value stored there. It is one in this case because we have just Poked one into it. If you Peek the next address or any other blank square on the screen, you will obtain the value 32, the value for a space.

The best way to appreciate Peeking and Poking the TV is to see it in action. The following two programs have been annotated step by step so you can see exactly what is going on.

In the game of Malachi, your piece appears as an asterisk on the right-hand side of the board. The Atom's pieces are exclamation marks on the four left-hand squares of the board. Your piece can move in four directions:

```
1     2

3     4
```

The object of Malachi is to eliminate all four of the Atom's pieces in the shortest number of moves. To eliminate one, you have to land on it — but the Atom has a few nasty tricks up its sleeve.

At random intervals throughout the game, the Atom will play its defender pieces — inverse greater than signs — on the next row out from the exclamation marks. You must clear the row of the defenders to win the game.

The game automatically stops when this row is cleared, even if some exclamation marks have survived.

Here is how we went about writing Malachi.

```
10 P.$12;@=0;C=0;D=150
50 P."(6 SPACES 10 ASTERISKS)" '
60 F.E=1TO4;P."(6 SPACES)" "$#2A"
   "$128" "$128" ""$128" "$128,$#2A
```

Note: there is a single space within the quote marks in line 60 and 70.

```
70 P."(6 SPACES)"$#2A,$128" "$128"
   "$128" "$#2";N;
80 P."(6 SPACES 10 ASTERISKS)" ' '
```

Line 10 clears the screen, sets the numeric field to zero and assigns the variables. C is the number of turns you take and D is the base score from which C is subtracted to give you your score.

(continued on page 37)

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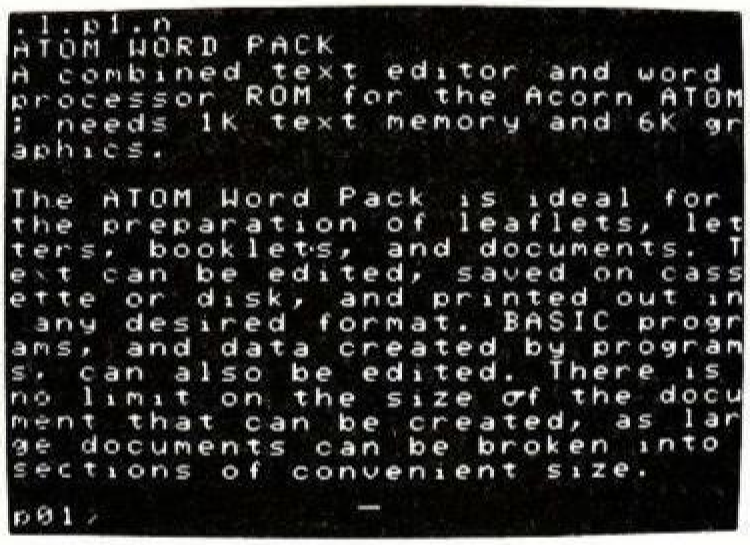

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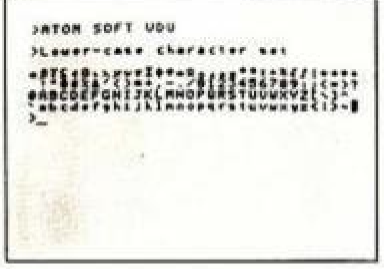

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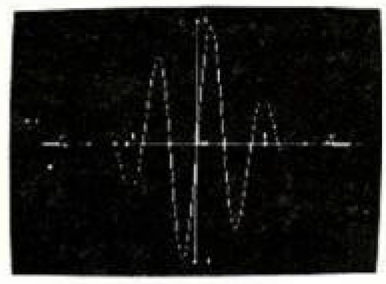

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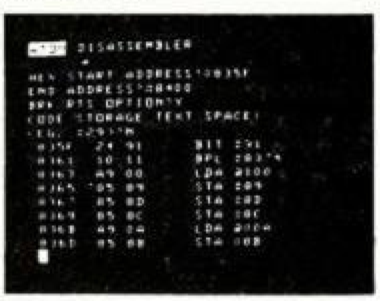

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(continued from page 35)

Lines 50 to 80 print out the board, using inverse spaces and asterisks. The asterisks are just to give the board a border.

```
110 F=71;F.G=1TO4;F?#8000
    =#A1;F=F+64;N.
```

Line 110 Pokes the Atom's exclamation marks into their positions on the board. The variable F is set to 71 which, when added to #8000, gives us the address of the first white left-hand side square of the board.

This address is Poked with the code for a exclamation mark.

F is then incremented by 64 to give us the address of the cell in the same position along the line, but two lines lower. That is, the next white square down the left of the board. The loop from one to four Pokes all four of the Atom's exclamation marks into place.

```
160 H=174;H?#8000=#AA
```

The Atom now Pokes your piece into place. The variable H is set to 174, which, when added to #8000, gives us the address of the third white square down the right side of the board. Code #AA is the code for an asterisk.

```
180 P."WHICH DIRECTION WILL YOU
    MOVE";IN.A;P.$11
200 C=C+1;F=71+((A.R.%4+1)*64)
```

The board is set ready for play, so the Atom asks you for your move. The command P. $11 at the end of line 180 is very important at this point. If the screen scrolls upwards, the characters move from the cells. So, to stop this happening, we use $11, which moves the cursor back up one line.

In line 200 the number of moves you have had is increased by one. The variable F is set to correspond to one of the four squares with exclamation marks when added to #8000. This is to determine which of the four base squares has the chance of sending a Defender piece into the next row.

```
250 K=A.R.%4+1;IF K  2 G.310
270 IF K=1 F=F+33
280 IF K=2 F=F-31
```

The variable K is set to a random number between one and four. If the random number is greater than two, the Atom does not send out a defender piece but skips the following routine and goes to line 310. However, if the number is one or two, the Atom decides where to send the defender piece.

```
250 IF F?#8000=74 G.320
300 F?#8000=#BE
```

Once it has made its choice, it checks to see if the square it has chosen is vacant. In other words, it Peeks the address F#8000. If address F#8000 contains the value 74 — the ASCII code for the asterisk — the Atom knows that it has chosen a square off the board and forfeits its move.

If the Peeked value of F#8000 does not equal 74, it means that it has chosen a valid square on the board. Line 300 then proceeds to Poke the value #BE into that address.

```
310 H?#8000=127
320 IF A=1 H=H-33
330 IF A=2 H=H+31
340 IF A=3 H=H+33
350 IF A=4 H=H-31
```

The variable H, you may remember, is assigned to the number which, when added to #8000, gives the address of your playing piece. The square your piece occupies is made blank — Poked with 127. H is then re-set depending on the direction in which you decided to move.

```
360 IF H?#8000=74 G.160
370 H?#8000=#AA; IF C<5G.180
```

If you decide to move off the board, line 360 will stop you and send you back to the start. In the same way that the Atom checks if it is moving off the board, it checks to see if you are trying to move off the board. Assuming you have moved correctly, the Atom Pokes your piece — the inverted asterisk — into your chosen square.

The If condition at the end of line 370 stops the Atom going into the win-check routine for the first five moves, because it is possible to make the Atom's second row blank before the first defender piece is positioned.

```
400 IF ?#8028<>190;IF?#8068<>190;
    IF?#80A8<>
    190;IF?#80EA<>190 G.a.
410 G.180
```

Line 400 is the win-check routine. It takes advantage of the way Atom logic is formed. The Atom will Peek each of its second-row squares in turn, and only if the value found is not equal to 190 — the value of the greater than character — will it pass along the line to check the next square.

If, and only if, all four squares contain values not equal to 190 will the Atom obey the command G.a. If at least one of the squares contains a defender, the Atom will be sent to line 180 to continue the game.

```
415 a T=71;R=0
420 IFT?#8000=#A1 C=C+10
425 T=T+64;R=R+1; IF R  4. G.420
430 F.W=1TO60;WAIT;N.;P.'
440 P."END OF GAME"''D-C"
    POINTS";END
```

Using lines 420 and 425, the Atom checks to see if you have taken all its pieces. If the Peeked value of an address equals #A1, it means that an exclamation mark is still present, and 10 is added to your score. After a short wait, your final score is printed as 150 minus the number of moves you took, plus any for forfeits for leaving any exclamation marks behind. The higher the score, the better.

As a contrast to the game of Malachi, we have included a rather amusing little game called Tartan Army. We shall not analyse this game as deeply as we did the previous one, since there is no point in explaining the same points twice.

You are a lone policeman, an inverted asterisk, on duty outside Wembley. You have several police vans with you — the letter Os. The crowd pour out after the game, and a rampage begins. How many hooligans can you arrest by landing on the same square before they overturn all of your police vans or do you a personal injury — which is much more painful than an impersonal injury.

You can move anywhere on the white area of the screen by entering a number — 1 is one square to the right; 32 is one square above; 64 is two squares below; and so on.

```
5 P.$12;@=0
10 F.F=1TO320;P.$128;N.
```

Lines 5 and 10 clear the screen and print out the white patrol area.

```
20 T=0;F.F=0TO319;K=A.R.%25;IF K=1
   F?#8000=#8F
30 IF K<>1 F?#8000=127
40 N.
120 X=A.R.%320;X?#8000=#AA
```

Line 20 decides where to put the police vans, character #8F, and line 120 decides where your policeman, character #AA, starts his beat.

```
130 M=0
150 F.F=1TO320;IF F?#8000=#8F M=M+1
160 N.
240 P.' "HOOLIGANS ARRESTED: "T"
    ''"POLICE VANS LEFT: "M"
250 P."(6 SPACES)"'';P.$11;P.$11
260 IF M<>1 G.c
370 IN.Z;W=X+Z
```

Line 150 checks how many police vans are left. Line 240 prints out the current situation. You earn one point for each hooligan you arrest. The instructions to move the cursor up two lines

```
P.$11;P.$11
```

are very important. If you do not include them, the scrolling caused by the printing would corrupt the screen positions and ruin the game.

Line 260 checks to see if you have any vans left.

```
390 IF W?#8000=143 G.a
400 IF W?#8000=190 G.b
405 IF W?#8000 127 P.$11;G.370
```

These three lines use the Peek function to check what value was stored in the square to which you have just moved. If it was 143, inverse letter 0, you go to subroutine "a" where you lose five points for overturning your police van.

However, if it is a 190, an inverse greater than, you go to subroutine "b" where you gain a point for successfully arresting a hooligan. If the value was not one of these, and is not a 127, you must have moved off the patrol area, and so your move is rejected.

```
406 X?#8000=127
410 W?#8000=170;X=W
```

The computer now Pokes your policeman into his new position.

```
440 F.F.=1TO A.R.%9+1;Q=A.R.%320;IF
    Q?#8000=170 G.c
450 Q?#8000=#BE;N.
470 F.F=1TO4;P.$11;N.;G.130
```

but the Atom takes its revenge by increasing the size of the crowd. If the computer wants to Poke a hooligan on to the square your policeman occupies, subroutine "c" is called:

```
500a T=T-5;G.406
510b T=T+1;G.406
520c P.$7;F.F=1TO100;X?#8000=#66;
     WAIT;X?#8000=#59;WAIT;N.
530  X?#8000=#BA; F.F.=1TO4;
     P.$11;N.;P.''';F.F=1TO4;P.$11;N.
540 P."YOU HAVE HAD IT" ';P.$11
550 P."YOU HAVE HAD IT" ';P.$11;G.540
```

Subroutine "c" — lines 520 to 550 — deserve some mention. P.$7 causes the Atom to give a short beep. The rest of the line rapidly Pokes alternating graphical characters into the square where your hapless policeman was standing. He finally ends up as a colon.

Lines 550 and 540 alternatively print out the words

YOU HAVE HAD IT

in ordinary then inverse letters. Moving the cursor up each time gives a flashing effect and keeps the display intact. ■

Old or new ZX Rom: how to make the switch

BY STEPHEN ADAMS

Converting programs written for the old Rom ZX-80 to run under the new Rom is time-consuming. Many owners of the new Rom have preferred to scrap their old programs and start building a new collection. In this article Stephen Adams presents his own alternative — putting both Roms into the ZX-80 and switching between them.

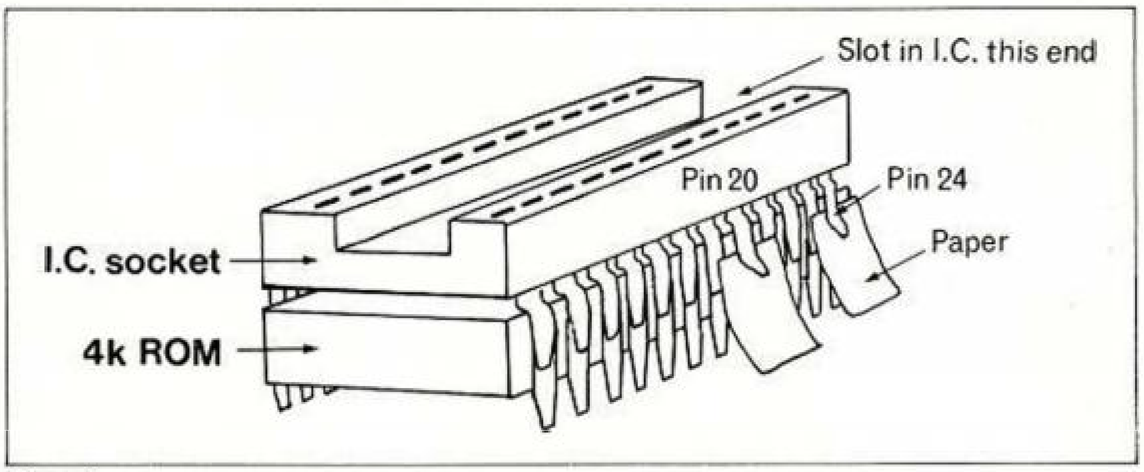

Figure 1.

AFTER WAITING six months for my new ROM from Sinclair, a brown paper package finally popped through the door. I fitted it and sat back to read the manual — then I realised I had a problem. It seems that the set-up of the RAM and various stacks meant that there was very little chance of converting my taped programs to run on the new ROM without re-typing in every listing again.

Not only would the listing have to be re-typed, but all the Peeks and Pokes in some of them would have to be different. This meant I would also have to discover how the programs work before doing that. Plus some of the programs contain machine code which uses routines within the ROM which are not there in the new 8K ROM.

Thus all my 60 old programs were so much old tape unless I could find some way of fitting the old 4K ROM back into the ZX-80. Yet, I still wanted to have my new ROM as well, so some method would have to be found of fitting them both in unless I wanted to pay for another ZX-80.

Having already found that both ROMs go into the same socket with no changes to the internal circuitry, my first task was to go to the circuit diagram to see what the connections were to the ROM.

Both ROMs are connected to all the address lines A0-A12 giving an 8K range, but I suspect that the A12 pin is disconnected internally in the 4K ROM as it has no effect. The other lines were +5 volts — pin 24 — 0 volts — pin 12 — not chip select line — CS, pin 20 — and, of course, the data lines.

This means that the two ROMs could be turned on separately if only the CS signal could be switched to only one ROM at a time. The only problem is that both ROMs occupy the same address space and cannot be moved as the Basic depends on them being there.

The only answer, therefore, was to put in a manual switch and either use the ZX-80 as a 8K ROM machine or 4K ROM one. That meant that any changeover of the ROM would also have re-set the ZX-80 so that the Basic might set itself properly. This Newing clears the RAM memory so that no programs or variables can be swopped between Basics. To re-set the ZX-80, pull out the power plug at the back and re-insert it after five seconds.

A 24-pin Dual In Line, DIL, integrated-circuit socket was bought from a local electronics shop and soldered to the top of the old 4K ROM as in figure 1. As the 4K ROM had been replaced by the 8K ROM in the machine, this was easily done, but remember: never do any soldering with the power on.

The only pins which were not soldered to the 4K ROM were pins 20, CS, and pin 24, +5 volts power. These were left to protrude at the sides with a piece of paper between the pins of the ROM and the socket to isolate them. These pins were then soldered to four 6 in. long pieces of coloured wire. Different colours were used to identify the different pins, and it is a good idea if you write down the colours for each pin as you do it.

Having done that, the 8K ROM was removed from the socket on the board very carefully using a small screwdriver to ease it gently from both ends. Great care should be taken not to bend the pins. Now, just as gently, re-insert the 4K ROM into the ZX-80 making sure that pins 20 and 24 of the ROM do not go into the holes in the socket, but protrude at the side of it. Also check that all the pins that protrude make no contact with any other components on the printed-circuit board.

Quantity	Components
1	Double-poled change-over switch. Cost: £1
1	24-pin IC socket. Cost: 50p
6	6in. pieces of coloured wire. Cost: 10p

Tools required
Soldering iron, solder, pliers, paper, screwdriver

Next, remove the entire printed-circuit board from its case. First pushing out the pins holding down the keyboard by applying a screwdriver to the centre of the fastener beneath the ZX-80 and pushing upwards until the centre pin rises from the top.

Secondly, the other fasteners inside the ZX-80 should be removed by pinching the tops with a pair of pliers and pushing them out of the bottom of the case. Both methods are shown in figure 2.

Turn the printed-circuit board over so that the integrated circuits are on the bottom, and find the ROM socket — it is the only one with 24 pins. Pin 20 is the fifth pin down from the right-hand side if you have the keyboard nearest to you. Solder another coloured wire on to this pin, making sure it cannot make contact with any other printed-circuit track or adjacent pins.

Mount the board back into the case securing it with the fasteners, but do not put on the top. Also make sure that the wire from pin 20 of the boards ROM socket runs up the side of the board to lay over the outside edge of the case. Solder a further coloured wire on to the large metal pad next to pin 24 of the ROM socket — this is the top pin on the right-hand side near the cassette sockets. This pad is at +5 volts from the ZX-80 internal regulator.

Now we have six coloured wires, four from the PROM and new socket, and two from the board. I hope you know which is which. The switch I used was a slide switch, but any switch can be used that will:

- Fit in the case without shorting out or touching any components on the printed-circuit board.
- Is a double-sided change-over switch.

The switch wiring is given in figure 3 and a

(continued on next page)

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circuit diagram in figure 4. Any badly-soldered joints here can result in a lost program, so pick a good switch and check all the joints after doing them.

Mount the switch in any spare space on the case — but not too far away from the ROMs as this can lead to problems. Do not forget to mark the switch positions as to which ROM you are using.

To test, switch to the 4K ROM position and apply power to the ZX-80. The reverse "K" cursor should appear showing that the ROM is being used. If if does not, check the switch and other connections. Having made the 4K ROM work, remove the power lead again and insert very carefully the new 8K ROM into its new socket on top of the 4K ROM.

Change the switch to the 8K ROM on the change-over switch and put back in the power lead. The reverse "K" cursor should appear, but this time with a long wait from switch-on. Again check the connections if this does not occur.

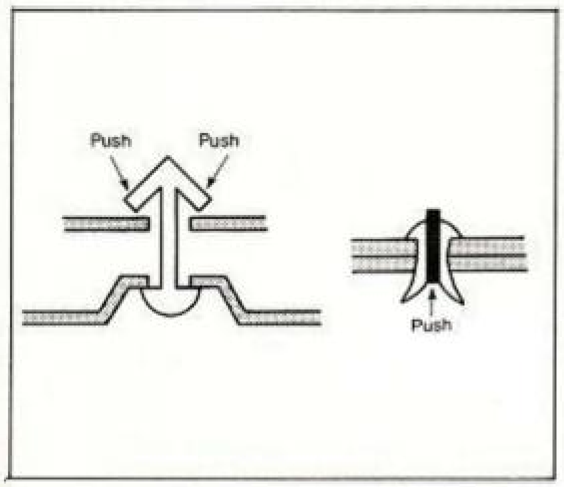
Now replace the top of ZX-80. If you have difficulty in making the cover secure because of the protruding ROMs, replace the pins holding the cover with six BA screws and nuts. This will leave about .5in. gap at the right-hand side of cover, but if it is unsightly cover the gap with some 1in. wide insulating tape.

Always remove the power from the ZX-80 before switching ROMs. This not only stops damage to the ROMs, but also re-sets the ZX-80 so that at switch-on, the ROM will set the correct operating conditions for its Basic in RAM. Failure to do this will lead to the ZX-80 becoming stuck or a crash. The only way out of a crash is to re-set the ZX-80 by removing the power or if you have fitted a re-set switch, by pressing it.

As the first thing both ROMs do is to clear the memory from top to bottom, there is no way to transfer anything in memory between different ROM programs. So, 4K and 8K ROM programs can now be run on the ZX-80, but not together. So that you do not lose your program, always Save it before changing ROMs to run another.

I still find that the 4K ROM has advantages over the 8K ROM when writing some programs as, although it only has integer arithmetic, it is much more economical on memory than the 8K one. So, some programs are written in 4K ROM and some in 8K ROM, but the choice is at last mine. ■

Figure 2. Fasteners.



The ZX-80 with a new Rom template.

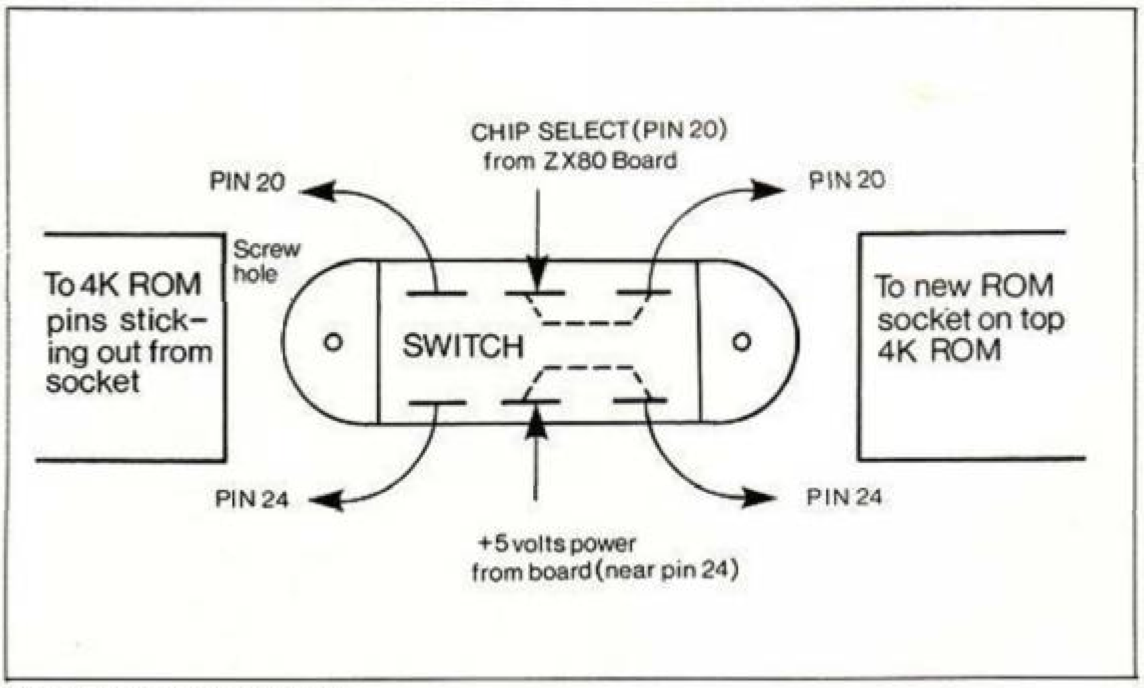
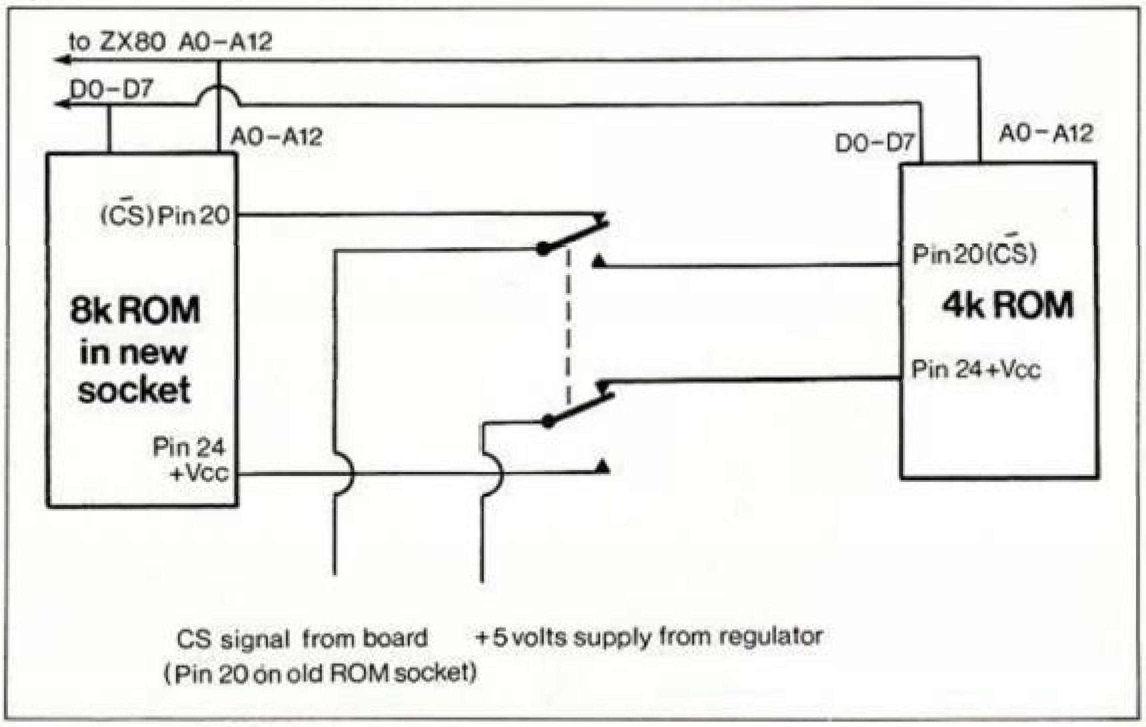


Figure 3. Switch connections.

Figure 4. Circuit diagrams.



sinclair ZX81

PERSONAL COMPUTER

Sinclair ZX81 Personal Comp
the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclair ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.

New BASIC manual

Every ZX81 comes with a comprehensive, specially-written manual – a complete course in BASIC programming, from first principles to complex programs.

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

New, improved specification

- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

How the ZX81 compares with other personal computers

SYSTEM IDENTIFICATION		ZX81	ZX80	ACORN ATOM	APPLE II PLUS	PET 2001	TRS 80 LEVEL I	TRS 80 LEVEL II
ROM		8K	4K	8K	8K	14K	4K	12K
GUIDE PRICE	Basic unit – inc. VAT	£70	£100	£175	£630	£435	£290	£375
	Unit plus 16K RAM (*12K RAM)	£120	£150	£285*	£630	£530	£360	£375
COMMANDS	LIST, LOAD, NEW, RUN, SAVE	●	●	●	●	●	●	●
STATEMENTS	PRINT, INPUT, LET, GOTO, GOSUB/RETURN, FOR/NEXT IF/THEN	●	●	●	●	●	●	●
	STEP	●		●	●	●	●	●
	TAB	●			●	●	●	●
ARITHMETIC	ABS, RND	●	●	●	●	●	●	●
FUNCTIONS	INT	●			●	●	●	●
	ATN, COS, EXP, LOG, SGN, SIN, SQR, TAN	●			●	●		●
	ARCSIN, ARCOS	●						
STRING	CHR$	●	●		●	●		●
FUNCTIONS	LEN	●		●	●	●		●
	ASC(CODE), STR$, VAL, INKEY$	●				●		●
NUMBERS	FLOATING PT $\pm 10^{\pm 38}$	●			●	●	●	●
	INTEGERS		●	●	●	●		●
NUMERIC	A-Z			●			●	
VARIABLES	AA-ZØ				●	●		●
	An-Zn, n = any alphanumeric string	●	●					
STRING	A$ & B$						●	
VARIABLES	A$ to Z$	●	●	●				
	An$ to Zn$ n = any alphanumeric character				●	●		●
NUMERIC	SINGLE DIMENSIONAL		●	●			●	
ARRAYS	MULTI DIMENSIONAL	●			●	●		●
DISPLAY	ROWS	24	24	16	24	25	16	16
	COLUMNS	32	32	32	40	40	64	64
	LOW RES GRAPHICS (<7000 pixels)	●	●	●	●	●	●	●
	HI RES GRAPHICS (>40000 pixels)			●	●			
SPECIAL	USR (CALL, LINK)	●	●	●	●	●		●
FEATURES	PEEK, POKE (OR EQUIV)	●	●	●	●	●		●

Sinclair software on cassette.

The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with others to form single-subject cassettes.

Software currently available includes games, junior education, and business/household management systems. You'll receive a Sinclair ZX Software catalogue with your ZX81 – or see our separate advertisement in this magazine.

The ultimate course in ZX81 BASIC programming.

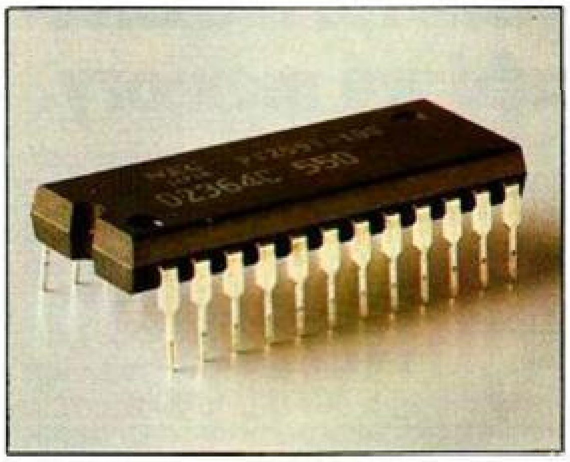
Some people prefer to learn their programming from books. For them, the ZX81 BASIC manual is ideal.

But many have expressed a preference to learn *on* the machine, *through* the machine. Hence the new cassette-based ZX81 Learning Lab.

The package comprises a 160-page manual and 8 cassettes. 20 programs, each demonstrating a particular aspect of ZX81 programming, are spread over 6 of the cassettes. The other two are blank practice cassettes.

Full details with your Sinclair ZX81.

If you own a Sinclair ZX80...



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

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

sinclair
ZX81

6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: (0276) 66104 & 21282.

REVIEW

MICROTAN 65 BY JOHN DAWSON

The construction of the kit version of the Tangerine Microtan was described by John Dawson in *Your Computer* June/July 1981. This review covers the use of the Microtan central processor unit and Tanex boards.

THE TANGERINE Microtan 65 is an excellent computer system both for laboratory/school use and for those who are learning about computing and/or who want a computer system which can be started for very little money and genuinely expanded at a rate that the user can afford.

The *Microtan companion* and the Toolkit EPROM — for which Microtanic Software has gained official approval from Tangerine — are indispensable additions to the system for anyone wishing to develop non-trivial software or who wants to know about the intricacies, the nooks and crannies of the machine and how it may be used most efficiently.

The Microtan computer system is constructed on a number of boards which plug into a rigid backbone or mother board. Figure 1 is a block diagram of the CPU card and Tanex, the expansion board. Both cards are necessary before the system can be expanded any further since the data bus is buffered on the expansion board. There are also dedicated links on the mother board from the CPU card to the Tanex. The remaining slots on the back plane are supplied by way of Tanbus lines.

Each board measures 20.3cm. by 11.5cm. and is connected to the back plane by a high-quality plug and socket. Half Eurocards will also accept the same connector and Vero make a half Eurocard prototyping board which can be plugged directly on to the Tanbus. The Eurocard dimensions are 10cm. by 16cm. and will fit into the system rack although, if it is to be supported by the rack slides, it will require a small amount of additional work.

You can use the CPU board as a microcomputer in its own right — it has an input capability — either the alpha-numeric keyboard or the Hexadecimal keypad — and an output function — the UHF modulator which connects to a standard 625-line television aerial socket. It is, however, only possible to save data and programs on tape if the Tanex board is connected into the system.

The Tanbug monitor allows machine-code processing using the 1,024 bytes of RAM on the board. Half the RAM is used by the video-display logic to provide a memory-mapped

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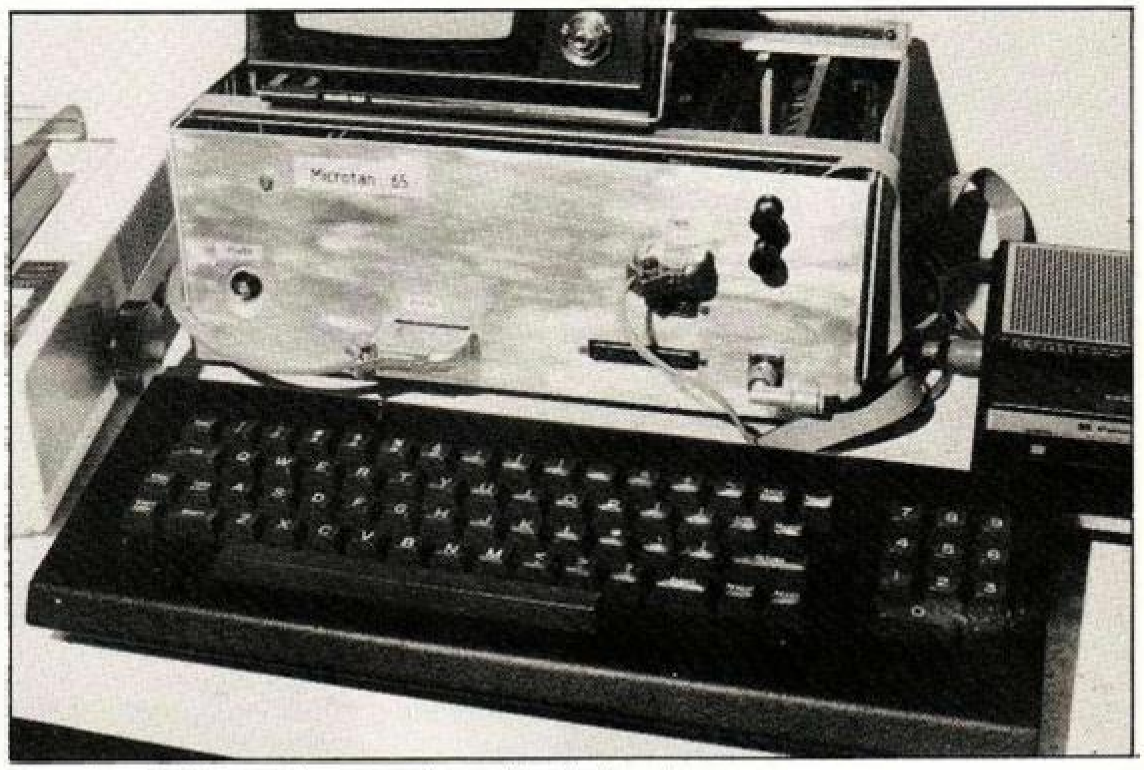
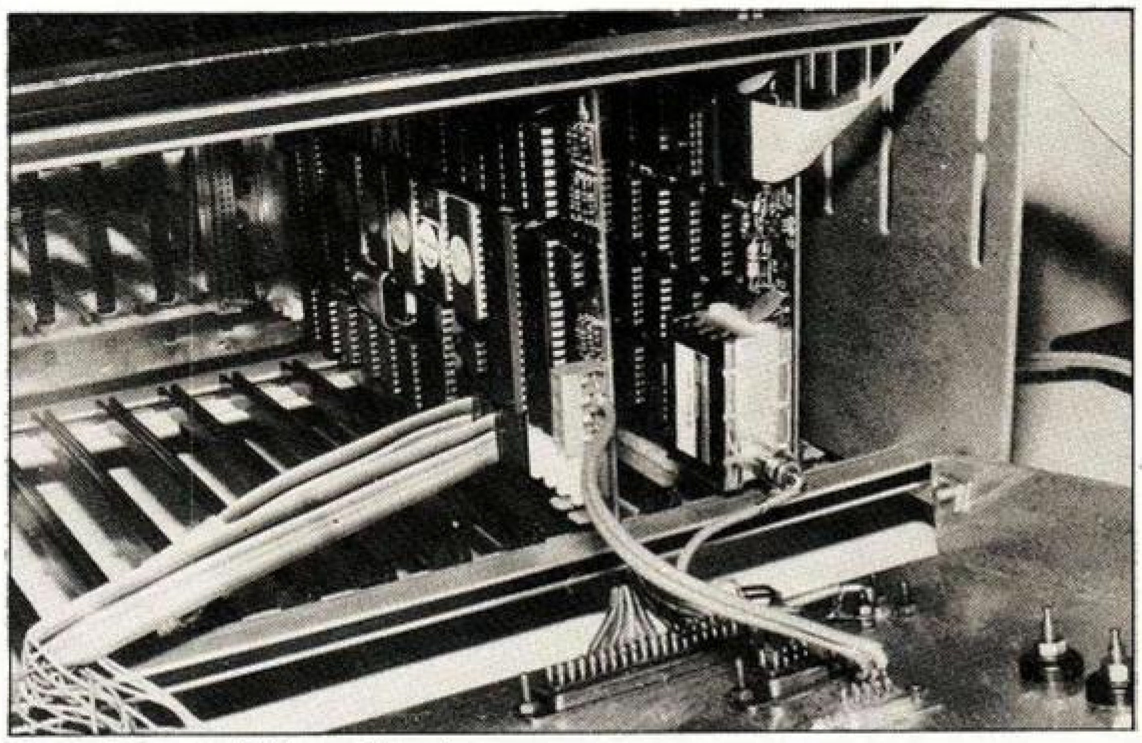


Close view of Microtan 65 — note the excellent keyboard



Mounted Tanex and Microtan 65 cards

Figure 3. Graphics demonstration routine to produce a sine wave

```
LIST

 10 £10,0: FOR J=1 TO 63
 20 £0,J,31+20 * SIN(J/5)
 30 NEXT J
 40 WAIT 49139,128
 50 £9,32
OK
```

Figure 4. Routine displays zero-page activity on top half of screen

```
L1FCF,8
1FCF A9 4C 85 10 A9 E9 85 11
1FD7 A9 1F 85 12 A9 C0 8D EB
1FDF BF 8D EE BF 8D E5 BF 4C
1FE7 4B FC 48 8A 48 A2 00 BD
1FEF 00 00 9D 00 02 E8 D0 F7
1FF7 A9 C0 8D E7 BF 68 AA 68
1FFF 40
```

(continued from previous page)

display of 32 columns by 16 rows. The type font produced by the character generator is unusually clear.

The second phase of the clock is used to avoid conflict between the CPU and the video logic and, consequently, the display is rock-solid without the snow on the screen which characterises less well-designed systems.

Additional integrated circuits to enhance the upper-case display are available from Tangerine and give lower-case letters and the ASCII graphics characters, and a set of 256 chunky graphics pixels 64×64=256. Again, for someone wishing to invest in a system at a price which corresponds to his spending power, this is convenient. The Microtan works perfectly with the original upper-case display and this can be enhanced by plugging in the extra chips as and when the user decides. No changes are necessary to the CPU board itself.

Figure 2 sets out the Tanbus connections — the lines which begin with DMA are intended for direct memory access and DMAPOT and DMAPIN establish a daisy-chain for setting priority of access in a DMA operation. There is both a non-maskable interrupt line and an open-collector interrupt request line.

The 6502 differs from the Z-80 CPU in that all input and output is memory-mapped and there are no separate I/O ports. An I/O line is provided on Tanbus so that you need decode only input/output addresses in the 1K I/O memory space rather than the full 65K address range.

Although it is not stated in Tangerine advertisements, the Tanram board which holds 40K of dynamic RAM can be paged by the new version of Tanbug, and the system rack, holding eight Tanram cards, can be expanded to a total core capacity of 328Kbytes.

Tanbug has evolved through a number of versions, of which the most recent is Tanbug 2.3. Tanbug is the machine-code monitor for the Microtan 65 and contains the fundamental input and output routines for the computer as well as the routines necessary for implementing the monitor commands.

At least 14 commands are available to the user — full documentation for the 2.3 version is being prepared — from either the Hexadecimal keypad or the full alpha-numeric keyboard. The commands, with a brief description of their function, are set out in table 1.

A major change in the new issue is the provision of software to drive a Centronics interface to a printer. The printer is turned on and off manually by typing Control P and data that is sent to the VDU is then echoed to the printer. The printer may also be switched on or off in a program by Basic instructions:

POKE 0, 144 turns the printer on
POKE 0, 128 turns the printer off

Command of the printer depends on one bit in memory location 0 and it would be better practice to logically-And the bits in the location, but the Poke instruction works well.

Tanbug is an elegant, logical and easy-to-use monitor. The terminator keys — carriage return, line-feed and escape — are used when modifying a memory location to execute a command and return to the main monitor, execute a command and proceed to the next higher memory location, and execute a command and return to the previous location.

These actions are carried through consistently into the editing commands for the Basic interpreter. The line-feed key, for example, updates the current line of Basic and then opens the next line for further editing. Uniformity of the system commands is part of the dialogue design standards which are a crucial element in making a computer friendly to the person who uses it.

The heavy manual supplied with the Microtan 65 CPU board lists the monitor software and gives, among many other things, details of Tanbug and examples of how routines in the monitor can be built into programs written by the user.

Xbug is a 2716 EPROM which contains cassette file-handling routines, and a simple assembler/disassembler package. The Tanbug monitor recognises the presence of Xbug on the Tanex board and the Xbug facilities can be accessed directly by monitor commands. The Xbug commands are described in table 1 and it seems a shame that the cursor and terminator keys could not have been standardised completely with the rest of the software.

The line-by-line assembler — Translator — and disassembler allow you to type standard 6502 assembler mnemonics. When the Microtan receives a carriage return, the line is checked for errors in the syntax and then translated into machine code.

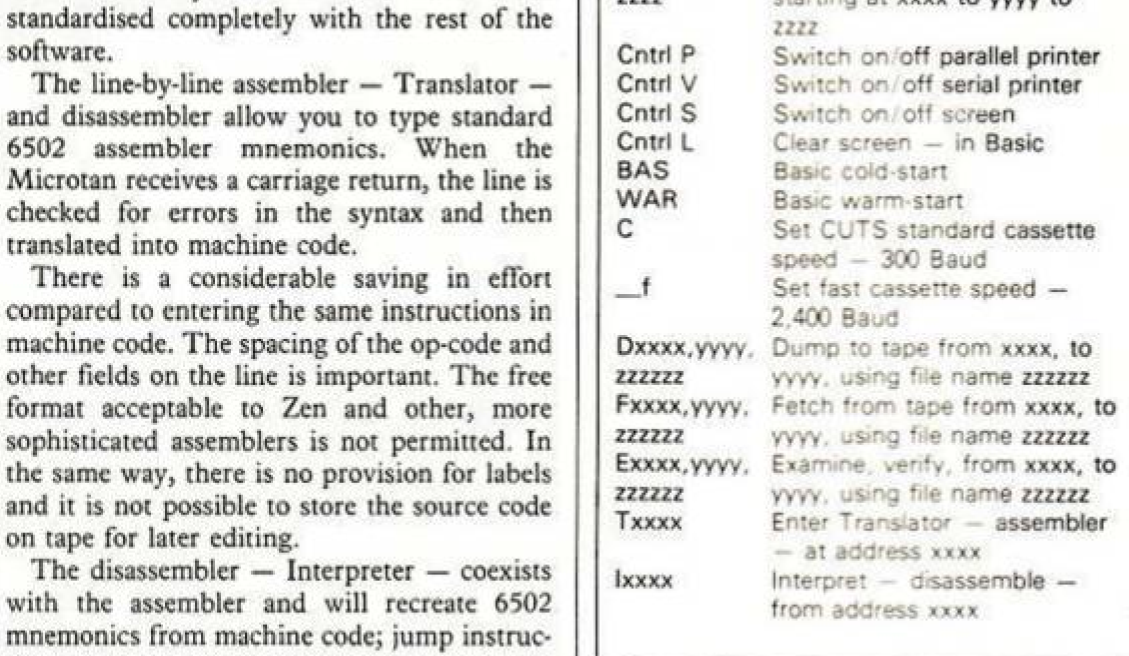
There is a considerable saving in effort compared to entering the same instructions in machine code. The spacing of the op-code and other fields on the line is important. The free format acceptable to Zen and other, more sophisticated assemblers is not permitted. In the same way, there is no provision for labels and it is not possible to store the source code on tape for later editing.

The disassembler — Interpreter — coexists with the assembler and will recreate 6502 mnemonics from machine code; jump instructions and subroutine calls display the absolute address to which the jump will be made. Once again, it is not possible to edit the disassembled lines. The fact that the two

Command	Function
RESET	Initialise system and display Tanbug mesage
Mxxxx	Modify memory at Hexadecimal address xxxx
LF	Step up through memory
esc	Step down through memory
space	Re-open currently-displayed memory location
cr	Close currently-displayed memory location
Lxxxx,y	List y lines of memory starting at address xxxx
Gxxxx	Go, begin program execution at address xxxx
R	Display pseudo-processor register locations
S	Set single-step mode
N	Return to normal mode — clear single step
P	Proceed, past break-point or next instruction — single step
Bxxxx,y	Set break-point number y at location xxxx
B	Clear breakpoints
Oxxxx,yyyy	Calculate offset between addresses xxxx and yyyy for branch instruction
Cxxxx,yyyy, zzzz	Copy block of memory starting at xxxx to yyyy to zzzz
Cntrl P	Switch on/off parallel printer
Cntrl V	Switch on/off serial printer
Cntrl S	Switch on/off screen
Cntrl L	Clear screen — in Basic
BAS	Basic cold-start
WAR	Basic warm-start
C	Set CUTS standard cassette speed — 300 Baud
_f	Set fast cassette speed — 2,400 Baud
Dxxxx,yyyy, zzzzzz	Dump to tape from xxxx, to yyyy, using file name zzzzzz
Fxxxx,yyyy, zzzzzz	Fetch from tape from xxxx, to yyyy, using file name zzzzzz
Exxxx,yyyy, zzzzzz	Examine, verify, from xxxx, to yyyy, using file name zzzzzz
Txxxx	Enter Translator — assembler — at address xxxx
Ixxxx	Interpret — disassemble — from address xxxx

Table 1. The Tanbug commands

Figure 1. Block diagram of Microtan and Tanex boards



b	a	
+5	+5	1
CLK	DMAREQ	2
01	02	3
RST	I/O	4
A1	A0	5
A3	A2	6
A5	A4	7
A7	A6	8
A9	A8	9
A11	A10	10
A13	A12	11
A15	A14	12
DMAGNT	IRQ	13
FB	NMI	14
DMAPOT	DMAPIN	15
IOE	RAME	16
ROME	R/W	17
SYNC	HB	18
	DB0	19
	DB1	20
	DB2	21
	DB3	22
	DB4	23
	DB5	24
	DB6	25
	DB7	26
		27
		28
		29
+12	+12	30
−12	−12	31
GND	GND	32

Figure 2. Tanbus connections

packages are permanently in the system and can be called instantly by a single-letter command reduces some of the disadvantages I have mentioned.

Why do you need to keep source code on tape when machine code can be stored, read back into the computer and disassembled instantly? However, the lack of the facilitiy to introduce new lines of code into a program displacing the rest of the program upwards, and re-computing any relative or absolute jump instructions is a noticeable limitation.

The Translator calculates relative jumps automatically and is probably worth having for that reason alone, as it requires less keyboard work and thought than the Offset command in the monitor.

The hardware and software combination in the Microtan 65 for dumping and fetching data to and from cassette tapes is extremely reliable at the standard Computer User's Tape System, CUTS, speed of 300 baud. The high-speed Tangerine format runs at 2,400 baud and requires more careful adjustment of the volume control level and a little more care in choosing a suitable cassette recorder. There is, of course, a test program in the Xbug manual.

The Basic interpreter for the Microtan 65 is supplied in three ROM chips which plug into the Tanex board. The interpreter occupies 10Kbytes and uses Xbug for the tape input and output routines. The Basic users' manual supplied by Tangerine with the interpreter integrated circuits has more than 80 pages of well thought-out and presented information.

The text is interspersed with many examples and would be a good general teaching manual for Basic. The value of the manual is increased in comparison to other Basic interpreters and has been written in English for a U.K. computer.

You do not have to cope with U.S. witticisms or translate the text from the Kim, Sym, Aim and Apple, Pet system specific tracts. The examples range from an immediate print statement:

PRINT 1/2, 3*10 (*means multiply, / means divide)

to the derivation of trigonometric functions such as the hyperbolic and inverse hyperbolic ratios and a simple routine for sorting lists of string data.

The examples are pure in that they are intended to show how the Basic language works rather than to demonstrate specific applications for the machine. The machine does not have the Acorn Atom's instant facility for entering assembler/machine code; nor are there instructions such as 'Print Using', If-Then-Else, or Print @.

Deek and Doke are absent and you cannot directly open and close a data file on tape. I confess that none of these omissions is particularly worrying or limiting except perhaps the If-Then-Else instruction, which I can achieve in any case with one extra line in a program.

On balance, I think that the machine's advantages lie with orthodoxy particularly when the *Microtan companion* book is available for those who wish to adopt a radical approach to their programming. The techniques in the *Microtan companion* for extending the machine-code call instruction, USR (I), should keep many people occupied for a considerable time.

The *Microtan companion* and the EPROM Toolkit give an extra dimension to the Tangerine Microtan. The EPROM contains a number of extraordinarily useful additional commands including, among others:

Control A	Clear screen and set alpha mode
Control G	Clear screen and set graphics mode
Control N	Autoline numbering
Append	Append a named file from tape
Re-number	Re-numbers lines, Goto and Gosub instructions
Control Z	Calculates a decimal number from an entered Hexadecimal number
# 0 to # 10	Powerful machine-code graphics routines

The Append command is worth the price of the chip alone as it makes serious programming possible by the development of sub-routines which can be stored on tape and then incorporated into other programs at a later date. For example, I shall store a standard set of printer routines on tape for use with an Epsom MX-80 F/T.

The graphics instructions are another giant leap forward for Tangerine owners. The routines are very fast and flexible, the VDU can be filled faster than your eye can twinkle and figure 3 is a listing of a demonstration program.

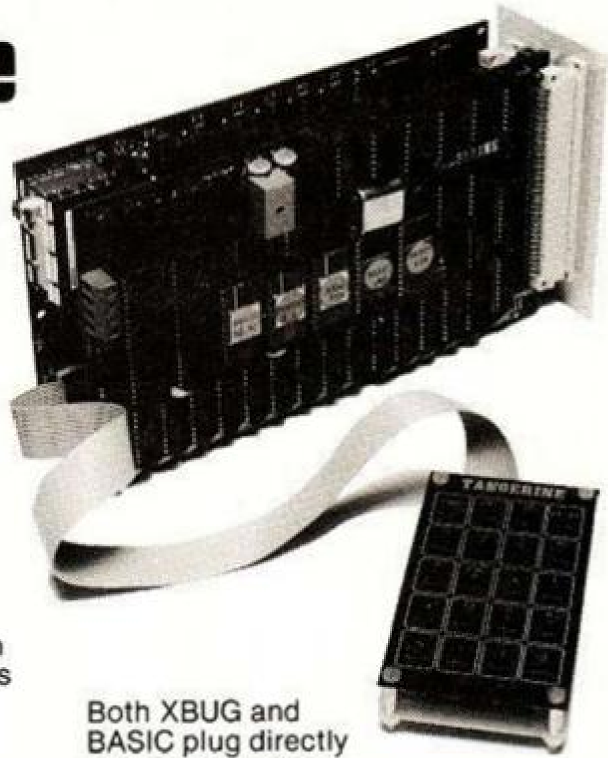
Having started by saying grandly that the Tangerine system reminds me of fine equipment, it is a little embarrassing to have to confess that the first integrated circuit containing the new Tanbug 2.3 which I received appeared to be faulty. Even Rolls Royces go wrong sometimes and then malfunctions occur; it is the attitudes of the manufacturer which are vitally important.

I have visited many small computer companies and there is an enormous diversity of management styles and staff attitudes. Some are disorganised, others are autocratic and repressive, others are friendly and enthusiastic. When I visited Tangerine I liked the attitudes as well as any I have seen anywhere. It should be self-evident that staff motivation and attitudes to work are an integral part of running a business successfully. ■

CONCLUSIONS

- The next product from Tangerine will be the Tangerine Tiger, which may be a packaged twin processor computer aimed at the domestic rather than the laboratory/hobby markets.
- External expansion from the Tiger may be by connection to the Microtan range of cards.
- Such a logical expansion based on bus compatibility between the Tiger and the Microtan would provide peace of mind for anyone who is considering buying a Microtan 65.
- Apart from its successful sales figures, the company's future plans are based on a complementary development of another system rather than the production of a second changed model of the Microtan.
- A high-resolution board offering 256 by 256 points and black-and-white graphics should be available soon and a disc operating system is also under development.
- Finally, you may like to try a program from the *Microtan companion* to whet your appetite for the book.
- Figure 4 is a machine-code program which displays the zero-page activity on the top half of the screen when another program is running: the machine-code instructions use a 6522 VIA in the second socket on the Tanex board.
- Enter the code, execute the program by G IFCF and enter Basic; protect the program by answering 8100 to "Memory Size?" and then be fascinated.
- Both the Toolkit and the *Microtan companion* enhance what is already a most attractive computer.

Step by step with the computer system designed for tomorrow.



Microtan 65

£79·00 +VAT Ready Built

£69·00 +VAT Kit

* ★ 6502 Microprocessor
* ★ 2K Monitor TANBUG
* ★ Intelligent socket accepts keypad or full ASCII Keyboard
* ★ Chunky Graphics and Lower Case Options
* ★ Connects to unmodified B/W or Colour TV

For the first time buyer or experienced user, Microtan 65 is a superb route into personal computing. If you are looking for a sophisticated machine with the capability of expansion into a professional system, then this is the computer for you. Step by step with the computer system designed for tomorrow. . . .

6502 Microprocessor
Probably the most popular CPU (central processing unit) for personal computers, having a powerful instruction set and architecture.

2K Monitor TANBUG
The built-in 'mind' of the machine, TANBUG controls all system functions and gives comprehensive machine-code facilities. Functions include:- set and clear breakpoints, single step through program, execute program, copy block of memory, modify memory locations and much more.

Intelligent keyboard socket
For absolute beginners we can supply an easy to use 20-way Hex keypad; for the more experienced user there is a full typewriter style ASCII keyboard. Either way, Microtan will work out exactly which type you are using and act appropriately.

Chunky Graphics Options
For drawing simple lines and graphs, or for animated games, Chunky Graphics is a low cost answer. This set of chips plug into the Microtan board and allow graphics to be built up on the screen at a resolution of 64 rows by 64 columns.

Lower Case Option
To extend the character set to 128 characters, allows for real descenders on lower case characters and a set of extra symbols and characters for simple graphics.

Microtan Accessories
20-way Hex keypad MPS 1 Basic power supply
Aerial connector lead
Full ASCII Keyboard
MPS 2 Full system power supply
Mini — motherboard

Microtan is available ready-built or as a kit. We recommend that you should have some soldering experience before attempting the Microtan Kit, although if you do run into problems you can make use of our "Get you Going" service (telephone for details).

TANEX

* ★ 7K Static Ram
* ★ 10K Microsoft Basic
* ★ 32 Parallel I/O lines
* ★ 1 Serial I/O port
* ★ XBUG
* ★ Cassette Interface

The first step in expanding your system. Tanex provides the extra facilities necessary for the serious programmer. Memory expansion: Tanex has provisions for up to 7K of static RAM and up to 14K of EPROM using 2716 or 2732 chips.

XBUG and BASIC
XBUG is a 2K extension to TANBUG that contains a mnemonic assembler and disassembler and cassette firmware running at 300 Baud CUTS, standard or high speed, 2400 Baud Tangerine standard with 6 character filenames. Tangerine have taken out a full O.E.M. licence for Microsoft BASIC, the microcomputer industry standard, this is a full feature implementation with interrupt and machine code handling, and a superb program editor. Both XBUG and BASIC plug directly into Tanex and are supplied with comprehensive user manuals.

Parallel I/O
When fully expanded Tanex includes two V.I.A.s (Versatile Interface Adaptors) which implement the cassette interface and the parallel I/O ports. Software in TANBUG V2.3 enables you to plug in and use a Centronics type printer. The two V.I.A.s also contain counter timers that can be used for a variety of applications enhanced by the use of the integral handshake facilities.

Serial I/O
Also on the expanded board is a serial I/O port that can be used to interface RS232 or 20Ma loop terminals or VDU's, again all controlled by TANBUG V2.3.

Whether Tanex is purchased in a minimum or maximum configuration, Tanex will buffer the data bus and configure the system memory map for maximum expansion.

To complete Tanex, a comprehensive user guide is supplied which contains full constructional details. This manual is also available separately.

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PROJECT

CONTROLLING ELECTRIC

In his last article John Dawson showed how a radio-controlled transmitter and receiver could be used with a computer, and built a radio-controlled pen recorder. Having shown in principle that a computer can be used as a remote device he now explains how DC electric motors can be controlled.

THE CHARACTERISTICS of shunt and series-wound DC motors can be complex. In them, electromagnets are used to generate a magnetic field inside which the rotor spins. The development of magnets made from rare-earth ceramic materials has produced far greater field strengths. Permanent-magnet DC motors are now used in many applications which would not have been feasible 10 or 15 years ago.

The concurrent development also of large power transistors, Darlington power transistors and, most recently, power field-effect transistors, FETs, permits the regulation of DC motors by using techniques such as pulse-width modulation, PWM, of the voltage applied to the motor.

New DC permanent-magnet motors are still expensive, but the excellent high-torque motor illustrated is available at a cost of £3 to £5. The motor is a windscreen wiper motor from a Datsun 120A and I obtained it from a car breakers.

The motor runs on 12V, can be reversed by reversing the polarity of the applied voltage, weighs 1kg. and consumes slightly less than 1 amp with no load. There are three brushes on the commutator inside the motor which are set at different angles, and various speeds can be achieved by switching the power supply between them.

The output shaft of the motor drives a worm-reduction gear which has a ratio of approximately 80:1 which slows the final shaft output speed to between 40 and 60 revolutions per minute, rpm. The gear driven by the worm is made of plastic, and inside the housing for the reduction drive there are two contacts which are connected when a metal segment on the plastic gear rotates past them.

At the output shaft, the motor has considerable torque. When the motor is stalled, which is impossible by gripping the shaft, the current consumption rises to between 3 and 4 amps.

The output shaft on the motor in the illustration is just under 2.5cm. — 1in. — long, which is unusual and makes this model much simpler to use. The wheel in the photograph is 15cm. in diameter — 6in. — and is available from many hardware shops. It is intended as a replacement wheel for domestic appliances and children's toys.

The wheel is a loose fit on the output shaft from the motor and if the retaining nut from the windscreen wiper motor shaft is forced into the hub of the wheel, a mechanically-inelegant but practical connection may be made.

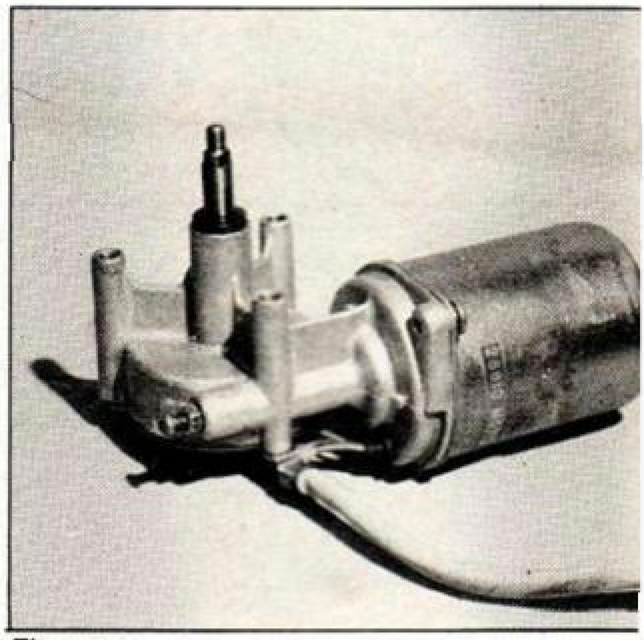
When the motor unit is mounted as one of two drive units on a remotely-controlled trolley, it will need a pin through the wheel hub and the axle to transmit both forward and reverse drive.

The Acoms AP-435 digital proportional radio-control system, which serves as our radio-control interface, was described in the last article. The servos used as actuators for model control are connected to the receiver by three wires. The red and black wires carry power from the 6V receiver battery to the servo and the control signal is transmitted as a series of variable width pulses down the third, white wire.

Figure 1 illustrates the PWM signal that sets the output from the servo. The horizontal scale in the figure is distorted to emphasise the change in width of the signal pulses.

Within the 20ms. period, a pulse for each of the four proportional channels is transmitted. One of the purposes of the receiver is to demultiplex the incoming stream of digital information, routeing information from the correct input channel, used for joystick movement, on the transmitter to each servo.

Clearly, the transmitter will need to send some information with each package of control data to synchronise the receiver. Taking into



The motor

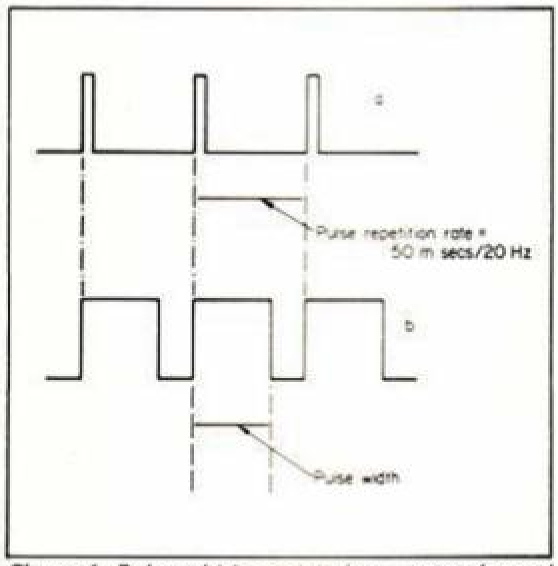
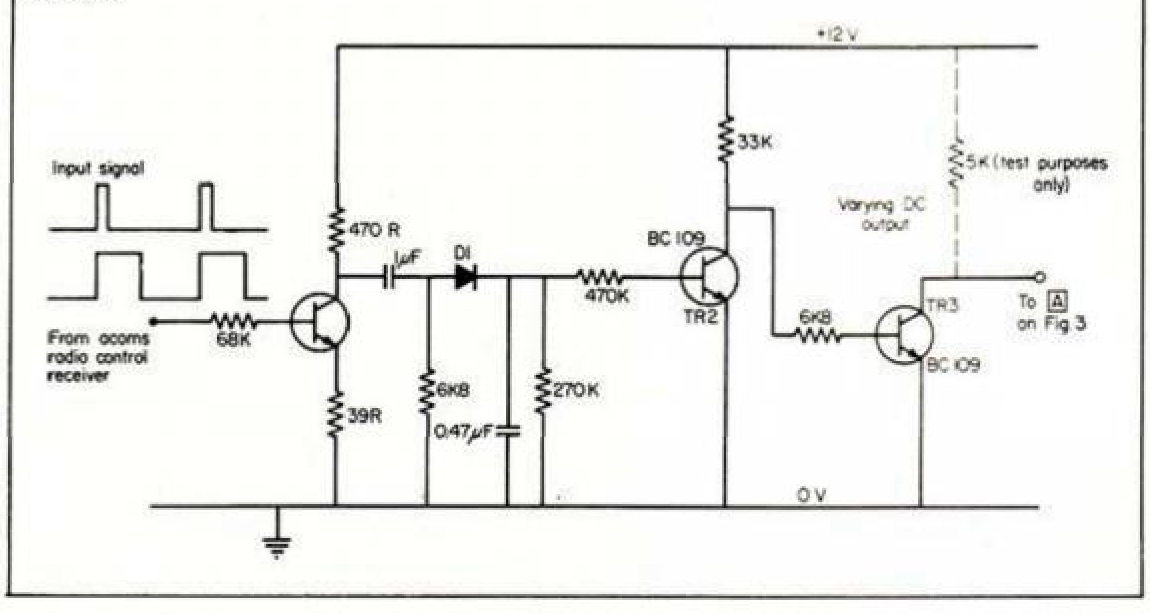


Figure 1. Pulse width modulation — one channel output from radio control receiver

Figure 2. Radio control PWM to analogue interface



MOTORS

The motor with wheel attached

account the fifth output socket on the radio-control receiver, you might expect that the maximum pulse width from one channel would be between 3 and 4 ms. — 3.5 × 5 = 17.5ms. total.

In fact the pulse width varies from 0.5ms. to 3.5ms. when the input to the transmitter encoder chip is connected to ground or +5V respectively.

The pulse stream output from the radio-control receiver cannot be used directly to control a motor as the duty cycle varies over a limited range — 0.5 to 3.5ms. repeated every 20ms. equals 2.5 percent to 17.5 percent. Effective PWM of a DC motor requires a duty cycle which is variable from close to zero to 100 percent.

Figure 3. Motor interface circuit

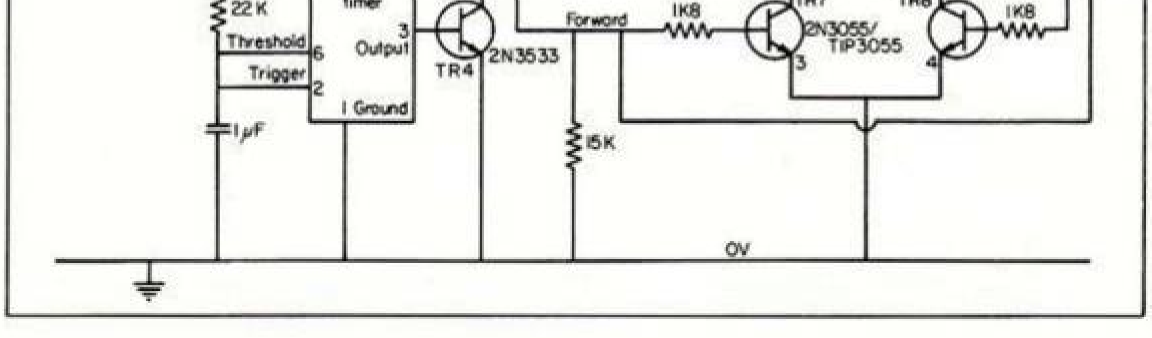


Figure 2 is the circuit diagram for an interface to convert the PWM signal from the radio-control receiver to an analogue DC output at the collector of TR3. To test the circuit on its own, a load of approximately 5,000 ohms should be connected between the collector of TR3 and the +12V supply line.

The transistor types should not be critical in this application and most small-signal NPN transistors should work successfully. Using the joystick on the radio-control transmitter — varying the width of the receiver output pulse from 0.9ms. to 1.7ms. — I obtained a swing in the collector voltage of TR3 of 2 to 7V.

Figure 3 shows the circuit I used to vary the power applied to the windscreen wiper motor. Four TIP3055 NPN power transistors, equivalent to 2N3055, are connected in a bridge and must be arranged so that either transistors 2 and 3 are conducting, which drives the motor in one direction; or transistors 1 and 4 conduct, driving the motor in the reverse direction.

The transistors on the same side of the bridge, i.e., 1 and 3, must never be allowed to conduct simultaneously as this will short-circuit the power supply and burn out the transistors.

The 555 timer IC is connected as a free-running oscillator with a variable mark/space ratio. In other words, the period of time for which the timer is turned off is constant while the time for which it is turned on can be varied by changing the DC voltage applied to pin 5.

The arrangement shown in the circuit diagram is unsophisticated and cannot have an ideal duty cycle from zero to 100 percent. A more complex circuit utilising a dual timer, the 556 made by several manufacturers, could be constructed in which one half of the IC generates a constant-width pulse when it is triggered by variable-frequency pulses from the other half of the chip.

In my experience, the minimum period for which the motor is turned on should be not less than about 50ms. to take account of the inertia of the rotor.

The fixed-space period in the simple circuit cannot be overcome by increasing the frequency at which the 555 chip operates since the mark period also shortens, and the point is reached at which the motor turns sluggishly while singing quietly to itself at the frequency of the applied modulation. This is unsatisfactory.

The IN3002 diode is intended to prevent voltage surges caused by the motor from interfering with the operation of the timer. Despite adding a 7812 voltage regulator IC to the positive supply line to the timer, there are conditions using the radio-control interface in which the system locks up, turning either full on or completely off.

I expect that replacing the 1,000 µfarad smoothing capactor with a 20,000-30,000 µfarad capacitor will help. Putting the motor drives on to a trolley powered by a car battery should reduce the problem, and the battery has a lower internal resistance than the mains power supply used for the initial construction and testing.

The motor can be reversed by applying the PWM signal to point B which will turn on transistors TR5 and TR8 — 1 and 4 in the bridge. Probably the simplest way to achieve this is to duplicate the 555 or 556 timer circuit for the reverse input to the bridge, breaking the pin 4 connection at E and connecting the re-set pin on each timer to alternate outputs on a 7474 flip flog IC — see figures 4 and 4a.

Using the Q and Not-Q outputs will guarantee that both arms of the bridge cannot be turned on at the same time and the motor can be reversed by putting a pulse into the clock input on the 7474 chip.

Alternatively, it should be possible to gate the stream of pulses from one 556 to either the forward or reverse inputs to the bridge using a flip-flop and some simple TTL 7400 Nand gates. The DC voltage which varies the frequency of the timer is applied at point A and could be derived from a local sensor as well as the remote computer.

For example, the classic tortoises built by Dr Grey-Walter had only two sensors — a rotating photocell on the top of the tortoises' "shell" and a sensor to detect a collision. Yet two of the machines would generate quite

(continued on page 53)

(continued from page 51)

complex behaviour when put together in a room, approaching each other and then retreating or circling.

Returning for a moment to figure 1 clarifies one aspect immediately — the servos used by Acoms can be controlled directly by the Microtan. The 6522 Versatile Interface Adaptor, 6522 VIA, contains timing circuits which can be used to generate variable-width pulses depending on data values stored in the appropriate memory locations. It should be a simple matter to run the pen recorder or many other devices directly from a Basic program in the Microtan.

The Tanex expansion board for the Tangerine Microtan computer uses the 6522 VIA to implement two eight-bit, bi-directional, parallel data ports, two 16-bit programmable timer/counters and a serial TTL data port. The board has sockets for two VIAs.

The 6522 VIA is truly a remarkable integrated circuit with more different functions built in than the Z-80 parallel input/output chip, PI/O. A block diagram of the 6522 IC — figure 5 — illustrates the internal organisation of the chip. The parallel ports allow each bit to be set up as either an input or an output by loading a profile or mask into the data direction register — DDRA/DDRB.

The second timer, T2, operates as an interval timer when a control bit is set in the auxiliary control register. The counting period for the timer is established by loading data using a write-T2C-H operation after the low byte has been loaded by "write T2L-L". Approximate outside values for the range of pulse length required — 0.5 to 3.5ms. — will be 325 decimal to 2250 decimal. The timer is triggered by the write-T2C-H operation.

The first timer, T1, consists of two eight-bit latches and a 16-bit counter. This timer can be programmed to act as a free-running variable-frequency oscillator. A number to control the width of the output pulse can be loaded into the low-byte latch and when a second number is written into the high-byte latch with a write-T1C-H operation, the data from both the latches is transferred to the 16-bit counter and the timing process started.

The counter is decremented at the system clock rate of 750kHz. When the counter passes zero an interrupt is generated and can be used to initiate a write operation to the high byte of timer 2 and, consequently, to produce an output pulse which will recur 20ms. later.

The circuits and devices in this article are not glossy, finished products — they work, certainly, but are intended primarily as a source of ideas on which you can build and explore. Unfortunately an oscilloscope is almost essential for examining variable pulse widths but it does not need a sophisticated specification to cope with the pulse trains produced by these circuits. The only other test instruments I have used are a 20,000 ohm/volt multimeter and a resistance substitution box.

It is very easy to imagine that something you wish to achieve can be done only with exactly the required tools, and the expansionist era of the 1950s and early 60s in the universities and other sectors of education tended to reinforce the philosophy that you had to have the proper equipment to conduct good research.

Yet an earlier generation of scientists were used to adapting what was often military surplus equipment. Many great men such as Faraday or Rutherford were used to constructing their own apparatus. When Lord Rayleigh was separating the rare gases from nitrogen he needed a dry room in which to carry out an experiment and he hung freshly aired blankets around the walls of his laboratory.

Resourcefulness of this nature can allow the production of effective equipment from simple materials whose original design often have no direct relevance. ■

Figure 4. Connection diagrams

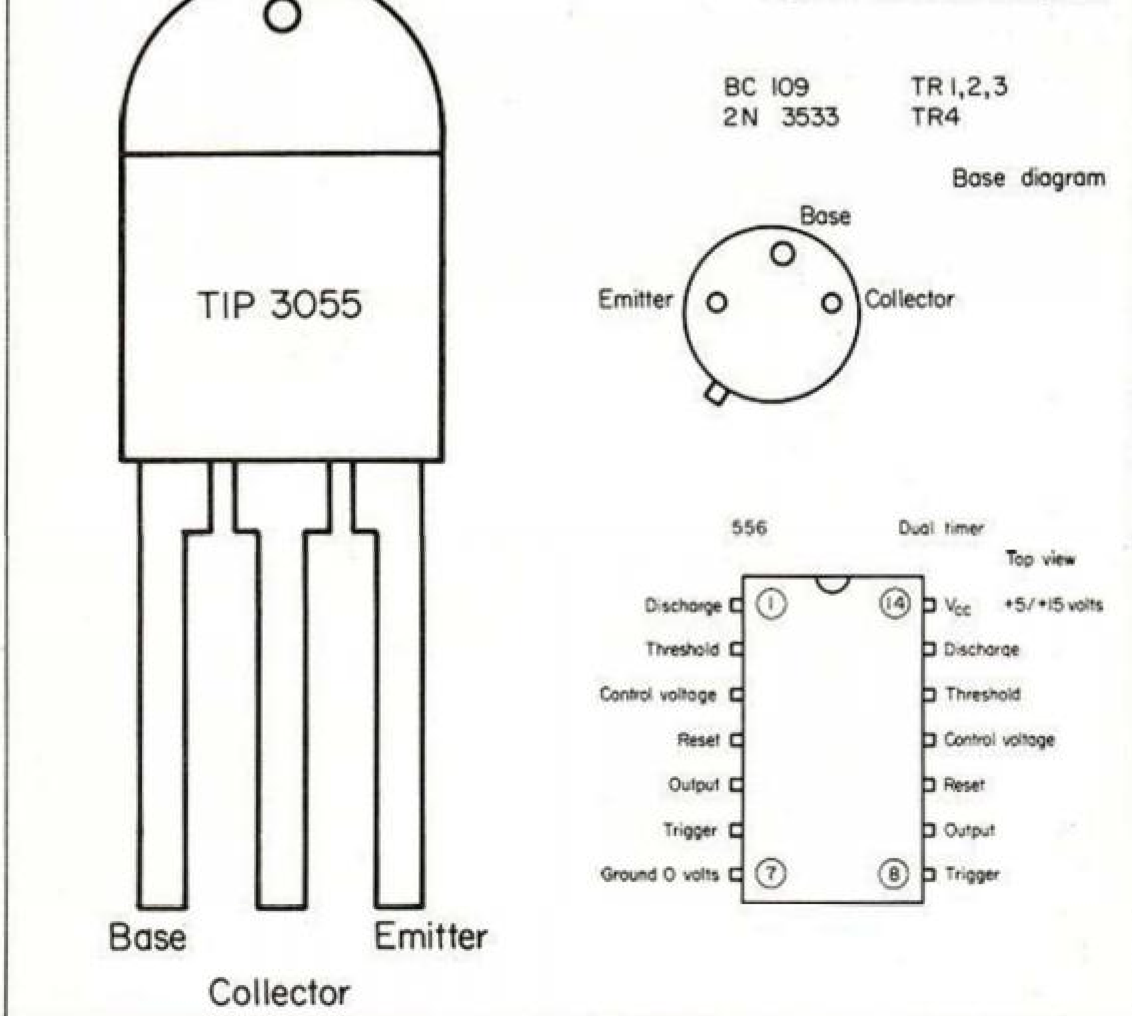


Figure 4a. 555 timer internal connections

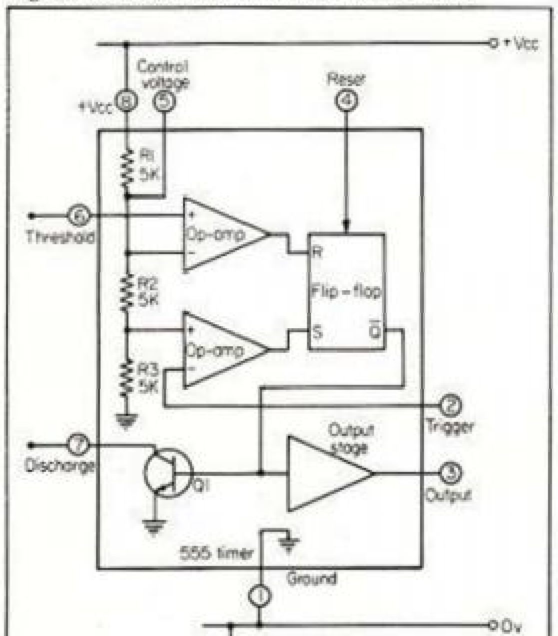
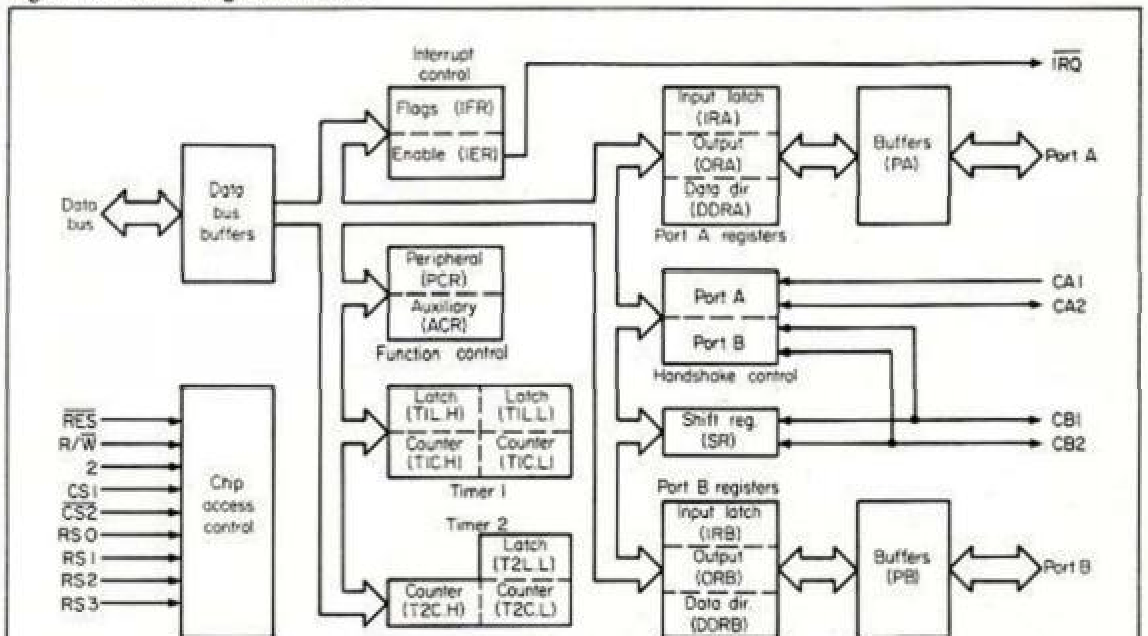


Figure 5. Block diagram of 6522



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VIC COLOURS

■ I saw the Vic in action at a computer show recently at Wembley, and was most impressed by the colours. Are they hard to program? I have not had any experience working with a computer.

Martin Marshall, Greenford.

THE COLOURS can, indeed, look most impressive on the Vic, but we are afraid any explanation on how you program them may not mean much if you have had little previous experience. However, you shouldn't worry about that — you'll find that after a few days' hand-on experience, you will be able to add colour easily to your programs. You can set the border, the area around the text area, with any of eight colours. Also, the background behind the text can be set with any of 16 colours. The colours are specified by bit patterns in the colour-control register at location 36879. You can choose the appropriate value for the pair of contours you want from a table which Commodore supplies. Suppose you want a black background and black border, then you enter:

POKE 36879,8.

While for a green background with purple border you enter:

POKE 36879, 72.

By setting bit 3 of the same register from one to zero, you can reverse for each colour position the colour of the graphic and that of the background.

ADAPTED ZX-80

■ I own a Sinclair ZX-80 equipped with the new 8K Basic ROM. Although much has been written on the functional capabilities of the ZX-80, and more recently with the ZX-81, very little information has been released with respect to the adapted ZX-80. I would greatly appreciate any information you may have on the adapted ZX-80. Furthermore, I am considering the possibility of increasing the storage capacity by fitting the 16K RAM pack. Do you think that the advantages will override the increased expense?

D Dawson, Leeds.

THE NEW-ROM ZX-80 is identical to the ZX-81 in all respects except one, and so nearly everything written for the ZX-81 will apply to your machine. The only exception is the display. As you know, the ZX-80 and those fitted with new ROMs exhibit the most alarming flicker whenever a key is pressed, and the screen goes blank while the machine is thinking. This does not happen on the new ZX-81 when in the Slow mode. You can now buy a kit from Compshop which gives new-ROM ZX-80s the flicker-free display, but the kit is certainly not for beginners. Apart from this, read everything on the ZX-81 as though it applies to your machine. As you probably realised to your sorrow, the 1K ZX-81 will take far less program than the 1K ZX-80, so for many programs a larger memory than 1K is required. Therefore, the 16K pack, which contains far more memory than you are ever likely to need, could be a wise investment. It is unfortunate that, despite claims to the contrary from Sinclair Research, the 16K packs have not proved in our experience very reliable, and tend to forget everything they are holding at random intervals. However, if you're prepared to accept this as a possible defect with the 16K pack you buy, by all means go ahead. There is a simpler solution if you feel 16K is more than you need — see P C Jowsey's letter.

TROUBLE IN STORE

■ We have a ZX-81 and find it impossible to store programs from it on cassette. Sinclair admits there have been problems, and has issued a leaflet but says it takes some time to distribute. Can you offer any advice?

D Somerville, Tettenhall.

YOU SAY you find it impossible to "store" programs on cassette. We assume you mean you can put something on to the cassette, but cannot then transfer it from cassette back into your ZX-81. If you find you cannot even put something on to the tape, you have a problem with your machine, and it should be returned for service. If, however, you can put the material on the cassette, but cannot then transfer it back, try the following. Always clean the recording head before loading or saving. Use computer quality tapes, preferably C-12s or C-20s. Buy good quality leads and do not let the leads from the ZX-81 to the power supply cross over your cassette leads. If you can afford it, buy a head demagnetiser, £5 to £11, and use it regularly. Make a security copy on your own machine of any software you buy. You'll find you have far less trouble loading programs recorded on your own equipment than you may do with software recorded on another cassette machine. The loading technique should be: Start the tape. When the silence begins, press Load then Newline. The ZX-81 needs at least half a second of silence to load. Make a short, three-line program, and use it to practise loading at different volume setting. When you achieve success, make the volume setting permanent — with a stuck-on paper arrow to mark the spot, or a little notch — and always set it to this point. Use batteries if you can, and do not use them for anything else except your ZX-81 so they stay fresh.

RANDOM NUMBERS

■ I have a Sharp PC-1211 pocket computer. There is no function on it to generate random numbers, and the routine given in the manual is long, and difficult to manipulate. Can you give me a simple program which will produce random numbers in a specified range?

I. Salter, London NW10.

HERE IS a one-line program which will fit the bill, and can be adapted easily for any computer with Basic and floating-point arithmetic. It has been set to produce numbers in the range one to six but that can be changed. Put it in a subroutine, and call it when a random number is required.

```
X=(X+77)π↑5:X=X−INT(X):
D=INT(X*6)+1
```

BASIC DIALECTS

■ As a would-be purchaser of a personal computer in the £200 range, I was interested to read the first edition of *Your Computer*. On page 35, Response Frame, under the heading "Best computer", you compare the ZX-80, the ZX-81 and the Acorn Atom. You say: "The Acorn Atom language is difficult and could be bewildering for a beginner". Yet the Acorn Atom advertisement opposite on page 34 states that the Atom operates in Basic. I understand that there are many dialets of Basic, but please could you explain, in simple language, what is particularly difficult about the Atom version?

R Humphreys, Liverpool.

THERE ARE many features of Atom Basic which are a little unusual, but which you will quickly master. Many Atom users find the going a little hard at first, but later swear by their machines. The Atom is so flexible, and — in our experience — so reliable, that this can outweigh the disadvantage of the unusual Basic. A few examples of Atom Basic: strings must be dimensioned before use; semicolons do not join print statements as in most Basics but are used to separate statements in a multi-statement line; the dollar sign is used very conveniently instead of the more usual CHR$ to print a character; you can Goto labels — inverse letters — rather than to line numbers. Many of these features prove very useful in practice, but could be, as we said, bewildering to a beginner. Also, remember that Acorn has a replacement ROM on the way to make the Atom compatible with the new BBC microcomputer, so you'll be able to take advantage of the BBC programs in due course without having to buy a new computer.

ZX-81 RAM

■ I have just constructed the Sinclair ZX-81 kit and note that the circuit diagram shows in the RAM location, the information that the position "will also accept 4816 2K×8 RAM in 28-pin pack". Sinclair keeps very quiet about this and I am writing to ask if you have any information about this possibility. The prospect of doubling the RAM in this simple manner appeals very much.

P C Jowsey, Inverurie.

YES, IT can be done, and makes an enormous difference to the computer. A 2K ZX-81 is more than twice as useful than a 1K ZX-81, and you will no longer have that infuriating result of finding the computer refusing to accept any more program when you're only a few lines from the end.

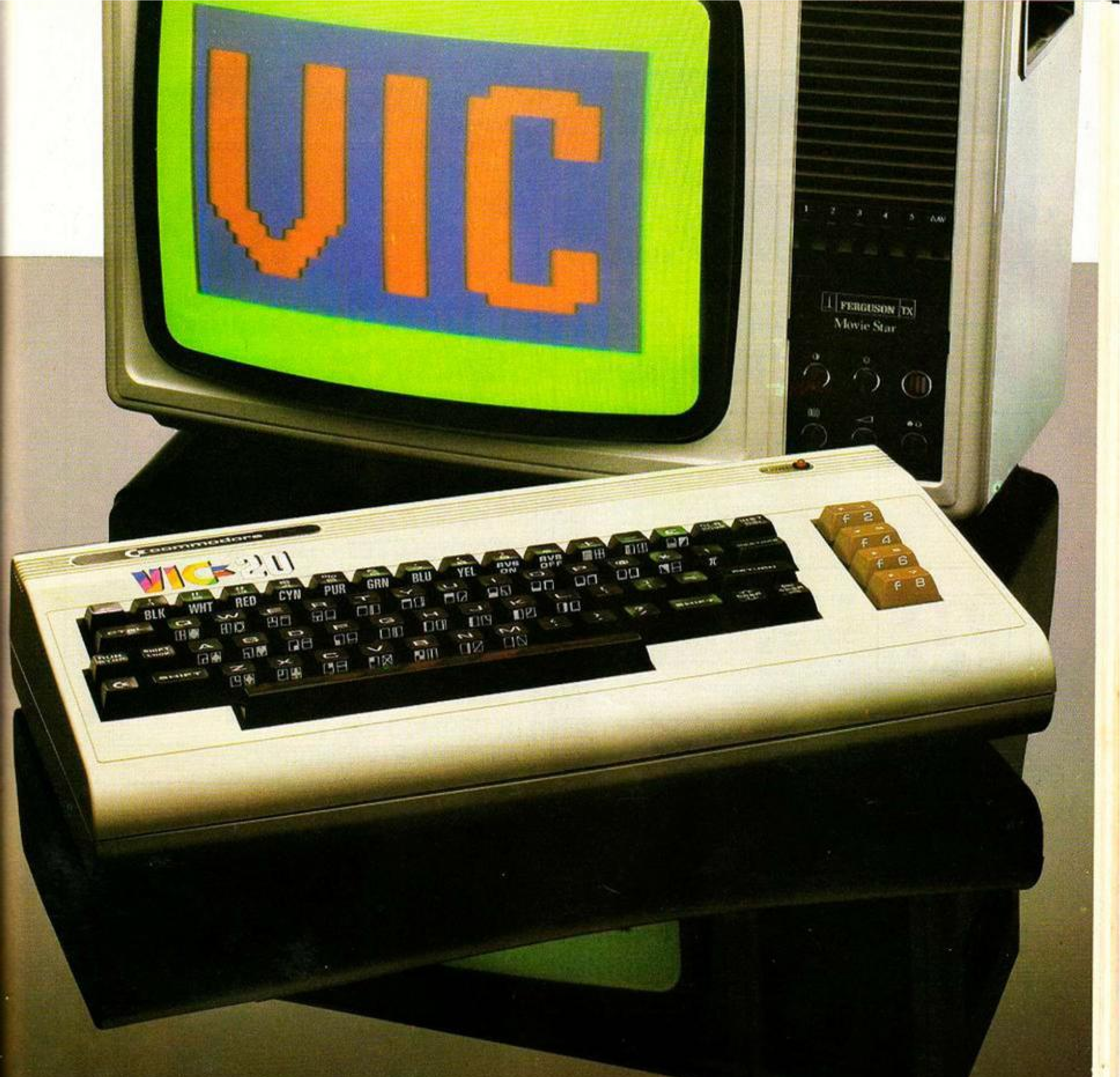
PERSONAL CHOICE

■ Your first issue was very good and I look forward to buying the magazine regularly. I am interested in purchasing a home computer and there are four which I feel I can afford — namely, ZX-81, Acorn Atom, Commodore Vic and Compumax 1. I think that 23 characters per line, as on the Vic, is a big disadvantage. What is your considered opinion of the likely price increase when MOS solves the problem so that 40 characters per line become available?

A A Mattick, Andover.

THANKS FOR the comments on the magazine. On the Vic, a line of Basic can occupy up to four lines, so line numbers of around 88 characters are possible in listings. There are three display modes on the Vic; test, multi-colour and high-resolution. In text mode, the display shows 23 lines of 22 characters. In the multi-colour mode, the screen has a resolution for plotting of 88 by 160 and in high-resolution, the screen has 176 by 160 plot points. There is more information on the Vic display in the August/September issue of *Your Computer* in the review by Nick Hampshire. ■

THE WAITING IS OVER. THE RUSH HAS BEGUN.



For the past few months you've all been hearing and reading a lot of good things about Commodore's new VIC 20.

Like the fact that it has a real typewriter keyboard with full graphics.

And music in three voices and three octaves, as well as language and sound effects. And eight border and sixteen screen colours.

Not to mention that it's the best home computer in the world!

Well, after all that, what could you do but hang on?

But all that's over now. The VIC is at your dealer's.

So rush down and see the VIC. And you'll see why it was well worth the wait.

commodore
COMPUTER

For more information on the VIC 20, telephone or write to Commodore Information Centre, PO Box 109, Baker Street, High Wycombe, Bucks. Tel: Slough 79292.

FINGERTIPS

Fingertips is our regular calculator column covering calculator news, programming hints and examples of unusual applications. The column is written and compiled by calculator enthusiast David Pringle who is glad to hear of any of your ideas. *Your Computer* pays £6 for each of your contributions published.

PERHAPS I DON'T read the right journals, but I have seen few feathers ruffled over Hewlett Packard's announcement of its new 32-bit microprocessor designed on a single chip. We must either be a bit blasé or numbed by the rate of progress if the feat of etching 450,000 transistors on a 6mm. square silicon chip doesn't raise the blood pressure a little.

Represent the narrowest metal channel by a line 2mm. wide and the circuit layout would cover a 30ft. square room. The chip will be used as the CPU of a microcomputer which will be capable of handling 32-bit words, as large as many mainframe computers. A colleague spoke on the phone to the head of the research team which designed the processor to be told: "Our next aim is 1,000 times that scale of integration — and we'll do it".

Until now, the logistics of placing so many components together has proven a major stumbling-block, but now computer-aided techniques have taken the present technology to its limit — literally, computers designing computers — what could be more efficient? The Hewlett Packard chip is still fabricated by shining ultra-violet light through a photo-resistive mask on to the chip, etching the required semiconductor pattern.

The limit of resolution is determined by the wavelength of the ultra-violet light and so the next step will be to increase the frequency of radiation used in generating the etched circuit. This will be achieved in the very near future with intense high-frequency laser light.

Yet consider that the wavelength of a beam of monoenergetic electrons is inversely proportional to their energy. Electron beams of high energy with masks which are electron- instead of photon-sensitive offer the possibility of greater packing densities. This technique will probably take a few years to reach its full potential.

Speed is another complementary area for expansion of microprocessors. The reaction time of a transistor in a switching circuit is limited by the draft velocity of the electrons in the junction material. New semiconductors such as gallium arsenide can maintain drift velocities approaching 10 times that of silicon and so the resources for 10 times faster chips are waiting to be tapped.

Delving into the realms of science fantasy, one wonders when optical techniques, limited only by the speed of light, will take over. Then we will have to replace wires with light guides, solder with optical grease and electronics with photonics.

All this may seem removed from the world of programmable calculators but you can be assured that the shock waves will reach us before long. Models with plug-in Basic compilers and 64K of RAM will become two a penny within five years.

A Japanese company have been selling just such a machine for £200 in the United States since last December. Their Panasonic RL-H1000, though, has one capability which I see as much further reaching. Data can be transferred, via an acoustic-coupler attached to a telephone line, from one model to another.

Until recently, the restricted means of input and output, via the keyboard, ROM mag. card or display, has strictly limited the use and application of hand-held programmables. This is all about to change. Already some of the more advanced calculators are to be seen grazing on pastures which were once the reserve of mini or micro-computers.

For instance, the Hewlett Packard 41-C has been used to collect and statistically analyse thousands of bits of information a minute in the radioactive assay of blood samples. The secret lies in realising that the optical-wand interface of the 41-C provides a convenient recepticle for any data in the form of micro-coded electrical pulses.

If one knows the code, one needs only provide the pulses to load data. The microprocessor clock of the 41-C beats every 2.8 microseconds, so high rates of data input may be achieved. How long will it be until we can interface a pocket programmable calculator with a mainframe? I await the future with bated breath.

On a much more serious vein, it is about time I gave the result of the Newton-Raphson approximation competition. Remember that we were looking for the neatest solution to the literature square root approximation.

$$\text{New guess} = \frac{(\text{old guess})^2 + \text{number to be rooted}}{2(\text{old guess})}$$

The winner, among a truly excellent bunch of entries, is Casio 502 owner Andrew Carter from High Wycombe, Buckinghamshire. Not only is his solution the fastest, but he amplifies some of the points I made last month and so wins immediate approval. Enter P1 to run.

```
Subroutine
Program register 0
MR 2
÷
MR 3
+
MR3
÷
2
=
MIN 3
X²
−
MR 1
=
X ≥ F
If X ≥ F do not skip next line
GSB PO
Main Program
Program register 1
AC
2
3
1
Min 1
÷
2
=
MIN 2
1
2
Min 3
1
EXP 6 ±
Min F
GSB PO
Go to subroutine PO
MR 3
```

The program takes less than 1.3 seconds and needs no extra data stored in memory. Note how the loop control is optimised by placing the subroutine at the top of the program register. As soon as a gsb PO is met, the program pointer immediately goes to the header block of the first program and so the loop is executed in the fastest possible time.

Normally, this use of subroutines would preclude a loop of greater than 10, the maximum nesting on the 502. I am assured, though, that the program is written such that when the 10th loop is encountered, the program immediately jumps to the 14th step in program memory and will then continue looping. This appears to have been a software fault in the earliest 502 models and is no longer with us.

Remember that every time you press the √‾ button on your calculator, a similar, but more efficient algorithm is read out of microprocessor ROM and evaluated. The calculator is much more than a fast set of log tables. More about this next month.

This month, I thought a good calculator game might restore your flagging spirits. Apologies to all non-HP-41C owners. I hand you over to Space Academy Flight Officer Frank Wales of Glasgow.

This game places you at the helm of a flight simulator in Space Academy, writes Frank Wales, where, in your capacity as pilot of a one-man craft in an uncharted region of space, your task is to retrieve the five starseeds scattered in this area, so that you may gain access to your base before time runs out.

The starseeds are the only things which will allow you to gain entry, and even though you begin at the position in the sector of space which your base occupies, you cannot enter until you have five starseeds.

You must complete the task within 60 stardates, and it is made harder by the fact that you may only collect a particular starseed when you have all the lower numbered starseeds, e.g., to pick up starseed 3, you must already have starseeds 0, 1 and 2. Each starseed tells you where to look for the next one.

Not only that, the area is randomly peppered by up to 10 black holes whose whereabouts are unavailable to you until you encounter them, and which will whisk you off through hyperspace to another part of the sector.

Beware of these, however, since your ship will take only so much damage before exploding. Starseeds may hide black holes, and *vice versa*, so be wary — even when treading on familiar ground.

The ship is guided by its on-board

JARGON

■ Mainframe
Once upon a time, this referred to a computer with its own separate CPU and so implied a reasonably large machine. The present architecture of microprocessors is sufficiently complex that micro-mainframe computers are appearing.

■ CPU
Abbreviation for Central Processing Unit. This is the brain of modern digital computers. All program instructions to be executed must be held within the CPU and all data to be processed must be loaded into this unit. The CPU talks to other parts of the system along parallel communication channels called Buses.

■ RAM
Random Access Memory. An array capable of storing a logical 0 or 1 at every point on the array. Each point or group of points — register — may be individually addressed. The electronic equivalent is a group of bistable flip-flops. A 64K RAM has 64 by 1,024 addressable elements.

■ ROM
Read Only Memory. A pre-programmed and inaccessible array of memory. The operating program and algorithms for a calculator are written on ROM inside the microprocessor. PROMs have no musical ability but may be programmed by the user.

autopilot which maintains a straight course unless told otherwise. You direct the ship using the keypad. The ship's position is represented on a 10-by-10 grid, base at 0,0, and positions referred to by Cartesian Coordinates x,y — x increasing to the east, and y increasing to the north.

The keypad imagines the ship to be on button five, and its new position is input simply by pressing the button which corresponds to the place which you would like the ship next to occupy, e.g., to go east, press 4, to go south press 2 etc. To find how much time you have left, and where the next starseed is with respect to the ship, press 0. Press any odd number to remain static — diagonal movement is not allowed.

When the ship's position is flashed, you have about one second to enter any course corrections you wish, before the ship continues.

If your course correction is not within the permitted range, it is rejected, and you are re-prompted. This program does not halt at any stage — data entry occurs while the message

SHIP AT x,y

appears in the display, but the program does not stop at this, or any other point. It can accept information without halting the program, due to the special treatment of the PSE, pause, instruction by the 41C, and the ability to test selectively for data input.

At the start, the ship has been told to remain static, and will do so, consuming time until given an obeyable command. Although you will waste time in trying, the ship cannot move off the grid, i.e., out of the sector.

At the end of a game, the program asks you whether you would like to try again — this should be answered in English — Y, yes, aye, All right, pal, N, No, Niet, Nein danke, No thanks, would all be interpreted correctly — using the Alpha keyboard. The program toggles this on and off for you, and waits in an infinite loop for you to answer it. However, it does not stop, so you do not need to worry about the R/S key — useful for people unfamiliar with the machine's operating system. If you answer yes, it starts the program again; if No, then it tidies up the registers and flags, display, stack Lastx and Alpha registers, re-sets the display format to default mode, then returns control to you.

The program does all its own setting up, and is completely independent of any setting up on the part of the user, although it would be advisable to ensure a fresh Prang seed in register 20 before you start.

The keyboard assignments are done automatically — it is unnecessary to make these assignments yourself. They are not assignments in the normal sense of the world — they are virtual assignments. Movements 1, 3, 5, 7, 9 all tell the ship to remain static; 2 tells the ship to go south; 4 tells the ship to go west; 6 tells the ship to go east; 8 tells the ship to go north; 0 is the status function, which gives a read-out of the next starseed's position relative to the ship, and the amount of time which the pilot has left. Pressing any of these buttons will consume one stardate.

Here are the messages produced by program. You must have a printer to see these:

Initialising: signals sector set-up.

Starseed 0 is (direction): shows direction of first starseed.

Ship at x,y: shows present ship position.

In flight: shows ship in flight.

You're out of time: flashed when time has run out, followed by

Stranded at x,y: shows where you got stuck.

Well done: signals success in completing a task. Followed either by

You've found starseed n: signals starseed found. Flag n in display is activated — flags form a running tally of starseeds found to date — or

You've made it home: shows you have completed your mission, and made it back to base.

Now return home: shown when all starseeds found.

Next starseed (direction): shows direction of next starseed

nn stardates: shows how much time you have left.

Black hole: shows that the ship has been caught by a black hole, sometimes followed by

Ship exploded: shown when ship breaks up on re-entry from hyperspace.

Try again: Shown when a game ends.

Directions are given as a combination of the following: north, south, east, west into any eight of the logical combinations: N, S, E, W, NE, NW, SE, SW, or, when the next starseed is to be found in the place where the ship presently is, here.

```
01 LBL"SPCH"
02 LBL 01
03 TONE 7
04 "INITIALISING"
05 AVIEW
06 -7
07 LBL 40
08 CF IND X
09 ISG X
10 GTO 40
11 CF 28
12 CF 29
13 -14
14 STO 18
15 61
16 STO 17
17 .004
18 STO 19
19 LBL 14
20 FIX 1
21 XEQ 20
22 X=0?
23 GTO 14
24 STO IND 18
25 ISG 18
26 GTO 14
27 5
28 STO 15
29 CLX
30 STO 16
31 "STARSEED 0 IS "
32 GTO 03
33 LBL 12
34 FIX 1
35 " SHIP AT "
36 ARCL 16
37 TONE 8
38 FIX 0
39 CF 22
40 AVIEW
41 PSE
42 PSE
43 FC?C 22
44 RCL 15
45 STO 15
46 X=0?
47 " IN FLIGHT"
48 AVIEW
49 INT
50 ABS
51 9
52 X<>Y
53 X<Y?
54 GTO 12
55 2
56 MOD
57 X=0?
58 GTO 05
59 DSE 17
60 GTO IND 15
61 "YOURE OUT OF TI"
62 "&ME"
63 TONE 6
64 TONE 0
65 AVIEW
66 "STRANDED AT"
67 FIX 1
68 ARCL 16
69 TONE 1
70 AVIEW
71 PSE
72 GTO 10
73 LBL 00
74 SF 07
75 CLA
76 GTO 03
77 LBL 02
78 RCL 16
79 FRC
80 X=0?
81 GTO 12
82 LASTX
83 .1
84 -
85 GTO 13
86 LBL 04
87 RCL 16
88 INT
89 X=0?
90 GTO 12
91 LASTX
92 1
93 -
94 GTO 13
95 LBL 05
96 RCL 16
97 GTO 13
98 LBL 06
99 RCL 16
100 INT
101 9
102 X=Y?
103 GTO 12
104 LASTX
105 1
106 +
107 GTO 13
108 LBL 08
109 RCL 16
110 FRC
111 .9
112 X=Y?
113 GTO 12
114 LASTX
115 .1
116 +
117 LBL 13
118 STO 16
119 FC? 04
120 GTO 00
121 X=0?
122 GTO 01
123 LBL 00
124 FS? 04
125 GTO 02
126 RCL IND 19
127 X=Y?
128 GTO 01
129 X<>Y
130 LBL 02
131 5.014
132 STO 18
133 LBL 41
134 X<>Y
135 RCL IND 18
136 X=Y?
137 GTO 11
138 ISG 18
139 GTO 41
140 X<>Y
141 GTO 12
142 LBL 01
143 SF IND 19
144 " WELL DONE"
145 AVIEW
146 BEEP
147 "YOUVE "
148 FS? 05
149 GTO 01
150 "&FOUND STARSEED"
151 "& "
152 RCL 19
153 INT
154 FIX 0
155 ARCL X
156 GTO 00
157 LBL 01
158 "&MADE IT HOME"
159 LBL 00
160 TONE 7
161 AVIEW
162 "WITH "
163 LBL 03
164 FIX 0
165 RCL 17
166 1
167 -
168 ARCL X
169 "& STARDATE"
170 1
171 X=Y?
172 "&S"
173 TONE 4
174 AVIEW
175 FS?C 07
176 GTO 01
177 FS? 05
178 GTO 10
179 ISG 19
180 GTO 00
181 LBL 01
182 FC? 04
183 GTO 00
184 "NOW RETURN HOME"
185 TONE 1
186 AVIEW
187 GTO 12
188 LBL 00
189 "NEXT STARSEED"
190 LBL 09
191 RCL 16
192 XEQ 02
193 X<>Y
194 RCL IND 19
195 XEQ 02
196 RDN
197 X<Y?
198 GTO 03
199 X=Y?
200 SF 05
201 X=Y?
202 GTO 00
203 "&SOUTH"
204 GTO 00
205 LBL 03
206 "&NORTH"
207 LBL 00
208 RDN
209 RDN
210 X<Y?
211 GTO 03
212 X=Y?
213 GTO 00
214 "&WEST"
215 GTO 01
216 LBL 03
217 "&EAST"
218 GTO 01
219 LBL 00
220 FS?C 06
221 "&HERE"
222 LBL 01
223 CF 06
224 TONE 8
225 AVIEW
226 PSE
227 GTO 12
228 LBL 02
229 INT
230 LASTX
231 FRC
232 STO L
233 CLX
234 10
235 ST*L
236 CLX
237 LASTX
238 X<>Y
239 RTN
240 LBL 11
241 "BLACK HOLE"
242 TONE 9
243 TONE 8
244 AVIEW
245 XEQ 20
246 2
247 X>Y?
248 GTO 00
249 XEQ 20
250 GTO 13
251 LBL 00
252 "SHIP EXPLODED"
253 TONE 2
254 TONE 0
255 AVIEW
256 PSE
257 GTO 10
258 LBL 20
259 RCL 20
260 9821
261 *
262 .211327
263 +
264 FRC
265 STO 20
266 10
267 *
268 FIX 1
269 RND
270 10
271 X=Y?
272 GTO 20
273 X<>Y
274 RTN
275 LBL 10
276 " TRY AGAIN?"
277 TONE 5
278 AVIEW
279 CF 23
280 AON
281 LBL 44
282 PSE
283 FC?C 23
284 GTO 44
285 AOFF
286 ASTO X
287 "      "
288 ARCL X
289 ASTOX
290 " "
291 ARCL X
292 ASHF
293 ASTO X
294 "N"
295 ASTO Y
296 X=Y?
297 GTO 01
298 "BYE"
299 AVIEW
300 -7
301 LBL 15
302 CF IND X
303 ISG X
304 GTO 15
305 CLST
306 ΣREG 00
307 CLΣ
308 ΣREG 06
309 CLΣ
310 STO 13
311 ΣREG 14
312 CLΣ
313 +
314 CLA
315 FIX 4
316 SF 28
317 SF 29
318 TONE 7
319 CLD
320 END
SIZE 021
```

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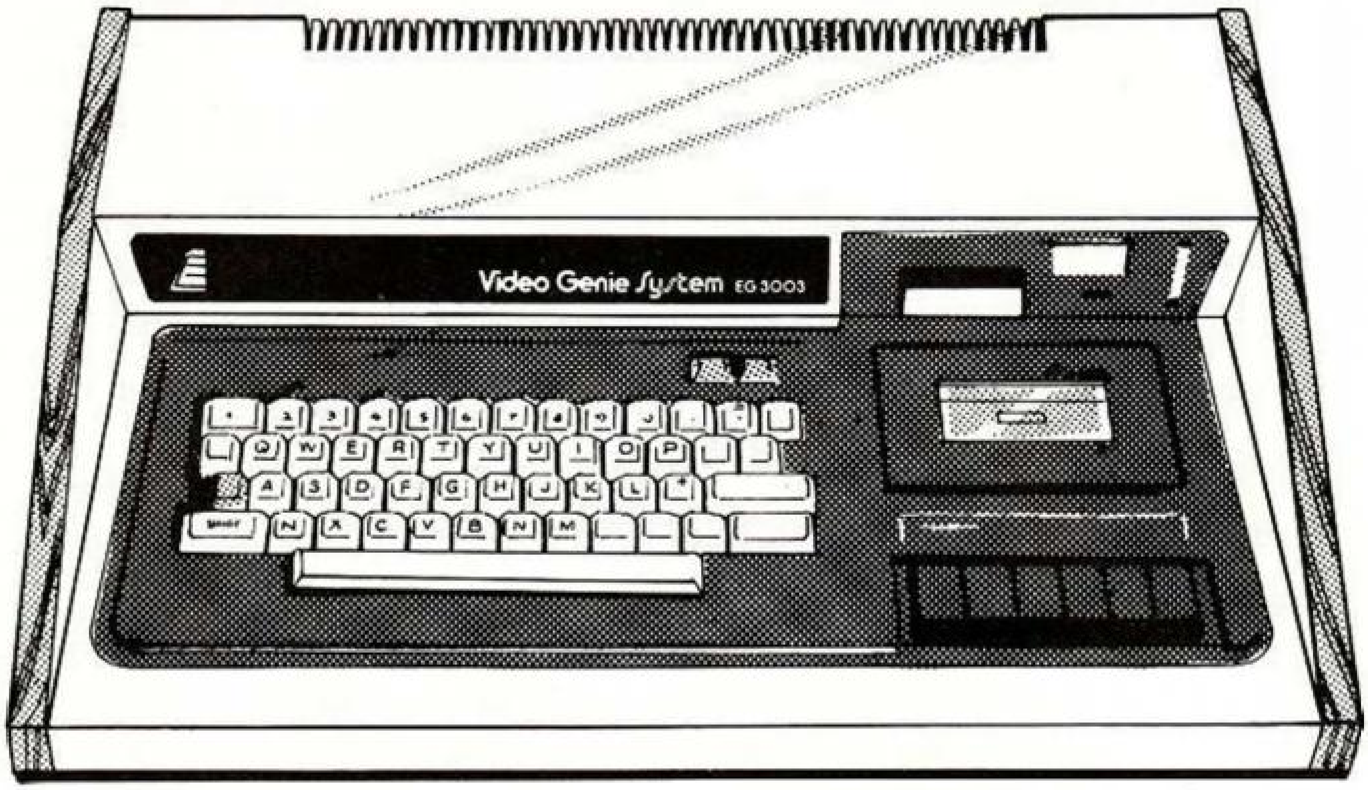
Video Genie...



Are you a home enthusiast taking your first tentative steps into the enthralling world of micro-computers? If so, the Video Genie is the ideal complete system for you!

It's a real micro-computer, not a pocket one, yet it only needs connecting to a domestic T.V. set to produce superb results.

The Genie is compatible with the popular TRS 80 16K level 2, the best selling computer of all time. As well as its lower price, the Genie offers an in built cassette deck, 16K RAM, 12K ROM with BASIC interpreter, full size keyboard and a stylish carrying case. So it is not only excellent value for money, but an ideal "First computer" on which to learn programming.

There are literally 1000's of pre-recorded programs available, including educational, leisure and small-business applications, and simple BASIC language means you can write your own programs with ease.

Extended BASIC.

The Microsoft extended BASIC has many powerful features, including double precision variables, scientific functions, formatted printing, extended editing sub-commands, automatic line numbering, multiple dimensional arrays, complete string manipulation, direct access to graphics and machine language sub-routines.

Memory.

The Genie EG 3003 model has 16K of internal RAM expandable externally to 48K using the special Expansion unit. 12K of ROM contains the Microsoft BASIC.

Cassette.

Two cassette interfaces are provided for both the internal and an external cassette unit.

CPU.

The machine uses the industry Standard Z80 micro-processor.

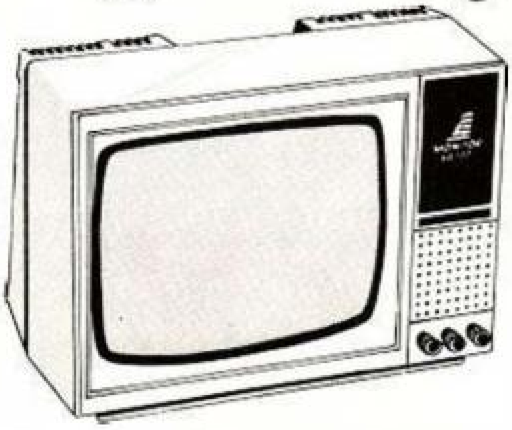
Display.

64 or 32 characters × 16 lines are available on the full display.

LOWE electronics

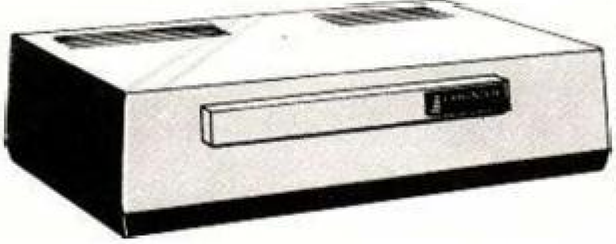
one giant step for micro-computer systems

12" Monitor.



The additional purchase of the EG 100 Monitor offers 3 distinct advantages

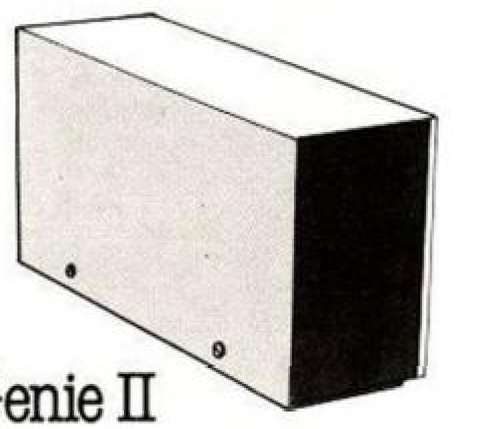
- It gives a considerably better quality display.
- It does not interfere with domestic T.V. viewing.
- It comes in an attractive matching style.



Expander.

The expansion box unleashes the full possibilities of the Genie. It contains a selection of interfaces, allowing the connection of up to 48K RAM, 4 disk drives, printers and S100 cards.

Disk Drive.



As well as the obvious advantage of mass-storage, the addition of the disk system to the Genie means much faster access to other languages and full random access file handling. Up to 4 drives can be used on a system.

. . . and introducing Genie II

. . . one giant leap for micro, business systems!

New and exclusive! The Genie II is a breakthrough for small business computers. Harnessing all the advantages of the Genie, including low price, Genie II adapts perfectly to commercial functions with the following features.

- Numeric keyboard
- Four usable, definable function keys.
- Extension to BASIC
- Basic business commands
- Fully expandable for same peripherals.

For full details and demonstrations of the Video Genie system or Genie II contact your local dealer, or write directly to the sole importers at the address below.

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SOFTWARE FILE

Software File gives you the opportunity to have your programs, ideas or discoveries published. We will accept contributions for any personal computer but will group programs for like machines together in the file. Please double-check your listings before sending them. Mark your letter clearly for *Your Computer.* We will pay £6 for each contribution published.

Innocent indexing

Tim Goldingham, Maidenhead, Berkshire.

ZX-81

YOU HAVE bought your Sinclair ZX-81, and now have it working but you know nothing about programming. How can you make the magic machine do something useful for you?

All you need to master for the time being is the Print statement. The format is simple: first a line number, then the word Print generated by pressing the P key, then a string of letters enclosed in inverted commas. The secret is in the line number.

Lines of Basic programs are identified by line numbers, and it is customary to number them in tens — 10, 20, 30 and so on — so that if you need to add an extra instruction, you can give it an intermediate number, say, 25.

Built into the Basic interpreter is a sorting mechanism which contrives to list your instructions in ascending sequence, whatever order they are in when you key them in. You can make use of this capability.

Suppose you want to build an index of telephone numbers. Try typing the following lines, in the order shown:

```
6000 PRINT "ST PANCRAS      387 9400"
4000 PRINT "LIVERPOOL ST    247 7600"
8000 PRINT "WATERLOO        928 5151"
2000 PRINT "EUSTON          387 9400"
5000 PRINT "PADDINGTON      723 7000"
```

Now look at the screen. What do you discover? — a sorted index. Press Run, and it will appear without the Print instructions.

All we have done is assign line numbers according to each item's place in the alphabet. Now, of course, we can use the Save command to store the index, and recall it by using Load.

For a simple directory, the method described should be all that is needed. However, if you have a 16K store and want to make the most of it you can, with a little more programming, adopt a rather more sophisticated approach.

A great advantage of this method is that it overcomes the limitations imposed by Sinclair Basic on the number of entries which could be stored either as string variables or as elements in an array. By using Print statements as in effect a data store, you can use almost the full range of line numbers — up to 9999 — less, of course, the few you allow for your program.

This program uses the first three letters of each entry to generate a precise line number, from 351 for AAA to 9139 for ZZZ.

The program will ask for the first three letters of the item you wish to enter or refer to. Taking our previous example, you would type "ST " for the first item, and "LIV" for the second.

The program then calculates a line number to spread the index entries over the available range of numbers. In this example, "LIV" gives 4184. If you are adding this as a new entry, you must, of course, check that the line number has not been used before. The program therefore displays the calculated number, followed by a listing of that area of the index. If the number has not been used, you can create a new line of program,

```
4184 PRINT "LIVERPOOL ST    247 7600"
```

If the number has already been used, you will have to use the nearest available free number. Alternatively, if your index has a number of entries beginning with the same initial letters, for instance, names beginning with Mac, you could jump to a subroutine in the unused area between 9140 and 9959.

If you do not wish to make any changes or additions, but simply to refer to the index, pressing "S" will list the index starting with the three-letter key. To list it from the beginning, press Newline on the initial prompt without typing in any three letters. You may like to pick out the first letter of each section by printing it in inverse video.

This program will run on the ZX-80, but is slightly less satisfactory than on the 8K Basic machine, as the 4K Basic clears the screen before Listing the program. This means that you will have to remember the calculated line number.

One or two changes are necessary to cater for the different formats of the 4K version. You will have to use TL$ in lines 90 and 110; and delete INT in line 130 and AT 17,0 in line 200. Line 210 should be changed from Print to Input C$; line 230 Stop is then superfluous.

```
  10 REM INDEX
  20 PRINT "TYPE FIRST THREE LETTERS,"
  30 PRINT
  40 PRINT "OR NEWLINE FOR INDEX PRINT"
  50 INPUT A$
  60 CLS
  70 IF A$="" THEN GOTO 351
  80 LET A=CODE A$-37
  90 LET B= CODE A$(2)-37
 100 IF B<1 THEN LET B=1
 110 LET C=CODE A$(3)-37
 120 IF C<1 THEN LET C=1
 130 LET D=A*338+B*13+INT(C/2)
 140 PRINT "TO CHANGE THE RECORD, TYPE A"
 150 PRINT
 160 PRINT "TO LIST THIS SECTION, TYPE S"
 170 INPUT B$
 180 CLS
 190 IF NOT B$="A" THEN GOTO 240
 200 PRINT AT 17,0;" = ";D
 210 PRINT
 220 LIST D-2
 230 STOP
 240 IF B$="S" THEN GOTO D
 250 GOTO 170
9960 INPUT D$
9970 CLS
9980 IF D$="**" THEN STOP
9990 RUN
```

Green-eyed monster

P Connell, Telford, Shropshire.

ZX-80

THE OBJECT of Othello is to place and win as many pieces as you can on an eight-by-eight board. Once you have sandwiched your opponent, those pieces then become yours, by changing to your colour. The game is over when the playing board is full, the one with the most pieces is the winner.

On running the program, you will see the start pieces already on the screen, with the computer waiting for an input. Your colour is white, your opponent, the ZX-80, plays black.

Having input your chosen co-ordinates, the screen blackens while the computer checks that you have made a legal move, if not, then another input is requested. The same applies if you accidentally input a co-ordinate which is off the screen. Having accepted your move, the computer then continues to calculate its own.

```
 10 CLS
 20 PRINT "12345678 "
 30 FOR A = 1 TO 8
 40 PRINT "++++++++";A
 50 NEXT A
 60 GOSUB 800
 70 POKE J + 57, 180
 80 POKE J + 58, 52
 90 POKE J + 47, 52
100 POKE J + 48, 180
110 INPUT C
120 LET Z = 0
130 LET N = 0
140 LET D = 52
150 LET E = C/10
160 LET C = C - E * 10
170 IF C>0 AND C<9 AND E>0 AND E<9 THEN GO TO 190
180 GO TO 110
190 LET F = C * 10 + E
200 LET E = 180
210 GOSUB 600
220 IF Z = 0 THEN GO TO 110
230 LET D = 180
240 LET N = 1
250 LET Q = 0
260 LET E = 52
280 LET R = 0
290 FOR F = 11 TO 90
300 LET L = 0
305 GOSUB 800
310 IF PEEK (J + F) = 19 THEN GOSUB 400
320 NEXT F
330 IF R = 0 THEN STOP
340 LET N = 0
350 LET F = V
360 INPUT A$
370 GOSUB 600
380 GO TO 110
400 GOSUB 600
410 LET R = R + 1
420 IF L>Q THEN GOSUB 500
430 RETURN
500 LET Q = L
510 LET V = F
520 RETURN
600 FOR A = 1 TO 8
610 LET X = A = 1 AND -1 OR A = 2 AND -11 OR
            A = 3 AND -10 OR A = 4 AND -9 OR
            A = 5 AND 1 OR A = 6 AND 11 OR
            A = 7 AND 10 OR A = 8 AND 9
620 FOR G = 1 TO 7
630 GOSUB 800
635 IF NOT PEEK (J+F)=19 AND A = 1 THEN RETURN
640 LET H = PEEK(J+F+X*G)
650 IF H = E THEN NEXT G
660 IF H = D AND G>1 THEN GOSUB 700
670 NEXT A
680 RETURN
700 IF N = 1 THEN GO TO 900
710 FOR K = 0 TO G-1
720 GOSUB 800
730 POKE J + F + X * K,D
740 NEXT K
750 LET Z = 1
760 RETURN
800 LET I = PEEK(16397)
810 IF>I 127 THEN LET I = I-256
820 LET J = PEEK(16396) + I * 256
830 RETURN
900 LET L = L + G
910 IF A = 2 OR A = 4 OR A = 6 OR A = 8 THEN LET
     L = L + (RND(2)-1)
920 GOTO 760
```

When the screen returns, it displays your move and automatically changes any black pieces you have sandwiched to white. The screen then requests a string input. Just hit the Newline key to display the computer's move. Then it is your turn again. If you wish to stop the game at any time, input a letter on your turn.

The computer's processing speed at the beginning of the game is a little slow — as it has to loop the loop 59×8×8 times — but as the game progresses, the off screen time is reduced. For those of you who wish to change the game, the following list of variables may help.

First, loops: A helps print the screen then controls which direction, one of eight, the computer scans; G counts the depth of search along a particular line; K pokes the loop.

Secondly, variables: C is input; D means playing piece at any one time; E is the opponent's piece at any one time; F is the number of bytes from the corner of the screen to the position being played; H is the playing piece at address being Peeked; I/J are the address of top left-hand corner of screen; L counts number of potential wins from one position; N allows Poke loop to be by-passed while the computer is scanning for its best move; Q stores the highest number of potential wins from all positions scanned; R checks if there are any more spaces left to play; V is the number of bytes from the corner of the screen to the computer's best position to play; X is for scan direction — with loop A; Z means if input "C" is an illegal move, it returns for another input.

Thirdly, sub-routines: In Line 20, there is a space after the "8"; 400 checks if the positions scanned are better than previous positions scanned; 500 means if the new position is better than previous positions scanned store the position and number of potential wins; 600 makes sure that move is legal — if it is, then go to 700.

Line 700 is the Poke routine; 800 is the screen address; 900 increments "L". Also, it provides the bias for the computer, i.e., to be biased towards the diagonals on a random basis as the corners of the playing board are the strongest positions to play from.

Exam marks

G A Genever,
Sevenoaks, Kent.

ZX-81

EXAM MARKS are a headache for teachers at the end of term. Here is how I used the ZX-81 to work out percentage and form positions for seven classes of about 30 pupils. It all started when my daughter Rachel told me, in the way children do, that she had volunteered me to help with the English marks because I had just acquired a ZX-81.

Each pupil had three marks; one for language, one for comprehension and one for essay. Each mark had to be calculated as a percentage of the maximum mark, and an overall percentage produced, for each pupil. Finally, an average percentage overall had to be calculated.

Ideally, I would have put all the processing into one program to avoid having to input the percentages again but this was not possible with 1K — of course, I have a 16K RAM on order. However, the programs were subjected to a thorough workout one Sunday afternoon when I processed the whole set of seven classes.

The marks were on seven sheets and as I put them through the final program of the suite "PC MKS", I copied the percentages back to the sheets. "PC MKS" is very abbreviated, and the letter N, L, C and E mean number of pupils in class, maximum language mark, maximum composition mark and maximum essay mark.

```
 10 LET G = 0
 20 PRINT "N,L,C,E ?"
 30 INPUT N
 40 INPUT L
 50 INPUT C
 60 INPUT E
 70 CLS
 80 FOR I = 1 TO N
 90 INPUT A
100 CLS
110 LET A = INT (A * 100/L + .5)
120 PRINT A;
130 INPUT B
140 LET B = INT (B * 100/C + .5)
150 PRINT TAB 5; B;
160 INPUT D
170 LET D = INT (D * 100/E + .5)
180 PRINT TAB 10; D;
190 LET P = INT (((A + B + D)/3)+ .5)
200 PRINT TAB 15; P;
210 LET G = G + P
220 NEXT I
230 PRINT "AV PC =";INT (G/N + .5)
```

Running totals are kept and finally the overall average is calculated. Naturally, your application may have a slightly different format but this program should give a useful structure. I avoided holding the marks in memory, or on the screen, so that any size of class can be input.

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To put the marks into order for the form, highest first, I used a bubble sort, which will handle 40 marks easily. I found that an identification number was very helpful when dealing with large classes. So, the sort takes as input for each pupil, the overall percentage and a sequential identification number which I pencilled directly on to the data sheets in the format of a decimal number. For example, 78.01 (Newline), 72.02 (Newline). The sort adds .001 to each identification number so as not to lose the trailing zeros.

```
SORT - 1 - V2

 10 REM "SORT - 1 - V2"
 20 SLOW
 30 PRINT "N?"
 40 INPUT N
 55 DIM A (N)
 60 PRINT "VALS?"
 65 FOR I = 1 TO N
 70 INPUT A (I)
 75 LET A (I)=A(I)+ .001
 80 NEXT I
 82 FAST
 85 LET S = 0
 90 FOR I = 1 TO (N-1)
 95 IF INT A (I))=INT A (I +1) THEN GOTO 125
100 LET O = A (I)
105 LET A(I)=A(I + 1)
110 LET A(I + 1) = O
115 LET S = 1
125 NEXT I
130 IF S>0 THEN GOTO 85
140 CLS
155 FOR I = 1 TO N
160 PRINT A (I),
165 NEXT I
```

When I first ran the program with an input of 40 items it took 1½ minutes to sort, and I thought that the ZX-81 had forgotten what it was doing. It had not — it was keeping the display going as well. So I added line 82 Fast, and then it took 15 seconds.

Do not be surprised that the screen goes blank — the ZX-81 is thinking furiously. The use of integer in line 95 means that the identification number is ignored for sorting purposes. If you run out of display file before all the records are printed, press Cont and Newline. To look at a record again after Cont, use command Print A (N) where N is the final sequence of the item.

The Plough

William Cartwright, Lostock, Bolton.

ZX-81

FIVE OF the seven stars in the Plough have a common proper motion, but two have separate proper motions. The program shows three aspects of the constellation graphically.

Latest score

Terence Wilson, Preston, Lancashire.

ZX-80

THE PROGRAM predicts the most probable score of a football match using only the difference in league points to make its decision. The program itself is very simple to use. All you have to do is submit the name of the first team and its points followed by the same details of the opposing team.

When this is completed the computer then tells you what it thinks the score will be.

```
I0  CLS
20  REM POOLS PREDICTION T.WILSON AUGUST'8I
30  REM FOR AN EXPANDED ZX80 (I6K)
40  PRINT"THIS PROGRAM PREDICTS THE SCORE OF"
50  PRINT"LEAGUE MATCHES ;PLEASE ENTER THE FIRST "
60  PRINT"MATCH AS FOLLOWS"
70  PRINT"**************************************"
80  PRINT"HOME TEAM/No.OF POINTS;AWAY TEAM/No.OF POINTS"
90  INPUT HT
I00 INPUT X
II0 INPUT AT
I20 INPUT Y
I30 LET X=X+2
I40 LET Y=Y-2
I50 IF X-Y=0 THEN GOTO  560
I60 IF X-Y=I THEN GOTO  570
I70 IF X-Y=2 THEN GOTO  560
I80 IF X-Y=3 THEN GOTO  570
I90 IF X-Y=4 THEN GOTO  580
200 IF X-Y=5 THEN GOTO  590
2I0 IF X-Y=6 THEN GOTO  580
220 IF X-Y=7 THEN GOTO  600
230 IF X-Y=8 THEN GOTO  6I0
240 IF X-Y=9 THEN GOTO  600
250 IF X-Y=I0 THEN GOTO  6I0
260 IF X-Y=II THEN GOTO  600
270 IF X-Y=I2 THEN GOTO  620
280 IF X-Y=I3 THEN GOTO  630
290 IF X-Y=I4 THEN GOTO  620
300 IF X-Y=I5 THEN GOTO  630
3I0 IF X-Y=I6 THEN GOTO  640
320 IF X-Y=I7 THEN GOTO  660
330 IF X-Y=I8 THEN GOTO  640
340 IF X-Y=I9 THEN GOTO  650
350 IF X-Y=20 THEN GOTO  650
360 IF X-Y=-I THEN GOTO  570
370 IF X-Y=-2 THEN GOTO  560
380 IF X-Y=-3 THEN GOTO  570
390 IF X-Y=-4 THEN GOTO  580
400 IF X-Y=-5 THEN GOTO  590
4I0 IF X-Y=-6 THEN GOTO  580
420 IF X-Y=-7 THEN GOTO  560
430 IF X-Y=-8 THEN GOTO  650
440 IF X-Y=-9 THEN GOTO  600
450 IF X-Y=-I0 THEN GOTO  6I0
460 IF X-Y=-II THEN GOTO  600
470 IF X-Y=-I2 THEN GOTO  6I0
480 IF X-Y=-I3 THEN GOTO  670
490 IF X-Y=-I4 THEN GOTO  680
500 IF X-Y=-I5 THEN GOTO  670
5I0 IF X-Y=-I6 THEN GOTO  680
520 IF X-Y=-I7 THEN GOTO  700
530 IF X-Y=-I8 THEN GOTO  690
540 IF X-Y=-I9 THEN GOTO  680
550 IF X-Y=-20 THEN GOTO  7I0
560 PRINT HT;" 0 "; AT;" 0 NON SCORE DRAW"GOTO 70
570 PRINT HT;" I "; AT;" I ****SCORE DRAW****"GOTO 70
580 PRINT HT;" 2 "; AT;" 2 ****SCORE DRAW****"GOTO 70
590 PRINT HT;" 3 "; AT;" 3 ****SCORE DRAW****"GOTO 70
600 PRINT HT;" I "; AT;" 0 HOME WIN"GOTO 70
6I0 PRINT HT;" 2 "; AT;" I HOME WIN"GOTO 70
620 PRINT HT;" 3 "; AT;" 2 HOME WIN"GOTO 70
630 PRINT HT;" 2 "; AT;" 0 HOME WIN"GOTO 70
640 PRINT HT;" 3 "; AT;" I HOME WIN"GOTO 70
650 PRINT HT;" 3 "; AT;" 0 HOME WIN"GOTO 70
660 PRINT HT;" 4 "; AT;" 2 HOME WIN"GOTO 70
670 PRINT HT;" 0 "; AT;" I AWAY WIN"GOTO 70
680 PRINT HT;" I "; AT;" 2 AWAY WIN"GOTO 70
690 PRINT HT;" 0 "; AT;" 2 AWAY WIN"GOTO 70
700 PRINT HT;" I "; AT;" 3 AWAY WIN"GOTO 70
7I0 PRINT HT;" 0 "; AT;" 3 AWAY WIN"GOTO 70
```

```
  5   Rem "THE PLOUGH"
 10   PRINT "THE PLOUGH 100,000 YRS AGO"
 20   PLOT  7, 26
 30   PLOT 24, 27
 40   PLOT 29, 25
 50   PLOT 36, 23
 60   PLOT 38, 12
 70   PLOT 49, 13
 80   PLOT 40, 40
 90   PAUSE 300
100   CLS
110   PRINT "THE PLOUGH NOW"
120   PLOT 15, 25
130   PLOT 24, 27
140   PLOT 29, 25
150   PLOT 36, 23
160   PLOT 38, 12
170   PLOT 49, 13
180   PLOT 49, 25
190   PAUSE 300
200   CLS
210   PRINT "THE PLOUGH 100,000 YRS FROM NOW"
220   PLOT 26,  7
230   PLOT 24, 27
240   PLOT 29, 25
250   PLOT 36, 23
260   PLOT 38, 12
270   PLOT 49, 13
280   PLOT 62, 25
290   PAUSE 300
300   CLS
310   GOTO 10
```

(continued on page 69)

SOFTWARE FILE

(continued from page 67)

Punters' draw

J Consadine,
Humberside.

PET

WHENEVER an office draw is held, usually for the Derby or Grand National, the moment eventually comes when a member of the group draws names from a hat. This invariably leads to cries of "It's a fix" or "I see the organiser has picked the favourite again". This can be especially embarrassing if the head of department has drawn the 40:1 outsider.

To avoid these problems, why not let the computer perform the draw for you with an unbiased shuffle?

My program, Punters' Draw, allows any number of items — usually horses — to be input and a similar number of punters' names. The names are matched randomly with the horses and are listed on the screen, page by page. Provision is also made to print a hand copy if desired.

```
10 REM*****************
20 REM**PUNTER'S DRAW**
30 REM*****************
40 REM**BY J.CONSADINE 20/7/81**
50 INPUT"[CLR][CUD][CUD][CUD]NUMBER OF HORSES RUNNING";N:PRINT"[CLR]"
60 DIMN$(N),P$(N),FL(N)
70 FORX=1TON:PRINT"[CLR][CUD][CUD]NAME OF HORSE NO.";X
80 INPUTN$(X):NEXT:PRINT"[CLR]"
90 FORI=1TON:PRINT"[CLR][CUD][CUD]PUNTERS NAME NO."I
100 V=INT((N*RND(-RND(0)))+1):IFFL(V)<>0THEN100
110 INPUTP$(V):FL(V)=1:NEXT
120 PRINT"[CLR][CUD][CUD][RVS]PRESS ANY KEY TO LIST DRAW.[CUD]":GOSUB230
130 R=9:Q=1:PRINT"[CLR]"
140 FORX=QTOR:IFX>NTHEN180
150 PRINTN$(X);" --";P$(X):PRINT:NEXT
160 PRINT"[CUD][CUD][RVS]PRESS ANY KEY TO CONTINUE LIST.":GOSUB230
170 PRINT"[CLR]":Q=R:R=R+R:GOTO140
180 PRINT"[CUD][CUD][RVS]PRESS(A)TO VIEW LIST AGAIN."
190 PRINT"[CUD][RVS]OR PRESS(P)TO PRINT HARD COPY.":GOSUB230
200 IFA$="A"THEN130
210 IFA$="P"THEN250
220 GOTO290
230 GETA$:IFA$=""THEN230
240 RETURN
250 OPEN1,4,1:PRINT"[CLR][CUD][RVS]PRINTING."
260 FORX=1TON:PRINT#1,N$(X)" - "P$(X)
270 PRINT#1:NEXT
280 CLOSE1:PRINT"[CLR]":GOTO180
290 END
```

Least squares

Kevin Polston,
Dagenham, Essex.

ATOM

THIS IS a scientific program which takes, as input, X-Y co-ordinates which as a set conform to, or nearly to, a straight line. The program then calculates the best straight line in the form Y = Mx + C and the estimated standard deviations in M, the slope, and C, the intercept. This program will be of use to anybody who does experimental work.

```
1 REM KEVIN POLSTON
2 REM DAGENHAM ESSEX
3 REM
5 DIM W(64)
10 P.$12,"            least squares",',
20 P."FOR A STRAIGHT LINE.",',
   "ASSUME X EXACT AND Y IN ERROR",'
30 P.',"TERMINATE BY -999",'
90 @=1
100 REM SET UP
110 %N=0
120 %P=0
130 %X=0
140 %Y=0
150 %S=0
160 %Q=0
170 REM INPUT SECTION
190 C=0
200aC=C+1
205 P.C
210 P."  X= "
220 FINPUT %I
230 FIF %I=-999 GOTO s
240 %N=%N+1
250 %X=%X+%I
260 %S=%S+(%I*%I)
270 P."    Y= "
280 FINPUT %J,'
290 %Y=%Y+%J
300 %P=%P+(%J*%I)
305 %Q=%Q+%J*%J
310 GOTO a
330sREM SOLVE SIM EQUATION
350 %D=((%N*%S)-(%X*%X))
360 %A=((%N*%P)-(%X*%Y))/%D
370 %B=((%S*%Y)-(%X*%P))/%D
390 REM OUTPUT SECTION
410 P.',';P.$12
411 P."           analysis of data",',
412 P."CORRELATION COEFF SHOULD BE +- 1",'
413 P."PROGRAM USES ONE PASS METHOD",'
414 P."BEWARE OF ROUNDING ERRORS",',
415 REM %G IS CORR COEFF
418 %G=%A*(SQR(%D/(ABS(%N*%Q-%Y*%Y))))
419P."CORRELATON COEFF = ";FP.%G'
420 P."SLOPE = ";FP.%A,'
430 P."INTERCEPT = ";FP.%B,'
440 REM %H IS VARIENCE
460 %H=((%A*%A*%D)/(%N*(%N-2.0)))*
    (1.0/(%G*%G)-1.0)
465 GOTO 480
470P."VARIENCE IN Y = ";FP.%H,'
480 REM %K IS VAR OF SLOPE
490 %K=(%H*%N)/%D
499 GOTO 510
500 P."VAR OF SLOPE = ";FP.%K,'
510 REM %K NOW BECOMES E.S.D
520 %K=SQR(%K)
530 P."E.S.D OF SLOPE = ";FP.%K,'
540 REM %L IS VAR OF INTERCEPT
550 %L=(%H*%S)/%D
555 GOTO 570
560 P."VAR OF INT = ";FP.%L,'
570 REM %L NOW BECOMES E.S.D
580 %L=SQR(%L)
590 P."E.S.D OF INTERCEPT ";  FP.%L,'
600 P."ANOTHER RUN (Y/N) "
610 INPUT $W,'
620 IF $W="Y" GOTO 10
630 IF $W="N" P."BYE-BYE";END
640 P."CAN ONLY ACCEPT Y OR N";GOTO 610
>RUN
```

(continued on next page)

(continued from previous page)

Bulls and cows

Graham Richards,
Sidcup, Kent.

MICROTAN

THE SUBROUTINE Random generates a pseudo random-number sequence including all numbers from 1 to FF Hex. On return, the accumulator contains the random number. Before use, locations 72 and 73 should be seeded with a starting number but not zero and a counter value. Avoid large numbers where speed is required and numbers which can be divided into FF as this will reduce the number of numbers available. Different seed values will generate different sequences.

The program Bulls and Cows when used with the subroutine Random prompts the user to break the five-number code set by the computer. The user can place the guess by using the cursor controls, left and right arrow, and the numbers 1 to 8.

All invalid input is ignored and the cursor cannot be moved outside its range. The guess can be changed until the user is satisfied the code has been broken. On typing Return, the truth will be revealed. The computer will display an "X" for each correct guess and an "O" for each correct number put in the wrong place. On breaking the code "XXXX" will be displayed. The starting address is 80.

Both programs will run together on an unexpanded Microtan, but they avoid the area used by the cassette software in XBug.

Here is a typical screen display:

```
G80
01   1 1 1 2 2
02   3 3 3 4 4  XO       }
03   5 5 6 7 7  XXO      }
04   3 5 6 3 5  XXX      } Complete
05   3 4 7 3 5  XXXO     } game
06   4 5 6 3 5  XX       }
07   3 5 7 3 7  XXXXX    }

01                       } Start of
?                        } next game
```

```
TYPE RANDOM.MTN

                         .SUBROUTINE RANDOM

                         .DATA
                         .=72

72      01      RAND:    .BYTE   1
73      10      COUNT:   .BYTE   10
74      00      CDOWN:   .BYTE   0
75      8008    BITBSE:  .BYTE   80,8,4,2
77      0402

                         .CODE
                         .=160

160     8A      RANDOM:  TXA             ;SAVE REGISTERS
161     48               PHA
162     98               TYA
163     48               PHA
164     A573             LDA     COUNT   ;SET UP COUNTER
166     8574             STA     CDOWN
168     A203    LOOP:    LDX     #3      ;START PARITY CHECK
16A     A000             LDY     #0      ;ON BITS 2,3,4 & 7
16C     B575    NEXTBT:  LDA     BITBSE,X
16E     2472             BIT     RAND
170     F001             BEQ     NOTSET
172     C8               INY
173     CA      NOTSET:  DEX
174     10F6             BPL     NEXTBT
176     98               TYA             ;GET PARITY BIT
177     6A               ROR     A       ;INTO CARRY
178     2672             ROL     RAND    ;AND PUT IN NEW RAND
17A     C674             DEC     CDOWN
17C     D0EA             BNE     LOOP
17E     68               PLA             ;RESTORE REGISTERS
17F     A8               TAY
180     68               PLA
181     AA               TAX
182     A572             LDA     RAND
184     60               RTS
                         .END


TYPE BC.MTN

                         .TITLE BULLS AND COWS

                         .DATA
                         .=60

60              CODE:    .BLKB   5
65              CTEMP:   .BLKB   5
6A              GUESS:   .BLKB   5
6F              BULL:    .BYTE   0
70              COW:     .BYTE   0
71              GONUMB:  .BYTE   0

                         .CODE
                         .=80

80      A204    BC:      LDX     #4      ;GET SECRET CODE
82      206001  GETNUM:  JSR     RANDOM
85      4A               LSR     A
86      4A               LSR     A
87      4A               LSR     A
88      4A               LSR     A
89      4A               LSR     A
8A      18               CLC
8B      6931             ADC     #31     ;CONVERT TO ASCII (1-8)
8D      9560             STA     CODE,X
8F      CA               DEX
90      10F0             BPL     GETNUM
92      A901             LDA     #1      ;INITIALIZE
94      8571             STA     GONUMB
96      2073FE           JSR     FE73    ;CRLF
99      A200    NGO:     LDX     #0
9B      866F             STX     BULLS
9D      8670             STX     COWS
9F      A571             LDA     GONUMB
A1      200BFF           JSR     FF0B    ;PRINT GO NUMBER
A4      2073FE           JSR     FE73    ;CRLF
A7      A200             LDX     #0
A9      20E600  PRNTCS:  JSR     CURSOR
AC      20FAFD  NCHAR:   JSR     FDFA    ;POLL KEYBOARD
AF      A501             LDA     1       ;LOCATION 1 HAS INPUT CHAR.
B1      C915             CMP     #15     ;RIGHT ARROW?
B3      D00B             BNE     TRYL
B5      E008             CPX     #8      ;OUT OF RANGE?
B7      F0F3             BEQ     NCHAR
B9      20EC00           JSR     NOCUS
BC      E8               INX
BD      E8               INX
BE      D0E9             BNE     PRNTCS
C0      C908    TRYL:    CMP     #8      ;LEFT ARROW?
C2      D00B             BNE     TRYRET
C4      E000             CPX     #0      ;OUT OF RANGE?
C6      F0E4             BEQ     NCHAR
C8      20EC00           JSR     NOCUS
CB      CA               DEX
CC      CA               DEX
CD      100A             BPL     PRNTCS
CF      C90D    TRYRET:  CMP     #D      ;RETURN?
D1      D006             BNE     TRYN
D3      20EC00           JSR     NOCUS
D6      18               CLC
D7      9017             BCC     SCORE
D9      C931    TRYN:    CMP     #31     ;VALID NUMBER?
DB      30CF             BMI     NCHAR
DD      C939             CMP     #39
DF      10CB             BPL     NCHAR
E1      9DC503           STA     3C5,X   ;YES SO STORE ON SCREEN
E4      D0C6             BNE     NCHAR

E6      A92D    CUSOR:   LDA     #2D
E8      9DE503  OUT:     STA     3E5,X
EB      60               RTS
EC      A920    NOCUS:   LDA     #20
EE      D0F8             BNE     OUT

F0      A204    SCORE:   LDX     #4      ;GET GUESS FROM SCREEN
F2      A008             LDY     #8      ;AND STORE
F4      B9C503  MOVE:    LDA     3C5,Y
F7      956A             STA     GUESS,X
F9      CA               DEX
FA      88               DEY
FB      88               DEY
FC      10F6             BPL     MOVE
FE      A204             LDX     #4      ;CHECK FOR BULLS
100     B560    NB:      LDA     CODE,X
102     9565             STA     CTEMP,X
104     D56A             CMP     GUESS,X
106     D009             BNE     NOBULL
108     E66F             INC     BULL
10A     A901             LDA     #1      ;MASK
10C     956A             STA     GUESS,X
10E     0A               ASL     A
10F     9565             STA     CTEMP,X
111     CA      NOBULL:  DEX
112     10EC             BPL     NB      ;CHECK FOR COWS
114     A204             LDX     #4
116     A004    NC:      LDY     #4
118     B96500  NCY:     LDA     CTEMP,Y
11B     D56A             CMP     GUESS,X
11D     D00A             BNE     NOCOW
11F     E670             INC     COW
121     A901             LDA     #1      ;MASK
123     956A             STA     GUESS,X
125     0A               ASL     A
126     996500           STA     CTEMP,Y
129     88               DEY
12A     10EC             BPL     NCY
12C     CA               DEX
12D     10E7             BPL     NC
12F     E8               INX
130     A958             LDA     #58     ;PRINT 'X' FOR BULLS
132     C66F    BULDIS:  DEC     BULL
134     3006             BMI     COWDIS
136     9DD103           STA     3D1,X
139     E8               INX
13A     10F6             BPL     BULDIS
13C     A94F    COWDIS:  LDA     #4F     ;PRINT 'O' FOR COWS
13E     C670    COWDS:   DEC     COW
140     3006             BMI     WIN
142     9DD103           STA     3D1,X
145     E8               INX
146     10F6             BPL     COWDS
148     ADD503  WIN:     LDA     3D5     ;HAS CODE BEEN BROKEN?
14B     C958             CMP     #58
14D     F005             BEQ     BREAK
14F     E671             INC     GONUMB  ;NO
151     4C9900           JMP     NGO
154     2073FE  BREAK:   JSR     FE73    ;YES — CRLF X 3
157     2073FE           JSR     FE73
15A     2073FE           JSR     FE73
15D     4C8000           JMP     BC
                         .END
```

Strings and arrays

Derek Haslam,
Colne, Lancashire

ATOM

A SIMPLE illustration of the flexibility of the Atom's memory is the way the contents of memory location 18 may be manipulated so that several programs may be held at the same time and even use the same line numbers. Nowhere is this freedom of more use than in the handling of strings and arrays. Acorn's documentation is well above average but there is more to be said on the matter of memory usage than the manual reveals.

There are two ways of allocating space for a string:

```
10 DIM A(16)
20$ A="THIS IS A STRING"
```

Users of other Basics will turn up their noses at the idea of having to dimension the string before assigning it. However, the seasoned Atom user will know the advantages of knowing exactly where that string is in memory — variable A contains the address of its first character — and being able to manipulate individual characters by means of indexed Peeks and Pokes.

```
10 A= # 8200
20$ A="THIS IS A STRING"
```

The difference between the two methods is that in the second, the user specifies where the string will go in memory, whereas in the first, he leaves it to the operating system. The first is safer since it reserves space above the program text which is not already being used. The second places much more responsibility on the programmer to ensure that strings will not overwrite each other, but allows him to make use of memory in his own fashion.

In the example given, the string is being put into the graphics RAM, immediately above the block used to map the screen in characters mode — or mode 0 graphics.

Since the lower text area of the Atom can hold only 5K on the main board and the graphics area can hold 6K of which only .5K is used when displaying ordinary text, the use of the graphics area for string storage has obvious attractions.

For the best of both methods, however, we would like to use the Dim statement with its automatic allocation of memory not already assigned and tell the computer to start its dimensioning in the graphics RAM. How can we achieve this?

The Dim statement works as follows. The address of the next free byte of memory is held in zero page at # 23, # 24. For those unfamiliar with the Atom, "#" indicates that what follows is a Hexadecimal number. This is the free-space pointer which the manual mentions but without telling you where it is.

On power-up, it contains the same address as that returned by the Top function — which is stored at # OD, # OE. As soon as a Dim is executed, however, the two values become different: Top indicates the next byte above the program text, # 23, # 24 gives the next byte above the arrays and strings which are dimensional after the program text.

We can re-direct the free-space pointer by inserting at the start of the program the line:

```
10 !# 23= # 8200
```

It now points at the start of the graphics RAM and all subsequent Dim statements will reserve memory in this area, leaving the whole of the lower text area available for the program. What is true for strings is, of course, also true for numeric arrays of integers and floating-point numbers dimensioned with lines such as:

```
20 DIM BB(20)
30 FDIM %BB(10)
```

Anyone who has worked with large arrays will know how they consume memory and an attempt to use them on the Atom without this ruse can be most frustrating. Even greater problems are possible with string arrays.

When you wish to use an array of strings on the Atom you must do two dimensioning sessions. The manual explains how, using a program of this type:

```
10 DIM BB(5)
20 FOR I=0 TO 5
30 DIM X(10); BB(I)=X
40 NEXT I
```

The principle is to dimension an array, BB, to hold the base addresses of the strings, then repeatedly dimension a simple string, X, and point the current element of BB at its first character. Statements such as:

```
50$BB(3)="THREE"
60 PRINT $BB(3)
```

may then be written, up to a maximum of six strings of length 10 characters.

The real problem is not, however, dimensioning the array but entering your string data into it. Most Basics have Read and Data statements to facilitate this; the Atom has not. Acorn describes a way of providing the equivalent effect, but this method suffers from the same disadvantages as the more conventional Read and Data: you have to store the data twice.

It is stored once in the form of program lines and a second time when it has been read into the string array. We users of machines with limited RAM cannot waste memory in this profligate way — so what do we do about it?

Suppose we have a list of data such as:

```
1000d FIRST
1010 SECOND
1020 THIRD
1030 FOURTH
```

which we wish to use as a string array so that a statement like

```
PRINT $BB(2)
```

will print Second. The first thing to notice is that we have only one item of data per program line. This is important: so are the spaces between the line numbers and the first letter of each string.

The point to realise is that each line of program in the Atom ends with a carriage return and is therefore in itself a string. The lines given, shorn of their line numbers, already constitute a string array stored in memory and there is no need to copy it to another part of memory. All we need do is find the address of the first letter of each word and store these addresses in an array:

```
10 DIM BB(4); P= # 2900
20 DO P=P+1; UNTIL ?P=13 AND
P?3=CH"d"
30 FOR I=1 TO 4
40 DO P=P+1; UNTIL P?—4=13
50 BB(I)=P
60 NEXT I
```

Starting at the beginning of the lower text space, # 2900, P is incremented until it encounters a carriage return followed, three bytes later, by the label d. P is then pointing at the terminator of the line immediately prior to line 1000.

Entering the For — Next loop, P is moved on again until it points to the byte four bytes after the return. This is the F in First. The address of this character is stored in BB(1) and the process continues until all the base addresses of the strings have been found.

Consult the oracle

D A Walker,
London SE13.

ZX-81

THE RND function in the I-Ching program does not seem very oracular to me — perhaps the nearest analogy to tossing a coin the ZX-81 can provide is to discover at a random moment whether the frame count is odd or even. This could bring the psychic factor into play.

I have devised this no-frills program to fit into my unexpanded ZX-81. It lets you know the result of each toss and builds a hexagram with moving lines — if any — in the middle of the screen. This is sufficient for consulting the book. The string in line 10 can be used to save on cassette.

```
 10 PRINT "I CHING. TO TOSS COIN PRESS 0"
 90 FOR N = 12 to 7 STEP -1
100 LET S = 0
110 FOR M = 1 to 3
120 IF INKEY$<>"0" THEN GOTO 120
140 LET X = PEEK(16436)
150 LET A = X - INT (X/2) * 2
160 IF A = 0 THEN LET S = S + 2
165 IF A = 0 THEN PRINT AT 21,0;M;"TAILS"
170 IF A = 1 THEN LET S = S + 3
175 IF A = 1 THEN PRINT AT 21,0;M;"HEADS"
180 IF INKEY$ = "0" THEN GOTO 180
190 NEXT M
200 IF S = 6 THEN PRINT AT N,14;"-x-"
210 IF S = 7 THEN PRINT AT N,14;"---"
220 IF S = 8 THEN PRINT AT N,14;"- -"
230 IF S = 9 THEN PRINT AT N,14;"-0-"
240 NEXT N
```

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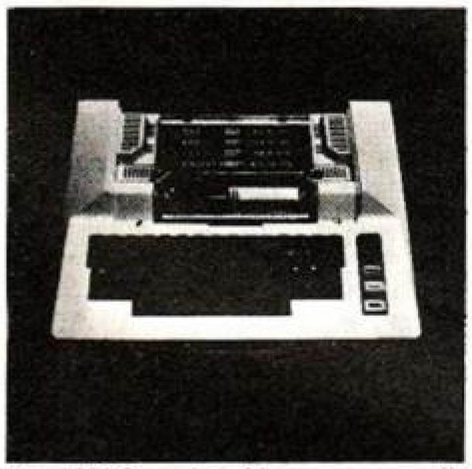

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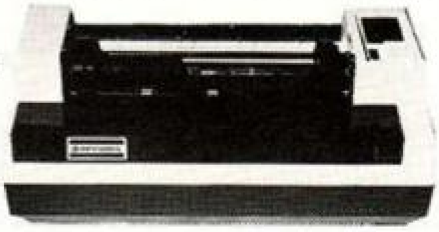

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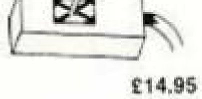

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BL MICROELECTRONICS: BLM, 1 Willow Way, Loudwater, High Wycombe, Buckinghamshire.
Biproc; £150 Z-80
Single-board micro with assembler.

COMPSHOP:
14 Station Road, New Barnet, Hertfordshire EN5 1QW. 01-441 2922.
UK101; £179 6502
British version of Superboard, software available.

CROMEMCO:
Comart, PO Box 2, St Neots, Huntingdon, Cambridgeshire PE19 4NY. 0480-215005.
Single-card; £273 Z-80.

NASCOM:
Nascom Microcomputers, Welton Road, Wedgnock Industrial Estate, Warwick, CV34 5PZ. 0926-497733.
Nascom 1; £125 Z-80
Well-established micro with full keyboard.
Nascom 2; £295 Z-80A
Advanced version of Nascom 1.

NEWBEAR COMPUTING STORE:
40 Bartholomew Street, Newbury, Berkshire.
7768; from £45
Single-board with cassette and VDU interface.

NEWTRONICS:
255 Archway Road, London N6. 01-348 3325.
Elf II; from £39 1802
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Explorer 85; from £299 8085
System expands in easy-to-build and affordable steps.

OHIO SCIENTIFIC:
33/35 Cardiff Road, Watford, Hertfordshire. 92-40588.
Superboard; £160 6502
Very popular single-board micro.

RCA: HL Audio, 255 Archway Road, London N6. 01-348 3325.
Cosmac; £79 1802
Micro with Hex-pad and machine code with Basic option.

ROCKWELL: Forby House, 18 Market Place, Brackley, Northamptonshire. 0280-702017.
Aim-65; £250 6502
Micro with built-in printer.

SINCLAIR RESEARCH:
6 Kings Parade, Cambridge CB2 1SN.
ZX-80; £79 Z-80A: now available second-hand
The biggest-selling British micro.
ZX-81; £49 Z-80A

SYNERTEC: Newbear, 40 Bartholomew Street, Newbury, Buckinghamshire. 0635-30505.
Sym-1; £160 6502
Similar to the now-defunct Kim-1.

TANGERINE COMPUTER SYSTEMS:
Forehill, Ely, Cambridgeshire. 0353-3633.
Microtan 65; £69 6502
Expandable, British-designed and easy to build.

TRANSAM COMPONENTS:
59 Theobalds Road, London WC1. 01-405 5240.
Tuscan; £150 Z-80
Can be expanded to full business system.
Triton; £296 8080
Can be expanded to a large system.

COMPUTERS AVAILABLE READY-BUILT

This only includes those which cannot be purchased in kit form.

HEWART: 95 Blakelow Road, Macclesfield, Cheshire. 0625-22030.
Hewart 6800s; £299 6800
Hewart 6800 mkIII; £152 6800

SHARP: Sharp House, Thorp Road, Newton Heath, Manchester M10 9BE. 061-205 2333.
PC-1211: £85
Pocket computer Basic, Cassette interface.

COMMODORE: 818 Leigh Road, Trading Estate, Slough, Berkshire, 75-74111.
Vic-20; £189.
New home computer for everybody — special colour graphics and sound.

CALCULATORS

SHARP:
Sharp House, Thorp Road, Newton Heath, Manchester M10 9BE.
EL 504 £18.95 29 program steps.
EL 507 £19.95 30 program steps.
EL 5101 £39.95 48 program steps.
EL 5100 £49.95 80 program steps.
EL 5103 £29.95 48 program steps.

HEWLETT-PACKARD:
King Street Lane, Winnersh, Wokingham, Berkshire. 0734-784774.
HP-33C £49.52 49-program-step scientific calculator.
HP-34C £83.43 210-program-step scientific calculator.
HP-38C £83.43 99-program-step financial calculator.
The following machines are not dedicated.
HP-67 £195.65 224 program steps.
HP-97 £404.35 224 program steps.
HP-41c £130.35 200-2,000 bytes plug-in memory.
HP-41cV £169.35 2,000 bytes.

TEXAS INSTRUMENTS:
European Consumer Division, Manton Lane, Bedford, MK41 9BE.
TI-57 50 program steps.
TI-58 480 program steps. Plug-in library module.
TI-59 960 program steps. Plug-in library module.
PC-100C Printer for S8 and S9.

CASIO: 28 Scrutton Street, London EC2. 01-377 9087.
fx 501 £64.95 128 program steps.
fx 502 £84.95 256 program steps.

COMMODORE: 818 Leigh Road, Trading Estate, Slough, Berkshire. 7574111.
PR-100 £24.95 72 program steps. ■

COMPETITION CORNER

A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in October. The name of the winner, the solution, and a competition report will be published in the December issue of *Your Computer.*

If you want to set a competition for *Competition Corner,* remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.

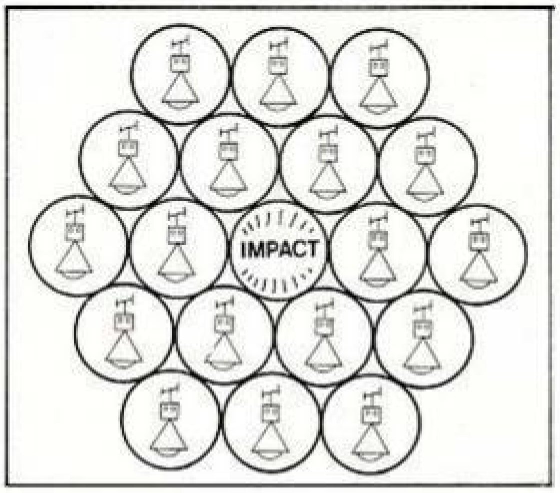
Crater robots

BY ANTHONY ROBERTS

THE OSCAR II — a robotic intergalactic space vehicle — has met with total disaster deep in space: it has plummeted straight into the centre of a small-cratered planetoid — the local map is shown here. Being quick-witted, the 18 robots survived by leaping from the craft just before impact and floating down — one into each of the nearby craters.

Some of the robots then ran their socio-survival programs, which caused them to climb into an adjacent crater so as to meet with other robots who had either moved into the new crater or were already there. Here a fault in the program became apparent: because no robot was now in a crater adjacent to a fellow automaton, each assumed that it was the only one left, and they settled to live out their remaining 25,000 year lives waiting for rescue.

How many different ways could they have grouped? Take no notice of how many there are in each group: just how many different distributions of groups are possible.



How to submit an article

WE WILL consider any articles submitted for publication but they should not be more than 3,000 words long. Articles on any subject are welcome and they should, ideally, have something to do with personal computers.

Submissions should be typed with double spaces between lines and where programs are included, they should be computer-printed with a sample run of the program. We pay £35 per published page.

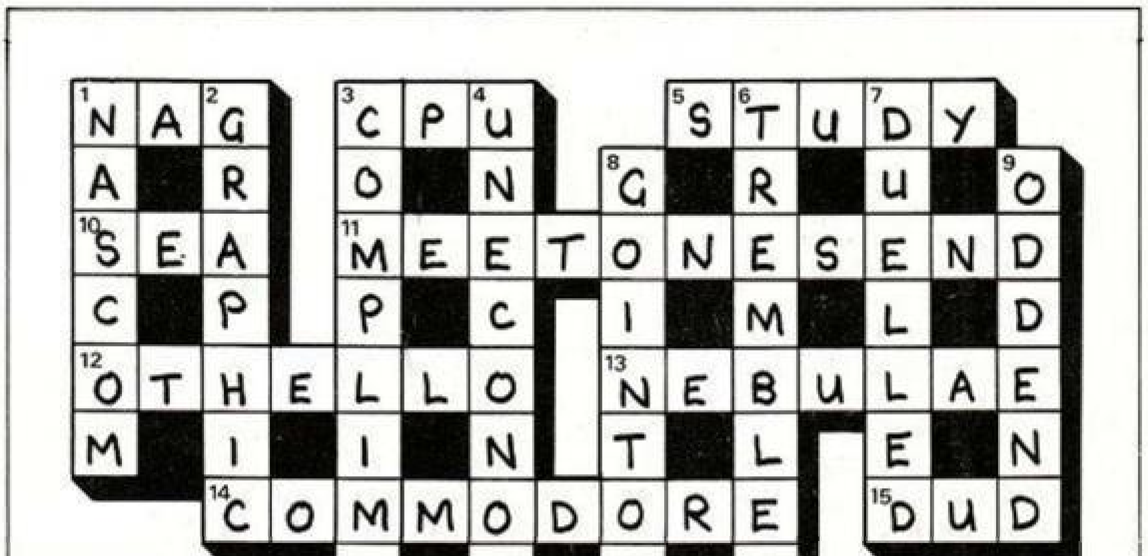
It is because there are no experts in personal computing that if you find a new trick with your computer which shows an interesting programming feature, then you stand a good chance of being the first person to have discovered it. We hope you will be willing to share your discoveries with the rest of us and send them to *Your Computer* for publication. In return, we will try and publish as many of your programs as we can.

The Editor cannot undertake to return submitted articles and while every effort is made to check the articles and listings, *Your Computer* cannot guarantee that programs will run and can accept no responsibility for any errors.

Vic-20 competition result

MANY THANKS to the 1,000 readers who dutifully sent in their cards for the Vic-20 competition. It took us some time to decide on the winner, but eventually we plumped for P. Goss, 5 Clarendon Drive, Wootton Bassett, Swindon, Wiltshire who successfully completed the crossword, found a space to write his address on the card and came up with the awful pun in 'I will use a personal computer for music generation, to make my Bach no worse than my byte.' Commodore should by now have supplied him with a Vic-20.

Some of the other entries deserve an honourable mention, notably Nicholas Willder with 'for fondling the deliberate pistakes in crisswrod composistions', Ian Flinders with 'for analysing chiropteran echo-location signals via interfacing with my ultrasonic bat detector', A. Wilkinson with 'for taking a silicon trip — letting the electronic brain take the strain', T. Vickers, writing about our other hobby, with 'for recording, classifying, coding and displaying movements in Scottish country dances', C. Collins with 'overcoming my addiction to programmable calculators', M. White of the Liverpool School of Dental Surgery with 'for simulating the 3-D bacterial structure of plaque from an artificial mouth' and J. Bolton with 'cutting out casual estimation and substitute clinical calculation (better family planning)'. ■



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PACK 16/2 includes all of:
ADVENTURE ATLANTIC: You may become very rich or you may be marooned forever; BREAKOUT; SQUASH PRACTICE; TRANSLATOR: translates any European language to any other, vocab on cassette; COMPUTAPRINT: use this program to predict horse races, or football pools!!
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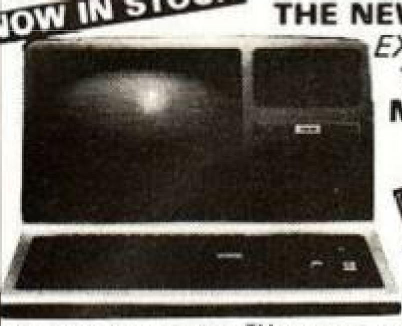

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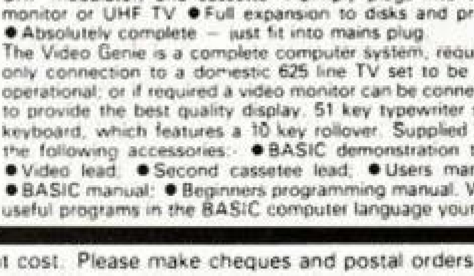

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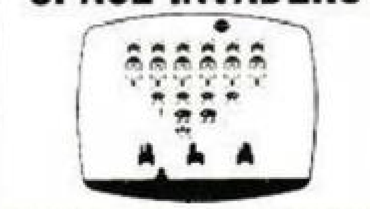

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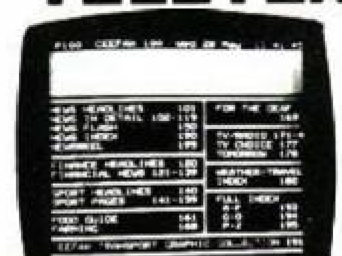

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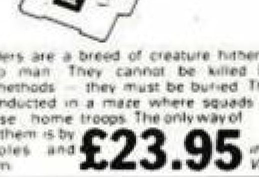

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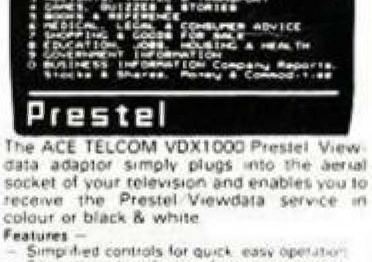
THE OLYMPIA — POST OFFICE APPROVED TELEPHONE ANSWERING MACHINE
WITH REMOTE CALL-IN BLEEPER

This telephone answering machine is manufactured by Olympia Business Machines, one of the largest Office Equipment manufacturers in the U.K. It is fully POST OFFICE APPROVED and will answer and record messages for 24 hours a day. With your remote call-in bleeper you can receive these messages by telephone wherever you are in the world. The remote call-in bleeper activates the Answer/Record Unit, which will at your command repeat messages, keep or erase them, and is activated from anywhere in the world, or on your return to your home or office. The machine can also be used for message referral, if you have an urgent appointment, but are expecting an important call, simply record the 'phone number' and location where you can be reached. With optional extra bleepers (£13 each) this facility can be extended to colleagues and members of the family. Using a C90 standard cassette you can record as many as 45 messages. The announcement can be up to 16 seconds long and the incoming message up to 30 seconds long.

The machine is easy to install and comes with full instructions. It is easily wired to your junction box with the spade connectors provided or alternatively a jack plug can be provided to plug into a jack socket. Most important, of course, is the fact that it is fully POST OFFICE APPROVED. The price of £135 (inc VAT) includes the machine, an extra-light remote call-in Bleeper, the microphone message tape, A.C. mains adaptor. The unit is 9½"x6"x2½" and is fully guaranteed for 12 months. The telephone can be placed directly on the unit — no additional desk space is required.

£135 inc VAT

PRESTEL VIEWDATA

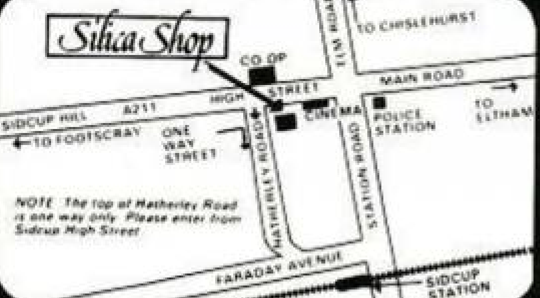


The ACE TELCOM VDX1000 Prestel Viewdata adaptor simply plugs into the aerial socket of your television and enables you to receive the Prestel Viewdata service in colour or black & white.

Features —
- Simplified controls for quick, easy operation
- Special graphics feature for high resolution
- State-of-the-art microprocessor controller
- Standard remote telephone keypad with Prestel keys * #
- Auto dialler incorporated for easy Prestel acquisition
- True PAL colour encoder using reliable IC chroma filter and dela line incorporated for minimum picture interference maximum fidelity
- Includes convenient TV — Prestel switchbox
- Easily connected to standard home or office telephone lines
- Fully Post Office approved

SPECIAL PRICE **£228.85** inc VAT

FOR FREE BROCHURES – TEL: 01-301 1111



NOTE: The top of Hatherley Road is one way only. Please enter from Sidcup High Street.

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