ACORN USER

For the BBC micro, Atom and Econet users

November 1982 £1

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Software for schools
Atom Graphics
Hints and tips
BBC news

TREK III

Space war game
page 15

WIN A BBC MICRO page 71

SOR

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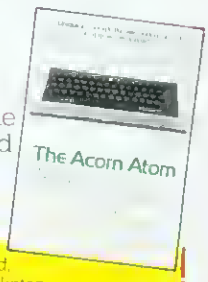

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Please rush me a complete list of the Atom range.

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Address _____

_____

_____

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Postcode _____

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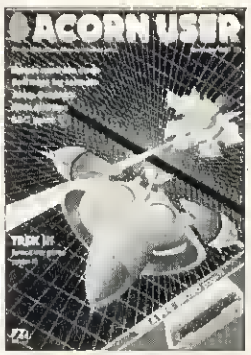
NOVEMBER 1982, NUMBER FOUR



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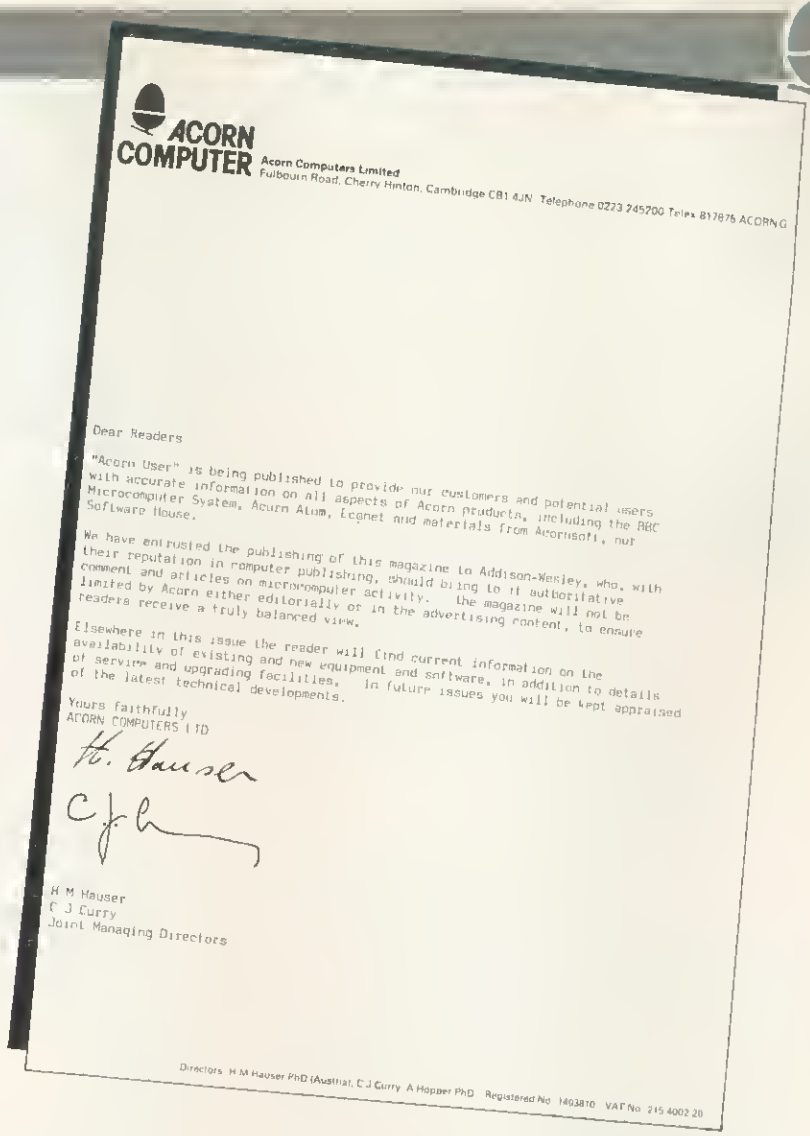
How to submit articles
You are welcome to submit articles to the Editor of *Acorn User* for publication. *Acorn User* cannot undertake to return them unless a stamped addressed envelope is enclosed. Articles should be typed or computer written. Black and white photographs or transparencies are also appreciated. If submitting programs please send a cassette or disc. Listings should not contain more than 39 characters per line for ease of reproduction. Payment is £50 per page or pro rata. Please indicate if you have submitted your article elsewhere. Send articles, reviews and information to: The Editor, *Acorn User*, 53 Bedford Square, London WC1B 3DZ.

Coming soon in *Acorn User*:

● Sound on the Beeb ● Software reviews ● Atom word processing ● Maths in Basic ● Programs for schools ● Progress at the BBC ● Festive hints and tips ● Econet details ● Listings for games ● Teletext graphics

Constructive approach to the problems of computing



ACORN COMPUTER
Acorn Computers Limited
Fulbourn Road, Cherry Hinton, Cambridge CB1 4JN Telephone 0223 245200 Telex 817875 ACORN G

Dear Readers

"Acorn User" is being published to provide our customers and potential users with accurate information on all aspects of Acorn products, including the BBC Microcomputer System, Acorn Atom, Econet and materials from Acornsoft, our Software House.

We have entrusted the publishing of this magazine to Addison-Wesley, who, with their reputation in computer publishing, should bring to it authoritative comment and articles on microcomputer activity. The magazine will not be limited by Acorn either editorially or in the advertising content, to ensure readers receive a truly balanced view.

Elsewhere in this issue the reader will find current information on the availability of existing and new equipment and software, in addition to details of service and upgrading facilities. In future issues you will be kept appraised of the latest technical developments.

Yours faithfully
ACORN COMPUTERS LTD

H M Hauser
C J Curry
Joint Managing Directors

Directors H M Hauser PhD (Austria), C J Curry, A Hopper PhD Registered No 1403870 VAT No 215 4002 20

TO THOSE of you who have never seen a copy of *Acorn User* before – welcome. You are reading the only magazine for users of the Atom, BBC microcomputers and Econet systems which has official support from Acorn Computers.

Acorn User is relatively new – it was launched in July – and this is the first issue to be distributed nationwide. Its role is to help you squeeze the best from your micro (and help you get one), as well as providing news of the latest developments from Acorn, the BBC and any other sources which are relevant.

The word 'users' is meant in its widest sense as readers come from all worlds – education, business, industry, home – and many countries. So whatever your interest, there should be something here, if not let us know.

Commentators in the media have had a field day with their criticism of Acorn – much of it deserved. But this magazine aims to provide a constructive side to its criticisms. Feedback presented in a proper way is valuable both to writer and target.

This effect is appearing in Acorn's attitude to its new, mass market microcomputer – the Electron. Hopes of a Christmas launch have now been dashed, and the company is delaying the launch to avoid production difficulties which bedevilled the BBC machine.

Anyway, less of all this theory and back to the interesting bits. David Allen is providing this month's article from the BBC on progress with the new TV series. But making programmes, just like building micros is all in the production, and serious filming won't start till early November.

Meanwhile, one of Auntie's offshoots, the Ceefax service, is preparing to launch telesoftware. Buying a receiver will enable computer users to download programs broadcast over the airwaves directly into the memory of their machines, and save them on cassette or disc. Imagine it, no more keying in! Prestel has also set up a computer database to provide a similar service, with the might of Buzby's British Telecom.

On the educational front, teachers are still faced with a dearth of software. As BBC micros spread through schools financed by the Government's microelectronics scheme, the need for decent programs will become more apparent. *Acorn User* hopes to remedy the situation by acting as a medium for ideas and printing listings.

That's all from the Editor for now, see you in December.

Acorn-Disney link up

British company joins forces with US film giant in schools competition

TRON, the science fiction adventure film, is the foundation of a major link up between Acorn Computers and American entertainment giant Walt Disney Productions.

A competition based on the film has been produced for primary and secondary schools in Britain – with BBC micros as the major prizes.

Acorn are offering a BBC microcomputer with disc drive, printer and software as first prize. There will be further awards given for regional entries.

But entrants need not already have a computer. All primary children need to do is describe the plot in 100 sentences of 10 words or less, while secondary pupils must write a story based on *Tron* laid out like a computer program.

Details are now being sent to schools.

At the risk of giving it all away, the story tells how Flynn, a programmer, has his video games stolen by a powerful computer company. In his attempts to find proof of the theft, Flynn is drawn into a computer.

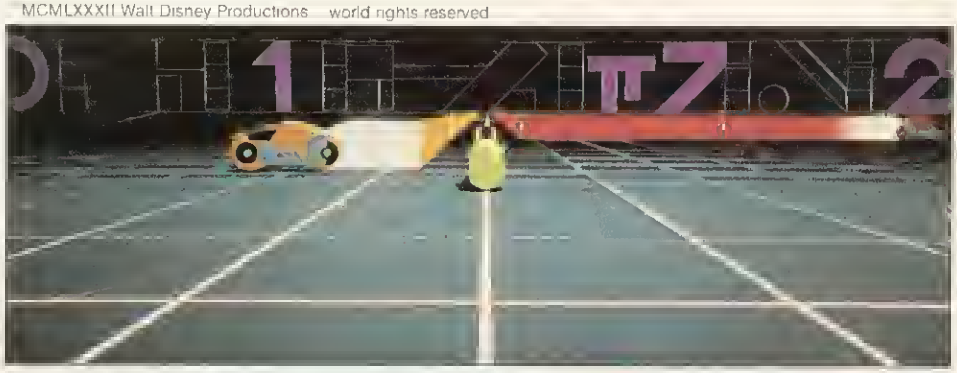
This fantastic electronic world is controlled by the Master Computer Programmer, who sentences Flynn to death by combat in the very video games he wrote in the outside world.

However, a mighty video warrior called 'Tron' comes to his aid in the battle against the MCP.

Much of the action takes place on light cycles, shown below. These leave a wall of energy behind them, which the riders use to try to trap their opponents. The machines travel at blinding speeds, and collision with one of these energy walls means death.

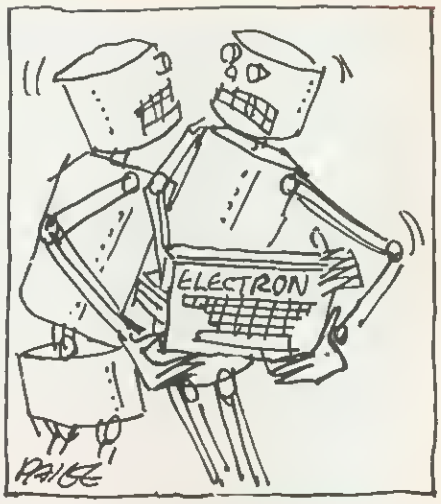
Tron lasts over 100 minutes, and makes extensive use of computer graphics. Disney spent over $20 million making the film – a quarter of this on the 15 minutes of wholly computer-generated sequences.

Unlike *Star Wars*, which used models and moving cameras to create battle scenes, *Tron* uses computers – with spectacular results. As the film's director of special effects said recently: 'It reminds you of something you have never seen before.'



Computer-drawn light cycles play a deadly game

Electron launch delayed



THE Electron will not be available before the end of the year – that's the disappointing news from Acorn.

The company had hoped for a Christmas launch and the machine was on schedule a month ago – with just the ULA to be finalised. However, this chip was always the determining factor, as director Chris Curry said in last month's *Acorn User*.

The ULA is not ready for main production, and so the project is being re-scheduled for spring.

Acorn's £150 Electron is designed to compete with the Spectrum, and will use add-on modules to provide interfaces for Econet, teletext and printers.

Another project still in the pipeline is a microdrive. The first hints of this 3½" micro-floppy were seen in *Acorn User*, and Acorn are still evaluating prototypes.

Meanwhile, games paddles at £13 a pair are being despatched and production of the voice synthesiser ROM is underway.

Australian inroads

BBC micros are beginning to make inroads into foreign markets.

The machines have already been accepted for schools in three Australian states, Tasmania, Victoria and Western Australia.

Progress has been slow as output has been fully taken up with supplying demand in Britain.

The BBC plans to export is *Computer Programme* to countries which have shown an interest, such as Australia.

Reports in Australian newspapers claim the country has more networks in schools for Beeb machines than England. Britain is claimed to have just two!

Beeb teletext expansion

TELETEXT adaptors for the BBC microcomputer system are now in production.

These will give the computer the ability to decode Ceefax transmissions, and download and save software from the BBC. Hence users will not have to key in programs.

The receiver will cost £225, including VAT. It comes in a case about the size of BBC micro cut in half from front to back, and will be made from matching plastic.

With each adaptor, a ROM is supplied to be fitted to the model B which contains the interface software to make the computer operate as a convential Teletext receiver. It also allows the computer to receive programmes which may be loaded and run in the computer, ie telesoftware. This chip will be fitted by dealers.

Within the case are contained a television tuner section, digital circuitry for teletext acquisition and a power supply. There is a mains lead and TV aerial connector on the rear panel and underneath the front of the case a cable joins the 1MHz bus connector on the model B.

On the rear panel, four controls each offer a tuning range over the UHF TV channels E21 to E69 (470MHz to 860MHz). A tuning aid program in the teletext software gives a graphic representation of tuning condition when setting up these four channels. Once adjusted at a particular user site no further tuning is required, allowing selection from four pre-set frequencies.

For good reception, an external UHF TV aerial which is not fed to the adaptor via a cable distribution system is normally required. The computer is designed to guarantee a teletext decoding margin in excess of 70% (50% would normally be sufficient).

Digital circuitry within the adaptor receives TV lines of teletext information every field period. Up to eight lines (320 characters), may be received in each period, although only two lines of teletext per field are being broadcast at present. In the UK with a TV field frequency of 50Hz, this means that the adaptor has an input data rate of 128k bits per second. (There is provision within the hardware for extension to 16 lines.)

After the teletext lines in each field, the adaptor interrupts the BBC micro and passes the teletext data received to the computer. If these lines are required to build up teletext page the computer is trying to acquire, they are stored, otherwise they are ignored.

The BBC microcomputer contains a full implementation of the teletext, including upper and lower case characters, colours, separated and contiguous graphics, double height and flashing characters.

Beware of adverts

SEVERAL readers have contacted this magazine to complain of delays in ordering products related to Acorn machines. Frustration has been further exaggerated by permanently engaged telephones.

The golden rule seems to be: buy it over the counter, or check it really is in stock before ordering by post. Reputable companies will be pleased to provide advice.

One company has been advertising BBC teletext and Prestel receivers as 'in stock' since September. In fact, the first is only just becoming available and the second isn't even in production.

Software for all

72 NORTH STREET, ROMFORD, ESSEX. TEL 0708 60725

FOR THE BEST IN BBC SOFTWARE

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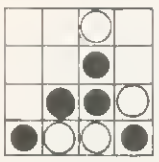
For 32K.

Fight for survival on an island inhabited by hungry, dangerous cannibals. Basic and machine code program

£7.95



Row of 4
For 32K

Try to outwit your computer opponent in this game of skill. Great graphics. Basic and machine code.

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NEW

Galactic Intruder
For 32K

Fast arcade style action game with hi-res colour & sound. Machine code

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TIME TRAVELLER
For 32K only.

Travel through over 100 rooms in different times, and find the key back to your own time.

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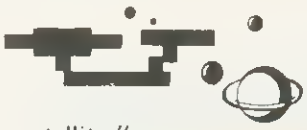
BEEBTREK
For 16/32K, real time advanced Startrek Game.



Extra facilities include "probe satellites", "damage reports" & "on-board computer".

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Utility Pack 1
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For 32K
Envelope program/variable print/ Text Scanner/Hex Dump

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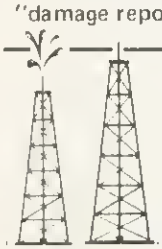

J.R.
For 32K only. Two player game, features include exploration, drilling, employment and Price Wars.

£6.95

Utility Pack 2
NEW

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Disassembler/Program Crunch/ Text Editor

£7.45

NEW

POLAR BEAR
For 32K

Educational game for 8-12 year olds. Incorperating simple maths tables.

£7.45

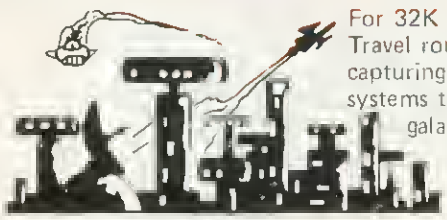
CAR WARS/ ALIEN PLANET
NEW

For 32K
Two Graphic games
Good Graphics
both Basic & Machine Code.

£6.95

NEW

Space Kingdom



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Tel: Romford (0708) 60725

Shrinking micros

THIS little chap is straight from a toy sports car. But what's he doing inside a microcomputer? That question will be answered by BBC TV's new computer series, which begins filming in November.

The plan, apparently, is that Ian McNaught Davis – 'Mac' – is going to do for the inside of computers what David Bellamy did for back gardens.

It is just one of many ideas being tried out for the new programmes which will be shown in the New Year.

David Allen, the producer, gives the lowdown on some of the plans he has on pages 10 and 11. Meanwhile, you'll just have to be content with repeats of the *Computer Programme* on BBC1, Sundays and Mondays.

Black box hooks up to robots

GIVING micros power over robots is the role of the black box pictured here.

The Bedfordshire Interface Module is designed to drive hydraulic and pneumatic valves, motors, and solenoids used in robotics.

Any micro with an eight-bit user port is suitable for the interface, which has served a year's apprenticeship in a mobile classroom.

Bedfordshire Education Authority's Technology Bus, (part of an A-level technology course), provided the test-bed.

Several other modules plug into the black box to provide joysticks, digital to analogue conversion or a speaker box.

Input to the module can be from four push-buttons on the front panel, or from microswitches, thermostats etc, connected via a 5-pin DIN socket or 3.5mm jack sockets.

The input signals go via a Schmitt trigger circuit to remove any noise and then on to opto-isolators. This ensures the computer input port is not damaged by inadvertant connection to high voltages.

Its makers, Educational Electronics can provide more information:
30 Lake Street,
Leighton Buzzard,
Bedfordshire LU7 8RX.

Network brains ring the changes

ORBIS, the brains behind the Cambridge Ring have joined forces with Seel of Edinburgh to produce local area networks.

The Edinburgh company will manufacture and distribute Orbis products, including the 16-bit network processors, based on Motorola's 68000 chip.

Co-operation between the two has already resulted in successful installations at Cambridge University, Rutherford and Appleton Laboratories, British Telecom Research and ICI.

Under the agreement, 68000 network systems will be supplied with Mace high speed intelligent network interfaces, providing on-board protocol software, up to transport layer (level 4). A range of Mace host adaptors, initially to Vax, PDP-11, Prime and GEC 4000 machines are also under development.

For their part, Seel will make available their range of interrupt-driven interfaces eg Multibus, O-Bus and S100 together with network nodes, conforming to the new CR82 British standard.

Orbis is part of Acorn Computers, and details of the network systems are available from Peter O'Keefe on (0223) 312449.

Dealer list

THERE are several changes to the dealer list on page 72, which we were unable to include.

The Microstore, London SW3 is not answering its phone and appears to have closed down.

Also the Typewriter centres in the Midlands are no longer Acorn dealers.

Micro knick-knacks

ALL sorts of weird and wonderful things are popping up to add to your Acorn micros.

Computer graphic design sheets (£4.95 for 100-sheet pad), decimal/hex scale rules (£7.95) and TV support stands (£29.50) are three of the latest products.

All are produced by Dracal Design Consultants, who will give bulk discounts to schools and members of some user groups.

The graphic design pads come with photostated sheets giving details of setting up user-definable characters, with practical examples of producing aliens and UFOs.

Information from Dracal (North West) Ltd, PO Box 130, Warrington, WA1 4QB

Modelling aids for education

A RANGE of products which model engineering devices has been produced for the Beeb and Atom.

These modules mimic equipment such as washing machines or diesel generators, to give the user some idea of control and feedback techniques.

The range, called Mica, is made by Feedback Instruments Ltd and designed as an aid in teaching robotics, environmental engineering and numerical control.

Applications modelled include: washing machine; stepping motor; diesel generator; temerature control; traffic control; binary input/output.

There is also an electronics project board and multifunction input/output available.

Feedback Instruments also produce interfaces for the application modules. The company's address is: Park Road, Crowborough, Sussex TN6 2QR.

Free advice

INDUSTRIAL and business readers in the Sheffield area can lay their hands on a micro at an advice centre in the city.

The South Yorkshire Microsystems Centre will be run by Sheffield Polytechnic, and forms part of a network set up by the National Computing Centre.

Advice will be free, but more complex consultancy sessions will be charged for.

The address is Dyson House, Suffolk Rd, Sheffield S1 1WB. Tel: 0742 738621

Characters

USERS with an Okidata Microline M80 matrix printer can now buy a character generator EPROM which matches Atom and Beeb keyboard codes.

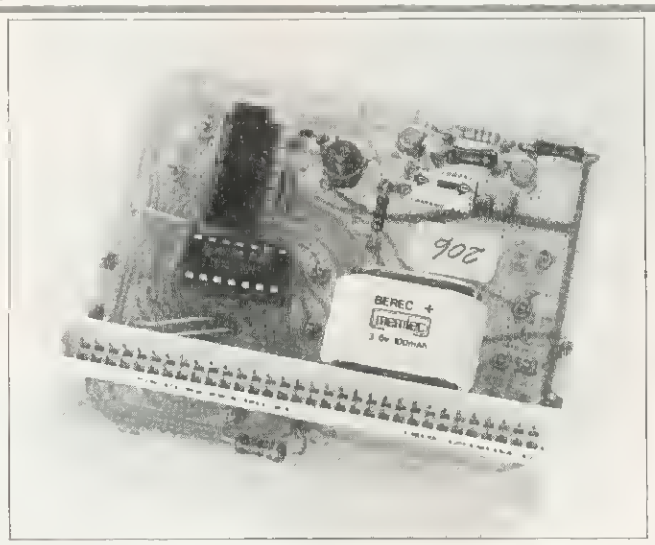
The generator has ASCII special symbols, slashed and unslashed zeros and costs £15 (plus VAT).

Computech, of 168 Finchley Road, London NW3 6HP, produce the firmware. They will supply the M80 and generator for £230 (plus VAT).

Beeb case

IF carrying your micro is a weight on your mind, special cases are available.

W.H. Hayden supply steel edged fibreboard cases at £34.95 (excluding postage and VAT). Details from 52 Holloway Road, London N7 8JL.



Time for the Atom

FOR those Atomists to whom time is of the essence, Varuna Electronics has produced a real-time clock and calendar.

The board fits inside the Atom's casing, and comes complete with its own battery for power when the machine is switched off.

Time and date are always available, and leap year calculation is automatic. Accuracy is claimed to be within one second a day at 20°C.

At £20 (inc postage and VAT), the clock comes with five sample programs and full instructions. Contact Varuna Electronics, Horsell Park, Woking, Surrey GU21 4LY.

Acorns overseas

SEVERAL readers have asked about distribution of Acorn computers overseas. The following companies should be able to give details:

AUSTRALIA
Consolidated Marketing Corporation (Imports) Ltd
Melbourne 419 3033

BELGIUM
Computing & Electronics International NV
Antwerpen 32 08 09

DENMARK
Bergqvist & Hobberstad Eng. A/S
Copenhagen (451) 133188

FRANCE
J C S Composants Sarl
Paris 1 355 9622

HOLLAND
Compac/Acoustical BV
Kortenhoef (35) 61614

IRELAND
Lendac Data Systems Ltd
Dublin 372 052

ITALY
Iret Informatica
0522 32643/4/5/6

PORTUGAL
Datamatic
Braga 71555

RSA
Durban 325 531

SWEDEN
Beckman Innovation AB
Stockholm 390 400

Meetings focus on microcomputers

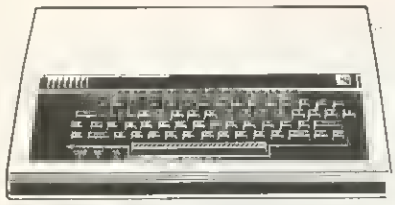
■ Microfest 82. December 11, 12. Repeat of exhibition held earlier in the year. Venue is UMIST in Manchester. Details from Richard Hewitt, Third floor, 121 Princess St, Manchester M1 7AG.

■ Development of new Teaching and Learning Methodologies, December 12-17, Bristol. Sessions on the BBC micro, December 12, 14. Fee is £82.50 including accommodation. Details from Registrar, Further Education Staff College, Coombe Lodge, Blagdon, Bristol BS18 6RG.

■ 'Can we use a desktop here?' Symposium of Institute of Chemical Engineers and Society of Chemical Industry on use of personal computers in the process industries. Contact either organisation.

■ Expert Systems Tutorial, December 20, London. Fee is £40. Details from Richard Forsyth, Maths Dept. Polytechnic of North London, Holloway Road, London N7

BBC MICROCOMPUTER



BBC Model A **£299** BBC Model B **£399** – (these prices include VAT, Carriage £8/unit)

Complete upgrade kit	£49.50	Installation	£15
Disc Interface ...	£70.00	Installation	£20
Memory Pack 8x4B16AP-3	£21.60		
Analogue Port Kit ...	£ 7.30		
Printer & User Port Kit	£ 9.50		
RS423 & VDU Port Kit ...	£10.B0		
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BBC Single Disk Drive	£235 + £6 Carr		
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All mating connectors with cables available in stock - Wide range of ACORNSOFT, 8UGBYTE & PROGRAM POWER in stock

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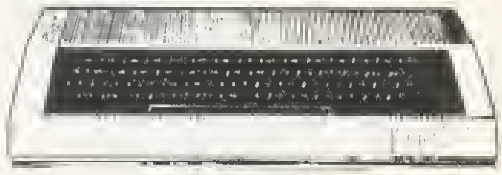
Single Drive Connector ...	£ B.50	Oual Drive Connector ...	£ 12

Phone or Send for our BBC List of Books, Software, Peripherials, Etc.

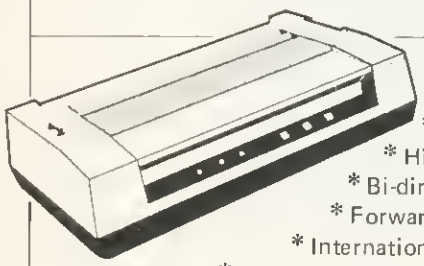
ACORN ATOM



ATOM Kit **£120**, Basic Built **£135**
Expended 12K+12K **£175**, 8K+5K+Colour Card **£169** (£3/unit Carr)
Atom Upgrade to BBC **£45**, F.P.ROM **£19**, 1K RAM **£1.80**
Word Pack ROM **£26** Tool Box ROM **£25**
All ATOM Buffers & Connectors in Stock
Atom Forth **£10**, Atom Lisp **£15**, Atom Calc **£34**
Monitor ROM for direct entry of Machine Code **£16**
Atom Disc Pack **£299** + £7 Carr.
4 Eprom Selector Board **£19.50**

Phone or Send for our Atom List for full details

PRINTERS



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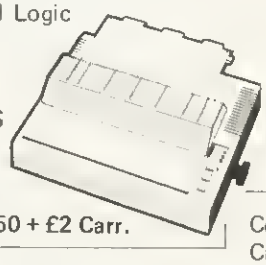

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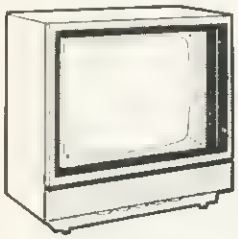

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ROBOTS GO SHOPPING

David Allen has stepped in to Paul Kriwaczech's shoes to produce the second BBC computer series. Here he details the programme's progress, and some of the strange things that go on

If you're watching the latest repeats of the *Computer Programme* (Sunday mornings on BBC1) you'll maybe be interested to know how next year's series – *Making the Most of the Micro* – will build on what has gone before.

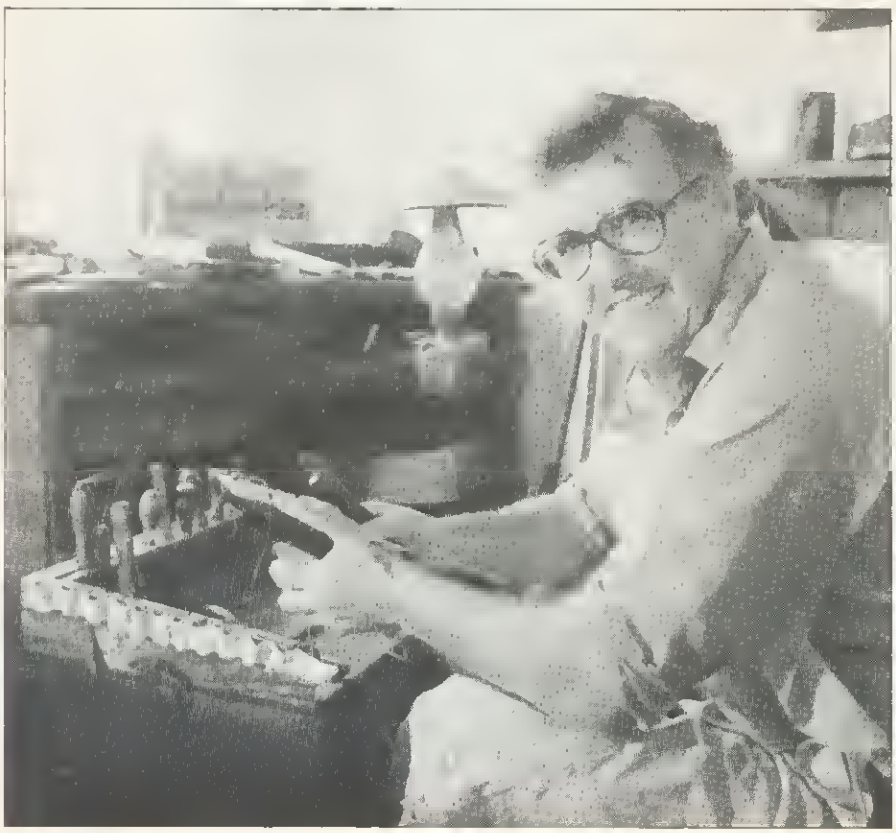
Originally, we conceived the *Computer Programme* as a 'hands-on' series concerned with 'how to do it'. Later we changed the philosophy because it became clear that what was needed was a series designed to explain the basic ideas of the wide world of computing to the general public – especially those with no experience of computing at all.

My colleague, Paul Kirwaczeck, achieved that elegantly in series one; it's now my job to produce a series for micro-owners and the technically curious – a heterogeneous audience, but including those who, perhaps thought series one was simple and slow.

Of course, we've got to be careful: our ultimate business is to illuminate, stimulate and inform our audience. But that audience does not just consist of BBC microcomputer owners. Whatever machine you might have, and however much knowledge you have, the television series has got to appeal and have some relevance – even if it is simply reinforcing ideas which you already understand – perhaps explaining them in a new way. This has forced us to look hard at the fundamentals of using micros – at the common ground of personal computing.

Take writing programs in Basic. Many viewers will not want to know how to do this, and others will already have a much greater knowledge than we can put over. Nevertheless, we are going to show Ian McNaught Davis – 'Mac' – doing some coding in most of the programmes.

Cobblers . . .'Mac' shoes how it's done



What matters to us and our advisors, in Programme 2, for example, is how to get across the idea of the main programming structures – that, amid all those parochial, machine-dependent techniques, there are only a handful of principles being applied. In showing this, BBC Basic is a great strength: long variable names, IF . . . THEN . . . ELSE, REPEAT . . . UNTIL and procedures make it so much easier to make a program clear to read – and that is important when we are trying to show these things on tlevision.

If you are working on a machine with Atom Basic, Sinclair Basic or Pet Basic, the code will be different, but the programming concepts – which is what really matters – will be just the same. On the other hand it would be foolish to give details of how to format the screen on a particular machine – each is different. But it is useful to look at good presentation – for example, when to avoid the top line of the display, being consistent about the centering or aligning of lines, and so on.

As before, the use of analogy is important as a way to get ideas home. So, in Programme 2, writing a program in Basic is likened to ordering a meal in a Chinese restaurant. The order must be given in 'appropriate' language – and then translated into hieroglyphics

Waiter . . . is there any machine code on the menu?

by the waiter (microcode) which the kitchen staff act on using their own local rules unbeknown to the customer (system software) – unless, of course, he wants to run his own Chinese restaurant (eg write in machine code).

Later in the series, we examine how to write a long program. This nearly always involves breaking things down into manageable chunks by the use of subroutines or procedures. So Mac is seen in Programme 3 in a supermarket, speculating about how a robot might be sent on a shopping spree, with orders to invoke PROC BEST-BUY, instructions on how to buy avocados and tomatoes with PROC PICK'N'WEIGH and elaborate details for PROC CHECKOUT.

Don't be alarmed at the thought of all that code – there'll be plenty of other things in the series. We'll be looking at the use of a home database, the fundamentals of which are introduced by Mac in the BBC's gramophone library with its one million records. (No, we don't suggest a micro could do that job!)

We'll look at word processing, artificial intelligence programs, at computer-aided design and so forth. And – important to our overall aim – most of the software you see in the series (like the earlier series) will be available in some form or another for BBC micro-owners to get hold of, primarily through BBC Publications.

Applications of all kinds will be shown – on a range of micros. Here we're only interested in what's behind the applications – the hardware is of secondary importance. And when we stray from the strict field of the micro (for example when we look at computer-aided design of shoes at Clarks factory in Somerset), the aim will be to see how the humbler machines can do similar – if more limited – things. In this case, manipulating a three dimensional 'model' with a joystick, introducing hidden line removal and allowing the user to colour the object in – not with one of a million different possible colours (as with the shoes) but with about four.

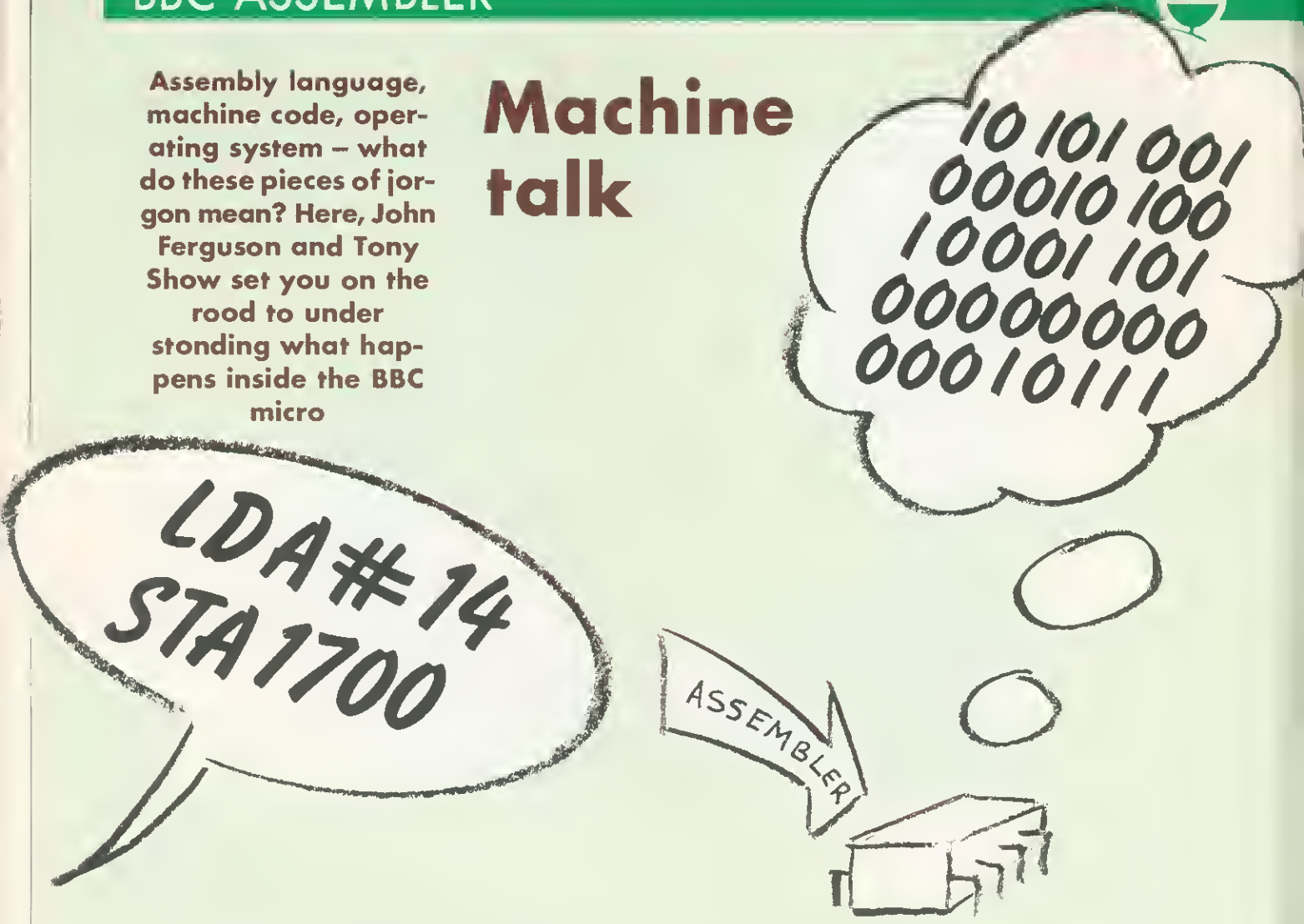
Our examples must show the limitations of the technology as well as show its strengths – so here the relatively slow speed of the micro will be shown up (to give the lie to all those clever, apparently instantaneous animation sequences you see on TV – they're really single, computer-generated pictures, shot one frame at a time on old technology (ie film). Finally, in that programme, we hope to show a professional two-dimensional CAD package (soon to be available on the BBC microcomputer), using the second processor and a precision joystick.

In other parts of the series there'll be demonstrations of the use of speech and music synthesisers, of how to get various sensors and control devices interfaced to the micro and how to use it as a communications device. For a rough breakdown of the subjects of each of the ten programmes, see *Acorn User*'s July issue.

There's an old adage in broadcasting – 'never work with children or animals'. We have now expanded it to include micro-electronics! As I write, we have yet to record a single programme: watch this space for news of our progress – above all, watch the series. Fingers (if not wires) crossed, it starts in January, late Sunday evenings, BBC1.

Machine talk

Assembly language, machine code, operating system – what do these pieces of jorgon mean? Here, John Ferguson and Tony Show set you on the rood to understanding what happens inside the BBC micro



Following in the footsteps of the Acorn Atom, the BBC micro contains a machine code assembler 'embedded' in the Basic interpreter. The version on the Beeb is even friendlier, providing the ideal tool for both the novice and the expert to tackle assembly language programming.

The beginner might ask: 'Why bother with assembly language?' The classic reply is that the microprocessor's own language allows you to tackle problems where speed is important, where actions are required in microseconds rather than milliseconds, or where memory space is restricted.

Assembly language also allows you to 'lift the lid' and dip into the machine operating system, the machine code program that runs the Beeb.

The language used by the microprocessor bears little resemblance to Basic. The processor follows instead a numeric language of 0's and 1's called machine code. For example, the set of binary numbers in the following program instructs the microprocessor to store the hex number 14 in memory location 1700 (hex).

Binary	Hex representation
1010 1001	A9
0001 0100	14
1000 1101	8D
0000 0000	00
0001 0111	17

A machine code program is similar to a Basic program in that both are a mixture of instructions and data. In the above example the code A9 tells the processor to load its accumulator (an internal register) with the next number, 14. The next code, 8D, instructs it to store the contents of the accumulator in the memory location defined by the next two numbers ie in 1700. The numbers representing the instructions are called operation codes or 'op codes'.

It is possible to write programs directly in machine code, but the process is slow and prone to error, requiring continuous reference to tables of operation codes *(User Guide*, p508).

An alternative approach is to write programs in a more human and friendly format called 'assembly language' where alphabetic abbreviations, rather than binary or hex codes, are used to represent the instructions.

Abbreviations LDA and STA, for example, are used to represent the operations 'LoaD the ACcumulator' and 'STore the Accumulator'. These mnemonic abbreviations are much easier to remember than op codes.

Written in mnemonics the above example becomes:

```
LDA #14
STA 1700
```

But how does this assembly language program become a machine code program? The answer is to use a special translating program called an assembler, which translates the 'friendly' mnemonics into machine code (figure 1).

You do not have to be an experienced 6502 asembly language

Figure 1. A simple assembly language program

```
100 REM Assembly language program
110 REM sub 32134 on Model B for 15750
120 REM Put an 'A' on the screen
130 CLS
140 P%=&1500
150 [
160 LDA #65
170 STA 15750
180 RTS
190 ]
200 END
```

Figure 2. Essential parts of the program

```
100 REM Assembly language program
110 REM sub 32134 on Model B for 15750
115 SLOC=15750
120 REM Put an 'A' on the screen
130 CLS
140 P%=&1500
150 [
160 LDA #65
170 STA SLOC
180 RTS
190 ]
200 END
```

Value given to P% determines where in memory the machine code will be placed by the assembler.

```
100 REM Assembly language program
110 REM sub 32134 on Model B for 15750
120 REM Put an 'A' on the screen
130 CLS
140 P%=&1500
150 [
160 LDA #65
170 STA 15750
180 RTS
190 ]
200 END
```

Everything within [ ] is treated as an assembly language program

RTS forces a return to Basic at end of machine code program.

```
100 REM Assembly language program
110 REM sub 32134 on Model B for 15750
120 REM Put an 'A' on the screen
130 CLS
140 P%=&1500
150 [
160 LDA #65
170 STA 15750
180 RTS
190 ]
200 END
```

programmer to be able to use the BBC assembler. The following simple program can be entered, assembled and run by someone with no previous knowledge of assembly language.

Using the BBC computer, there are three essential features of any assembly language program (figure 2).

The most fundamental is the pair of square brackets – [ ] – (arrows in teletext mode). These tell the Basic interpreter that what appears between the brackets is to be treated as an assembly language program.

The value given to the parameter P% determines where in the memory the machine code program will be placed by the assembler.

The 6502 assembly language instruction RTS placed as the last item within the assembly language program ensures that program control will ReTurn to the Basic interpreter.

In the program shown in figure 2:

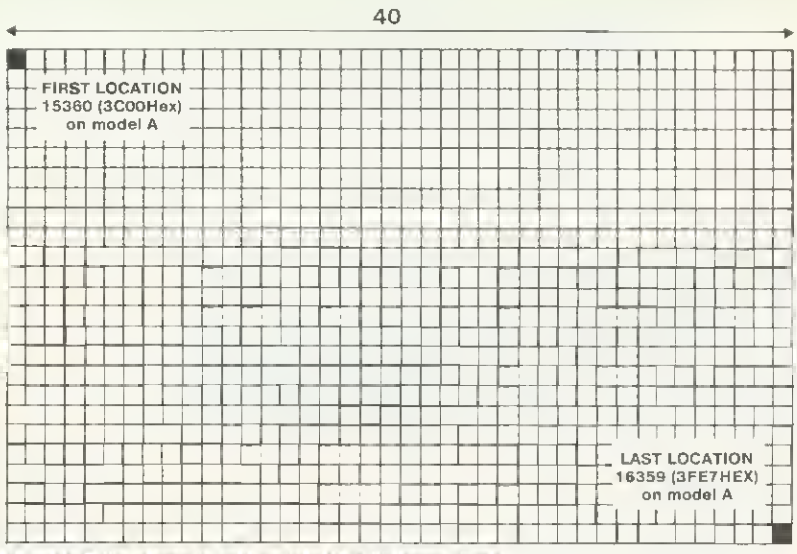
LDA #65 loads the accumulator with the value 65.
STA 15750 stores the contents of the accumulator (65) in location 15750.

When in mode 7, this will make an 'A' appear on the screen, since location 15750 is part of the memory-mapped screen display and 65 is the ASCII value for 'A'. (Note that model B users should use location value 32134.) The phrase 'memory mapped' and the abbreviation 'ASCII' are briefly explained in figures 3 and 4.

Before attempting to assemble the program, ensure your computer is in mode 7. The following sequence of commands will then make our simple program perform its intended task.

```
>RUN
>CALL &1500
```

Each of these commands performs a function essential to the successful operation of the program. In running the Basic program, the assembly language statements contained between the square brackets are translated into machine code. The translated program – essentially a series of 0's and 1's, is placed into an area of



In mode 7 the screen is split up into 40 x 25 boxes. Each box corresponds to a particular memory location inside the computer, the first location, top left, lies at memory address 15360 on Model A or 31744 in Model B.
(Note – when the screen scrolls the whole map moves up the screen)

Figure 3. The memory map

CHARACTER	CODE	
	Decimal	Hex
SPACE	32	20
!	33	21
"	34	22
#	35	23
$	36	24
%	37	25
&	38	26
⅜	39	27
(	40	26
)	41	29
*	42	2A
+	43	2B
'	44	2C
-	45	2D
.	46	2E
/	47	2F
0	46	30
1	49	31
2	50	32
3	51	33
4	52	34
5	53	35
6	54	36
7	55	37
6	56	36
9	57	39
:	56	3A
;	59	3B
<	60	3C
=	61	3D
>	62	3E
?	63	3F
@	64	40
A	65	41
B	66	42
C	67	43
D	66	44
E	69	45
F	70	46
G	71	47
H	72	46
I	73	49
J	74	4A
K	75	4B
L	76	4C
M	77	4D
N	78	4E
O	79	4F
P	60	50
Q	61	51
R	82	52
S	63	53
T	64	54
U	65	55
V	66	56
W	87	57
X	66	56
Y	69	59
Z	90	5A
←	91	5B
½	92	5C
→	93	5D
↑	94	5E
▛	95	5F

Computers work only with numbers and use a coding system to represent letters of the alphabet etc. The most common system is the American Standard Code for Information exchange or ASCII code.

Secret message
65 67 79 62 76 63 32 65 62 69 32 76 65 64 63

```
100 REM Assembly language program
110 REM sub 32134 on Model B for 15750
120 REM Put an 'A' on the screen
130 CLS
140 P%=&1500
150 [
160 LDA #65
170 STA 15750
180 RTS
190 ]
```

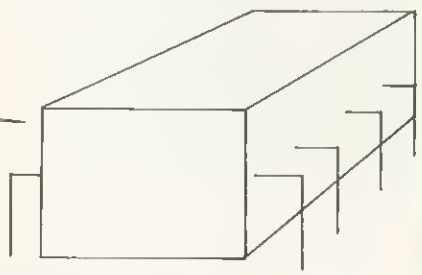


Figure 5. Effect of RUN on assembly language program

memory beginning at P% – &1500 in our example (figure 5). A listing will also be produced, which will be described later. It is possible to turn off the listing function.

Call is a Basic command that transfers program control to the program residing in memory at the location specified following Call. So this command is required to run our program, which was placed in the locations following &1500. The effect of CALL is illustrated in figure 6.

Once control has been transferred to the program, starting at location &1500, the computer's microprocessor will automatically attempt to execute the contents of succeeding memory locations. The important RTS is executed after the two instructions of our program (LDA and STA) have been carried out. This forces program control to return to the Basic interpreter – and normality is restored.

So the BBC assembler has been successfully used to create a machine code program from the assembly language statements included within our original Basic program. There are features that make the BBC especially powerful, and some of these will be illustrated later. But to continue with the simple example, what do the contents of the listing tell us?

The listing displays the memory address and memory contents in hexadecimal, together with the corresponding mnemonics. RUN will automatically generate an assembler listing, unless an OPT statement (*User Guide* p314) has been used.

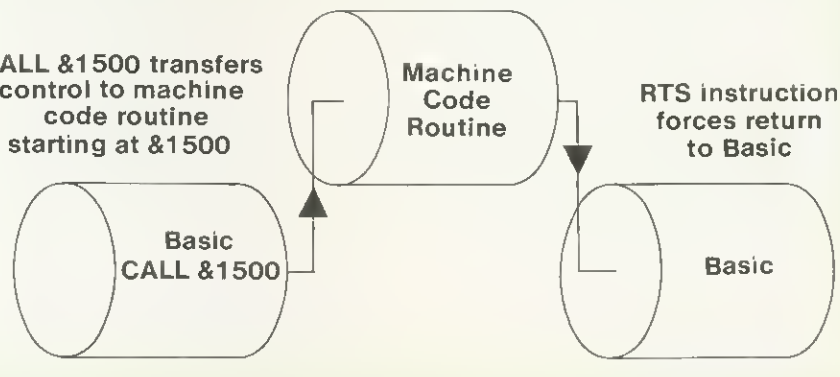
```
1500
1500 A9 41    LDA #65
1502 8D 0A 7D STA 15750
1505 60       RTS
```

In the same way that the Rem statement can be used to include comments within a Basic program, comments can be incorporated in an assembly language program by preceding them with a backslash character (/). In the teletext mode, this is displayed as one half (½).

Comments are an important part of any program. However, given the lack of 'readability' of assembly

▶page 78

Figure 6. Program flow



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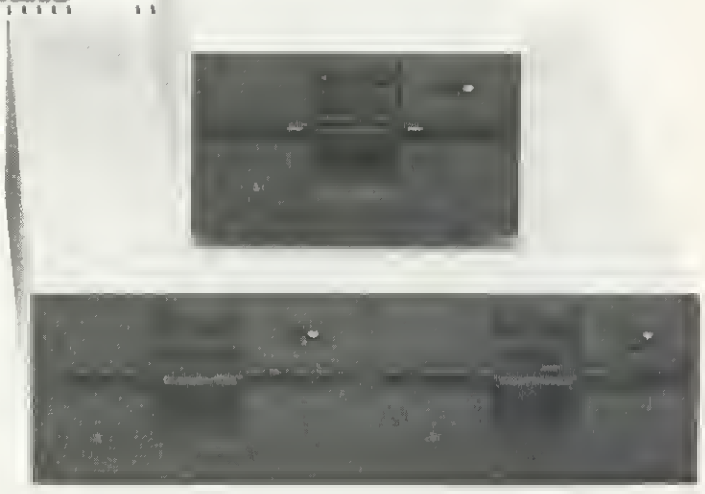

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PROGRAMMER'S FORUM

The chance for readers to earn up to £20 by providing original hints and tips. Coping with BREAK is the subject of this month's column

THIS is the start of a new column in *Acorn User*. In the next three issues, Ian Birnbaum will be providing ideas on increasing the programmer's control and understanding of the BBC micro. This month he looks at the BREAK key. In the next two months, among other things, he will be showing you how to cope when you type OLD or O. instead of OLD or O.; how to save your program from within the program itself. But the real purpose of this column is for you, the readers, to send in your own tips.

These three columns should give you an idea of the sort of thing we want. What matters is that the hint is original, in that the gist of it should not have been published in any other magazine, and that it is described clearly and fully.

We will pay £5 for any hint published, with £10 for any which merits a one-star award, and, exceptionally, £20 for any which merits a two-star award.

Hints should be typed or computer written, and any substantial listings should be on cassette (programs should be included only if they illustrate a point). Mark the top of your contribution 'BBC Forum'. If you want your contribution returned, please enclose a stamped addressed envelope.

This column is also here to solve programming problems. If you have a problem you want answered, mark your letter 'Problems'. Ian cannot answer letters personally, but will endeavour to include a cross-section of the most interesting and commonly-occurring issues.

YOU can program the BREAK key *KEY 10, and this can be used to effectively 'disable' the Break key within a program.

```
*KEY10 OLD|MRUN|M or
*KEY10 OLD|MC.100|M
```

are the usual ways of doing this. In this sense, you are trapping BREAK in the same way you trap ESCAPE with ON ERROR.

But there is a difference. With ESCAPE you do not lose all the values of the variables within a program: with BREAK you do. This can be important in word processing, for example, where hours of editing and appending text can be wasted by the simple accident of pressing the BREAK key. However, there is a way to restore the values lost, and to build this into the programming of the BREAK key.

To understand how this is possible we must first understand how the BBC micro records the values it uses. First, the so called static variables,' A% to Z%, are stored in fixed memory from &404 to &46B and are unaffected by the BREAK key (@% is also static, stored at &400 to &403, but this is affected by the BREAK key). Therefore if you use static variables for all your integer values BREAK will not harm them. This has the disadvantage of reducing readability in your program, but there is a second advantage of their being faster to access than variables with long names.

Location

All string, floating point and non-static variables are dynamic in that

Conducted by Ian Birnbaum

This column will also answer readers' queries. Hints or problems should be addressed to Beeb Forum Acorn User, 53 Bedford Square London WC1 B 3DZ

```
10 A=5:B=9:C=4:D=9:T=7:@%=4
20 PROCTEST
30 !&DF0=!2+24:!&DF2=!&482:!&DF6=!&48
   6:!&DFA=!&4A8
40 *KEY10 O.!M@%=4:?2=?&DF0:?3=?&DF1:
   !&482=!&DF2:!&486=!&DF6:!&4A8=!&DFA|MG.
60 !M
50 A1=6:A2=1:A%=GET
60 E=3:PROCTEST:PRINTA,A1,A2,B,C,D,E,
   T:END
70 DEF PROCTEST:PRINT"OK":ENDPROC
```

their position in memory depends upon the program in which they are used and on the order they are accessed within that program. The location of the first variable of each initial letter is stored in a fixed place, however. The location of the first variable starting with A which has been met in a program is stored at &482, that with B at &484 and so on up to Z at &4F4.

When you type RUN, all these locations are set to zero (ie each contains &0000) : this is also true after you have pressed BREAK. It follows that if we can store the contents of these locations prior to BREAK being pressed, then we can restore them after BREAK has been pressed.

Since we do not know when BREAK will be pressed, this means we will have to initialise our variables early on in the program before we put the relevant details into memory. This has already been suggested for strings (see article on string handling last month page 24), so it means that in addition it has to be done for floating point and non-static integers. This could be very laborious in some cases, but there is a way to make it easier. If, for example,all your floating point and integer variables begin with the letter A then you need only initialise one of them early on. The rest are fixed relative to this first one in that the place where the first is kept contains the address where the second is kept, and so on.

Speed factor

Of course, it is rather extreme to have all your variables starting with A; it also slows things down since the interpreter will have to skip through quite a few variables in memory to get to the A's at the end of the list. But if you always arrange to initialise first those variables where speed is a factor, and to use only a few of the available letters to start your variables, then it is not too laborious to initialise the key variables prior to saving locations in memory.

One more fact is required before we see how to program the BREAK key. The interpreter has to keep track of where the first free location in memory is at any time: the information is kept in locations two and three. This information will change as more variables are created. For this reason, we must reserve space for all the variables uninitialised prior to the saving of two and three. As a rule of thumb, allow 10 plus the name length for each integer or floating point variable. Also dimension all arrays prior to saving two and three.

We are ready to look at an example now. Run the program given.

When OK comes up, press BREAK – the values of all the variables will be displayed. Moreover, the PROC will still work: the reason for this will be discussed in next month's column.

Contamination

It should be clear how this program works. Line 30 saves the relevant values (using the 'pling' operator – see chapter 39 of the *User Guide* for details) in &DF0 to &DFB: these are otherwise unused in a standard system. Line 40 programs the BREAK key to put these saved values back into their original places. We cannot generally use !2 here for it would contaminate locations four and five which is the stack pointer (in fact it would be safe in this particular example).

Experiment with this, and try to incorporate the idea into your own programs where pressing the BREAK key could otherwise be disasterous.

In a far-flung galaxy on an uncharted edge of Earth's decaying Empire, a lone Starship fights a losing battle as it stalks its prey – the Klingons.

But the enemy ships are lying dormant, waiting for the Earthship to come within range. Then, they pounce. And the battle-weary humans can only take so much. Their precious energy dwindles with every move and each encounter saps the Starship's strength.

But the Klingons can be beaten. Supplies are available from Starbases – though they are few and far between, and their positions unknown. So it will take careful planning and every last ounce of the Starship Commander's cunning to win.

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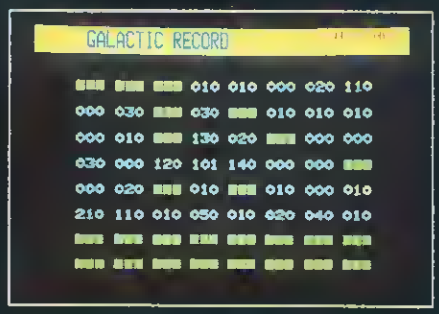
TREK III

A STARSHIP'S LAST STAND



Your job as Starship Commander is to destroy all 15 Klingons (red arrows), using as little time and energy as possible. Your initial energy level dictates the level of difficulty.

First you have to find the enemy. Your Starship (yellow arrow) is moved using the BBC micro's four cursor keys. The normal screen, or short range scan, gives one sector of an eight by eight area of space. Your sector position is given under 'AREA' (see short range scan, SRS, above left).

Two computers are under your control – nav-com and arm-con. To enter the first, press N on the keyboard, and hold it down for a couple of seconds. The screen will change to give information on energy and sector and four command choices:

- *Return to SRS;* this gives you back the normal screen.
- See *Cumulative Galaxy Record;* essentially says where you have been (above right). The three digits give first the number of Klingons, the number of stars (red * in SRS), and the number of Starbases in each sector you have explored.
- *Starbase data;* provides co-ordinates of bases found and energy left. Each contains up to 20,000 units of fuel. To dock at a Starbase (blue @) just position the Starship on top. Energy may be left for later.
- *Enter armaments computer.* This can be achieved also by pressing A when in short range scan.

The arm-com gives details on energy, photon torpedos fired (you have seven), shield level and number of Klingons destroyed. Its three commands are:

- *Return to SRS*
- *Fire photon torpedos;* these never miss when a Klingon is in range.
- *Reset shield; input energy up to 2000 units*
- *Enter nav-com.*

The shields give protection from Klingons, who automatically attack when you enter their sector. If you have no shields, your computers are put out of action for 30 seconds. Enemy hits are inversely proportional to shield strength, but each weakens the shields and costs energy. So the sooner you destroy the attacking Klingon, the better.

As well as the photon torpedos, you have phasers. But these must be aimed and fired in one of four directions by the keys 1(up), 2(right), 3(down), 4(left), when using the normal short range scan display.

When you meet a Klingon, or start running low on energy the screen will flash and give a STATUS RED report. If you try to leave the eight by eight grid, you find you can't and lose all shield energy.

Each torpedo and phaser uses 1000 units of energy. Each move uses ENERGY/1000 units, resetting shields uses SHIELD/40 units. Energy is the deciding factor, so use it wisely.

To play, LOAD "TREK III", wait for the cursor prompt > and then RUN.

Good luck, and happy hunting.

```
  1Ø MODE7:*FX4,1
  2Ø YC$=CHR$131:RC$=CHR$129:CC$=CHR$1
3Ø
  3Ø PRINTTAB(6,1)CHR$141;CC$;CHR$136"
       T=R=E=K III":PRINTTAB(6,2)CHR$1
41;CC$;CHR$136" T=R=E=K III"
  4Ø PRINTTAB(5,12)YC$"4Ø IS EASIER":P
RINTTAB(2,1Ø)YC$"INPUT DIFFICULTY (5-4Ø
) ";:INPUTD
  5Ø VDU23,Ø,11,Ø,Ø,Ø:PRINTTAB(Ø,24)
  6Ø ENVELOPE 1,3,2,2,2,5Ø,3Ø,3Ø,126,-
1,-1,-1,9Ø,8Ø:ENVELOPE 2,1,1ØØ,1ØØ,1ØØ,
1ØØ,1ØØ,1ØØ,126,-5Ø,-5Ø,-5Ø,12Ø,9Ø
  7Ø DIM quadrant%(8,8),klingon%(15,2)
,base%(5,2),recharge%(5)
  8Ø OK$=YC$+"ALL SYSTEMS OK      ":Dn
av$=RC$+"NAV-COM DAMAGED      ":Darm$=RC
$+"ARM-COM DAMACED      ":NK$=YC$+"NO KL
INCONS IN RANCE"
  9Ø HK$=YC$+"KLINCON DESTROYED   ":LS
$=RC$+"SHIELD LOW          ":LE$=RC$+"E
NERCY LOW          ":R$=RC$+CHR$136+"RE
D "
  1ØØ C$=CC$+"GREEN"
  11Ø star$=CHR$133+"*":phaser$=CC$+CHR
$255:base$=CHR$134+"@":klingon$=RC$+"^"
:enterprise$=YC$+"^":blank$=GC$+CHR$255
+CHR$255+CHR$255
  12Ø status$=G$:report$=OK$:Dnav=Ø:Dar
m=Ø:Dkli=Ø
  13Ø energy=D*1ØØØØ:kl=15:NQ=Ø:B=Ø:mov
e=Ø:shield=1ØØØ:phaser=Ø:photon=7:hit=Ø
:torpedoe=Ø
  14Ø navT=9999999:armT=9999999:klT=999
9999
  15Ø PROCinst:TIME=Ø
  16Ø PROCsrs:PROCscreen
  17Ø PROCsrsfill:PROCmove:PROCenergy:P
ROCcommand:PROCklingon:PROCcheck
  18Ø GOTO17Ø
  19Ø DEFPROCinst
  2ØØ FORX=1 TO 8:FORY=1 TO 8
  21Ø quadrant%(X,Y)=11Ø
  22Ø NEXTY:NEXTX
  23Ø QposX=RND(8):QposY=RND(8)
  24Ø SposX=RND(22)+3:SposY=RND(1Ø)+4
  25Ø FORL=1 TO 1ØØ
  26Ø R1=RND(8):R2=RND(8)
  27Ø quadrant%(R1,R2)=quadrant%(R1,R2)
+1Ø
  28Ø IF L>15 GOTO 34Ø
  29Ø RX=RND(8):RY=RND(8)
  3ØØ quadrant%(RX,RY)=quadrant%(RX,RY)
+1ØØ
  31Ø klingon%(L,1)=RND(22)+3:klingon%(
L,2)=RND(9)+4
  32Ø IF L>5 GOTO 34Ø
  33Ø base%(L,1)=RND(8):base%(L,2)=RND(8)
  34Ø NEXTL:ENDPROC
  35Ø DEFPROCsrs
  36Ø CLS:SOUND3,-15,2ØØ,1
  37Ø PRINTTAB(1,3)CHR$15Ø;CHR$55;TAB(1
,15)CHR$15Ø;CHR$117;TAB(28,3)CHR$1Ø7;TA
B(28,15)CHR$122
  38Ø FORZ=3 TO 27:PRINTTAB(Z,3)CHR$96;
TAB(Z,15)CHR$112;:NEXTZ
  39Ø FORZ=4 TO 14:PRINTTAB(1,Z)CHR$15Ø
;CHR$53;TAB(27,Z)CHR$15Ø;CHR$1Ø6:NEXTZ:
PRINTCHR$159
  4ØØ PRINTTAB(3Ø,2)CHR$132;CHR$157;YC$
;"TIME  ";CHR$156
  41Ø PRINTTAB(29,5)CHR$131;CHR$157;RC$
;"ENERCY  ";CHR$156
  42Ø PRINTTAB(29,8)CHR$133;CHR$157;YC$
;"STATUS  ";CHR$156
  43Ø PRINTTAB(3Ø,11)CHR$134;CHR$157;CH
R$132;"AREA  ";CHR$156
  44Ø PRINTTAB(29,14)CHR$13Ø;CHR$157;YC
$;"SHIELD  ";CHR$156
  45Ø PRINTTAB(1,17)CHR$129;CHR$157;YC$
;"STATUS REPORT:  ";CHR$156
  46Ø ENDPROC
  47Ø DEFPROCnavcom
  48Ø IF Dnav=1 LET report$=Dnav$:GOTO1
7Ø
  49Ø CLS:SOUND3,-15,1ØØ,2
  5ØØ H$="NAVIGATION COMPUTER":PROChead
ings
  51Ø PRINTTAB(Ø,6)CHR$129;CHR$157;YC$;
" ENERGY:"
  52Ø PRINTTAB(Ø,7)CHR$134;CHR$157;CHR$
132;" QUADRANT:";QposX;",";QposY
  53Ø PRINTTAB(2,14)YC$;"<1> _ Return t
o S.R.S."
  54Ø PRINTTAB(2,15)YC$;"<2> _ See cumu
lative galaxy record"
  55Ø PRINTTAB(2,16)YC$;"<3> _ Star base
 data"
  56Ø PRINTTAB(2,17)YC$"<4> _ Enter arm
aments computer"
  57Ø A$=INKEY$(1Ø):A=VAL(A$)
```

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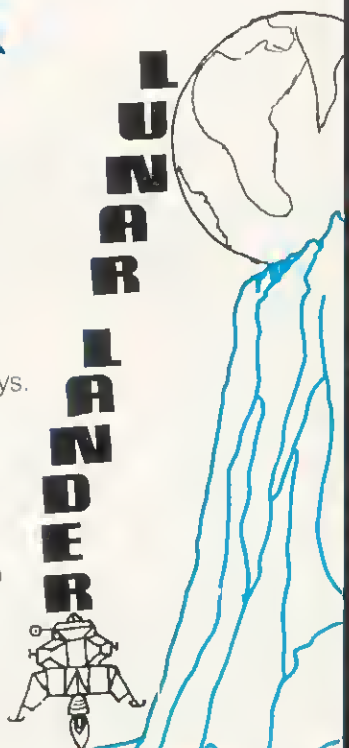

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```
  58Ø *FX15,Ø
  59Ø PROCenergy:PROCklingon:PRINTTAB(1
5,6);energy
  6ØØ IF A<>1 AND A<>2 AND A<>3 AND A<>
4 GOTO57Ø
  61Ø ON A GOTO 16Ø,216Ø,24ØØ,64Ø
  62Ø ENDPROC
  63Ø DEFPROCarmcom
  64Ø IF Darm=1 LET report$=Darm$:GOTO1
7Ø
  65Ø CLS:SOUND 3,-15,15Ø,2
  66Ø H$="ARMAMENTS COMPUTER":PROCheadi
ngs
  67Ø PRINTTAB(Ø,6)CHR$129;CHR$157;YC$;
" ENERGY:"
  68Ø PRINTTAB(Ø,7)CC$;CHR$157;YC$;" PH
OTON TORPEDOES:"
  69Ø PRINTTAB(Ø,8)CHR$134;CHR$157;CHR$
132;" SHIELD:"
  7ØØ PRINTTAB(Ø,9)CHR$133;CHR$157;YC$;
" KLINGONS:"
  71Ø PRINTTAB(2,14)YC$;"<1> _ Return t
o S.R.S."
  72Ø PRINTTAB(2,15)YC$;"<2> _ Fire pho
ton torpedoes"
  73Ø PRINTTAB(2,16)YC$;"<3> _ Reset sh
ield"
  74Ø PRINTTAB(2,17)YC$;"<4> _ Enter na
vigation computer"
  75Ø B$=INKEY$(1Ø):B=VAL(B$)
  76Ø *FX15,Ø
  77Ø PROCenergy:PROCklingon:PROCarmfil
l
  78Ø IF B<>1 AND B<>2 AND B<>3 AND B<>
4 GOTO75Ø
  79Ø ON B GOTO 16Ø,8ØØ,82Ø,48Ø
  8ØØ IF LEFT$(STR$(quadrant%(QposX,Qpo
sY)),1)="1" report$=NK$:klT=TIME:GOTO16
Ø
  81Ø photon=photon-1:torpedoe=1ØØØ:PRO
Chit:GOTO16Ø
  82Ø PROCshield:GOTO16Ø:ENDPROC
  83Ø DEFPROCsrsfill
  84Ø PRINTTAB(32,3)CHR$129;INT(TIME/1Ø
Ø)
  85Ø PRINTTAB(31,6)CHR$131;energy;" "
  86Ø PRINTTAB(3Ø,9)CHR$133;status$
  87Ø PRINTTAB(32,12)CHR$134;QposX;",";
QposY
  88Ø PRINTTAB(32,15)CHR$13Ø;shield;" "
  89Ø PRINTTAB(3,18)report$
  9ØØ ENDPROC
  91Ø DEFPROCenergy
  92Ø energy=INT(energy-(shield/4Ø)-pha
ser-torpedoe-hit-move):move=Ø:phaser=Ø:
hit=Ø:torpedoe=Ø
  93Ø ENDPROC
  94Ø DEFPROCcommand
  95Ø C$=INKEY$(Ø)
  96Ø *FX15,Ø
  97Ø IF C$="" GOTO1Ø3Ø
  98Ø SOUND3,-4,22Ø,1
  99Ø IF C$="1" OR C$="2" OR C$="3" OR
C$="4":SOUND3,-15,1ØØ,5:PROCphasers
 1ØØØ IF C$="N" PROCnavcom
 1Ø1Ø IF C$="A" PROCarmcom
 1Ø2Ø IF C$="S" PROCshield
 1Ø3Ø ENDPROC
 1Ø4Ø DEFPROCscreen
 1Ø5Ø IF MID$(STR$(quadrant%(QposX,Qpos
Y)),2,1)="1" GOTO1Ø9Ø
 1Ø6Ø FOR L=1 TO (VAL(MID$(STR$(quadran
t%(QposX,QposY)),2,1)))-1
 1Ø7Ø PRINTTAB(RND(22)+3,RND(1Ø)+4)star
$
 1Ø8Ø NEXTL
 1Ø9Ø IF LEFT$(STR$(quadrant%(QposX,Qpo
sY)),1)="1" GOTO 113Ø
 11ØØ FOR L=1 TO VAL(LEFT$(STR$(quadran
t%(QposX,QposY)),1))-1
 111Ø  PRINTTAB(klingon%(kl,1),klingon%
(kl,2))klingon$
 112Ø NEXTL
 113Ø ENDPROC
 114Ø DEFPROCmove
 115Ø NQ=Ø:PRINTTAB(SposX,SposY)"  "
 116Ø M=INKEY(Ø):IF M=-1 GOTO131Ø
 117Ø *FX15,Ø
 118Ø move=energy/1ØØØ
 119Ø IF M=136 SposX=SposX-1:enterprise
$="["
 12ØØ IF M=137 SposX=SposX+1:enterprise
$="]"
 121Ø IF M=138 SposY=SposY+1
 122Ø IF M=139 SposY=SposY-1:enterprise
$="^"
 123Ø IF SposX<3 QposX=QposX-1:SposX=25
:NQ=1
 124Ø IF SposX>25 QposX=QposX+1:SposX=3
:NQ=1
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 125Ø IF SposY<4 QposY=QposY+1:SposY=14
:NQ=1
 126Ø IF SposY>14 QposY=QposY-1:SposY=4
:NQ=1
 127Ø IF QposX<1 QposX=QposX+1:SposX=3:
shield=Ø
 128Ø IF QposX>8 QposX=QposX-1:SposX=25
:shield=Ø
 129Ø IF QposY<1 QposY=QposY+1:SposY=14
:shield=Ø
 13ØØ IF QposY>8 QposY=QposY-1:SposY=4:
shield=Ø
 131Ø PRINTTAB(SposX,SposY)enterprise$
 132Ø IF NQ=1 GOTO16Ø
 133Ø ENDPROC
 134Ø DEFPROCklingon
 135Ø K=VAL(LEFT$(STR$(quadrant%(QposX,
QposY)),1))-1:IF K=Ø GOTO 144Ø
 136Ø SOUND1,1,1Ø,1Ø:SOUND2,1,3Ø,1Ø:sta
tus$=R$
 137Ø FOR Z=1 TO K
 138Ø hit=RND(23ØØ-shield):shield=INT(s
hield-(hit/23))
 139Ø IF RND(shield+5)=3 Dnav=1:navT=TI
ME
 14ØØ IF RND(shield+5)=4 Darm=1:armT=TI
ME
 141Ø IF shield<Ø Dnav=1:navT=TIME:Darm
=1:armT=TIME
 142Ø PRINTTAB(6,21)"          ":PRINTTAB(
2,21)YC$;"HIT:";hit
 143Ø NEXTZ
 144Ø ENDPROC
 145Ø DEFPROCphasers
 146Ø P=VAL(C$)
 147Ø IF P=1 X1=Ø:Y1=-1
 148Ø IF P=2 X1=1:Y1=Ø
 149Ø IF P=3 X1=Ø:Y1=1
 15ØØ IF P=4 X1=-1:Y1=Ø
 151Ø phaser=1ØØØ:M2=Ø
 152Ø IF SposX+(M2*X1)=klingon%(k1,1) A
ND SposY+(M2*Y1)=klingon%(k1,2) PROChit
:GOTO158Ø
 153Ø PRINTTAB((SposX+((M2-1)*X1)),Spos
Y+((M2-1)*Y1));"  ";TAB((SposX+(M2*X1))
,(SposY+(M2*Y1)));phaser$
 154Ø IF SposX+(M2*X1)>24 OR SposX+(M2*
X1)<4 OR SposY+(M2*Y1)>13 OR SposY+(M2*
Y1)<5 PRINTTAB(SposX+(M2*X1),SposY+(M2*
Y1))"  ":GOTO159Ø
 155Ø M2=M2+1:SOUND3,1,2ØØ,1
 156Ø PROCenergy:PROCsrsfill:PROCklingo
n
 157Ø GOTO152Ø
 158Ø PRINTTAB(SposX+((M2-1)*X1),SposY+
((M2-1)*Y1))"  "
 159Ø ENDPROC
 16ØØ DEFPROCshield
 161Ø SOUND3,-15,18Ø,1:MS=Ø:shield=Ø
 162Ø PRINTTAB(2,23)GC$;"SHIELD:"
 163Ø D$=INKEY$(Ø):S=VAL(D$)
 164Ø PROCenergy:PROCklingon
 165Ø IF S=3 PROCarmfill ELSE PROCsrsfi
ll
 166Ø IF D$="S" OR D$=""GOTO163Ø
 167Ø IF S<Ø OR S>9 GOTO163Ø
 168Ø MS=MS+1:PRINTTAB(12,23)S
 169Ø IF MS=1 S=S*1ØØØ
 17ØØ IF MS=2 S=S*1ØØ
 171Ø IF MS=3 S=S*1Ø
 172Ø shield=shield+S
 173Ø IF MS=4 GOTO175Ø
 174Ø GOTO 163Ø
 175Ø IF shield>2ØØØ shield=2ØØØ
 176Ø PRINTTAB(32,15)"          ";TAB(2,23
)"                    "
 177Ø ENDPROC
 178Ø DEFPROChit
 179Ø SOUND2,2,1ØØ,1Ø:SOUNDØ,-15,4,8:Dk
li=1:report$=HK$:klT=TIME:status$=G$
 18ØØ quadrant%(QposX,QposY)=quadrant%(
QposX,QposY)-1ØØ
 181Ø PRINTTAB(klingon%(k1,1),klingon%(
k1,2))"  "
 182Ø k1=k1-1:PRINTTAB(2,21)"
    "
 183Ø ENDPROC
 184Ø DEF PROCarmfill
 185Ø PRINTTAB(17,6)energy;TAB(25,7);ph
oton;TAB(17,8)shield;TAB(17,9)k1
 186Ø ENDPROC
 187Ø DEF PROCbase
 188Ø PRINTTAB(15,1Ø)base$
 189Ø PROCenergy:PROCsrsfill:PROCmove
 19ØØ IF SposX<>15 OR SposY<>1Ø GOTO196
Ø
 191Ø report$=YC$+"DOCKED:       "+STR$(
recharge%(L1))
 192Ø IF recharge%(L1)=2ØØØØ report$=RC
$+"DOCKED:NO FUEL     ":GOTO188Ø
```

```
 193Ø energy=energy+1ØØ:recharge%(L1)=r
echarge%(L1)+1ØØ
 194Ø SOUND1,-1Ø,(2ØØØØ-recharge%(L1))/
1ØØ,3:SOUND2,-1Ø,(2ØØØØ-recharge%(L1))/
1Ø1,3
 195Ø GOTO188Ø
 196Ø ENDPROC
 197Ø DEFPROCcheck
 198Ø IF kI=Ø PROCwin
 199Ø IF energy<Ø PROClose
 2ØØØ FORL1=1 TO 5
 2Ø1Ø IF QposX=base%(L1,1) AND QposY=ba
se%(L1,2) PROCbase
 2Ø2Ø NEXTL1
 2Ø3Ø IF RIGHT$(STR$(quadrant%(QposX,Qp
osY)),1)="Ø" quadrant%(QposX,QposY)=qua
drant%(QposX,QposY)+1
 2Ø4Ø report$=OK$:status$=G$
 2Ø5Ø IF VAL(LEFT$(STR$(quadrant%(QposX
,QposY)),1))>1 status$=R$
 2Ø6Ø IF shieId<1Ø shieId=Ø:report$=LS$
 2Ø7Ø IF Dkli=1 report$=HK$
 2Ø8Ø IF Dnav=1 report$=Dnav$
 2Ø9Ø IF Darm=1 report$=Darm$
 21ØØ IF TIME>navT+3ØØØ Dnav=Ø:navT=999
999:report$=OK$
 211Ø IF TIME>armT+3ØØØ Darm=Ø:armT=999
999:report$=OK$
 212Ø IF TIME>klT+1ØØØ DkIi=Ø:klT=99999
9:report$=OK$
 213Ø IF energy<2ØØØØ report$=LE$:SOUND
3,1,energy/1ØØ,5:status$=R$
 214Ø ENDPROC
 215Ø DEFPROCgaIrec
 216Ø CLS
 217Ø H$="GALACTIC RECORD":PROCheadings
 218Ø FOR X=1 TO 8:FOR Y=1 TO 8
 219Ø SOUND1,-12,(X*3Ø)+Y*2,1
 22ØØ IF QposX=X AND QposY=Y col=135 EL
SE col=134
 221Ø R=VAL(RIGHT$(STR$(quadrant%(X,Y))
,1)):M=VAL(MID$(STR$(quadrant%(X,Y)),2,
1))-1:L=VAL(LEFT$(STR$(quadrant%(X,Y)),
1))-1
 222Ø Nbase=Ø
 223Ø IF R=Ø PRINTTAB(X*4,(11-Y)*2)bIan
k$:GOTO226Ø
 224Ø FOR L1=1 TO 5:IF X=base%(L1,1) AN
D Y=base%(L1,2) Nbase=Nbase+1:NEXT L1
 225Ø PRINTTAB((X*4),(11-Y)*2)CHR$coI;L
;M;Nbase
 226Ø NEXT Y:NEXTX
 227Ø A=GET:GOTO16Ø
 228Ø ENDPROC
 229Ø DEF PROClose
 23ØØ CLS:PRINTTAB(2,3)"!!    YOU FOOL
  !!"'''"YOU RAN OUT OF FUEL IN ";TIME/
1ØØ;" secs"
 231Ø GOTO237Ø
 232Ø DEF PROCwin
 233Ø CLS:PRINTTAB(2,3)"!! WELL DONE CA
PTAIN !!"'''"YOU EXTERMINATED ALL THE K
LINGONS"
 234Ø score=INT((energy/(TIME/1ØØ))*(41
-D)):IF score>H% H%=score
 235Ø PRINTTAB(1,8)"STARBASE COMMAND AW
ARDS YOU ";score'" POINTS"
 236Ø PRINTTAB(5,12)"HI-SCORE=";H%
 237Ø PRINTTAB(2,2Ø)"PRESS 'R' TO ERADI
CATE ANOTHER SECTOR"
 238Ø IF INKEY$(Ø)="R" RUN ELSE GOTO238
Ø
 239Ø DEF PROCbasedets
 24ØØ CLS
 241Ø H$="STAR-BASE DATA":PROCheadings
 242Ø PRINTTAB(Ø,5)GC$+"STARBASE    POS
ITION   ENERGY AVAILABLE"
 243Ø FOR Z=1 TO 5:SOUND3,-1Ø,Z*5Ø,1:PR
INTTAB(1,(Z*2)+6)CHR$131;Z
 244Ø IF RIGHT$(STR$(quadrant%(base%(Z,
1),base%(Z,2))),1)="Ø" PRINTTAB(14,(Z*2
)+6);"   ":GOTO246Ø
 245Ø PRINTTAB(14,(Z*2)+6);base%(Z,1);"
,";base%(Z,2)
 246Ø PRINTTAB(3Ø,(Z*2)+6);2ØØØØ-rechar
ge%(Z)
 247Ø NEXTZ:A=GET:GOTO16Ø
 248Ø DEFPROCheadings
 249Ø PRINTTAB(Ø,2)CHR$131;CHR$157;CHR$
132;CHR$141;TAB(6,2)H$
 25ØØ PRINTTAB(Ø,3)CHR$131;CHR$157;CHR$
132;CHR$141;TAB(6,3)H$
 251Ø PRINTTAB(26,2)CHR$131;CHR$157;CHR
$129;CHR$136;CHR$14Ø"ON-LINE";TAB(Ø,3)C
HR$131
 252Ø ENDPROC
```

MATHS SHAPES UP WITH GRAPHICS

Computer Graphics can put some fun into maths lessons for children in middle schools. Robin Norman explains how his class used a BBC machine

Open evening was looming and word went out that a contribution on 'shapes in maths' was required from each class. Then, at a staff meeting, came the great idea – let's get the children to design pictures made of triangles and program the smart BBC computer to draw them on the screen.

The decision taken, the design stage went without a hitch. We all laid out grids on squared paper, and drew X and Y scales going from 0 to 1250 and 0 to 900 respectively, in steps of 50. The Y axis was kept a little short to make room for names and titles. Programming would be easier, I suggested, if the corners of triangles were all on grid intersections, and we agreed that clever pictures would have some of their triangles joined edge to edge. And then we were off – stars, boats, birds, space shuttles and Snoopies . . . next time I will set a limit of five or seven triangles and make it a challenge!

While felt pens in their dozens were brightening up the pictures, I was considering how to bring the computer in. A BBC model A in mode 5 will paint pretty triangles in red, yellow or white, but the coding to do this is complicated for 12-year olds.

```
L.
    1 REM TRIPIC2. (C) 1982 R.J.NORMAN
  100 MODE5
  110    VDU23;8202;0;0;0:PRINT
  200 REPEAT
  210 PROCDATA
  220 UNTIL FALSE
 10000  DEFPROCTRIPIC:LOCALA$,X%,Y%,C%,S%
 10010  READname$:IFname$="END"ENDPROC
 10020 READtitle$:PRINTTAB(0,1);name$;:S
       %=20-LENtitle$:IFS%<LENname$+2PRINT;
 10030    PRINTTAB(S%);title$
 10040 READA$
 10050  IFA$="NEXT"PROCPAUSE:CLS:GOTO10010
 10060  IFA$="M"READX%,Y%:MOVEX%,Y%:GOTO10040
 10070  IFA$="P"READX%,Y%:C%=C%+1
 10080 IFC%>3THENC%=1
 10090 GCOL0,C%:PLOT85,X%,Y%:GOTO10040
 10200 DEFPROCDATA
 10210  RESTORE10230
 10220 PROCTRIPIC
 10230 DATA ANTHEA,FREDDY FISH,M,250,400,
       M,450,300,P,450,550,P,950,400,M,1050,30
       0,P,1100,550,NEXT
 10240 DATA SNOOPY,YACHT,M,400,100,M,125,250,
       P,1100,100,P,1150,250,  M,600,250
       ,M,300,300,P,600,800,M,600,900,P,750,85
       0,M,600,800,M,600,250,P,1150,300,NEXT
 10300 DATA END
 10310 ENDPROC
 10400 DEFPROCPAUSE
 10410 *FX15,0
 10420 P%=INKEY(500)
 10430 ENDPROC
```

I did want the class to feel they had done something towards the programming, so we hit on a compromise. Each child had to convert his picture to a data line containing his name, the picture title and a combination of the following commands

MOVE eg M,100,250

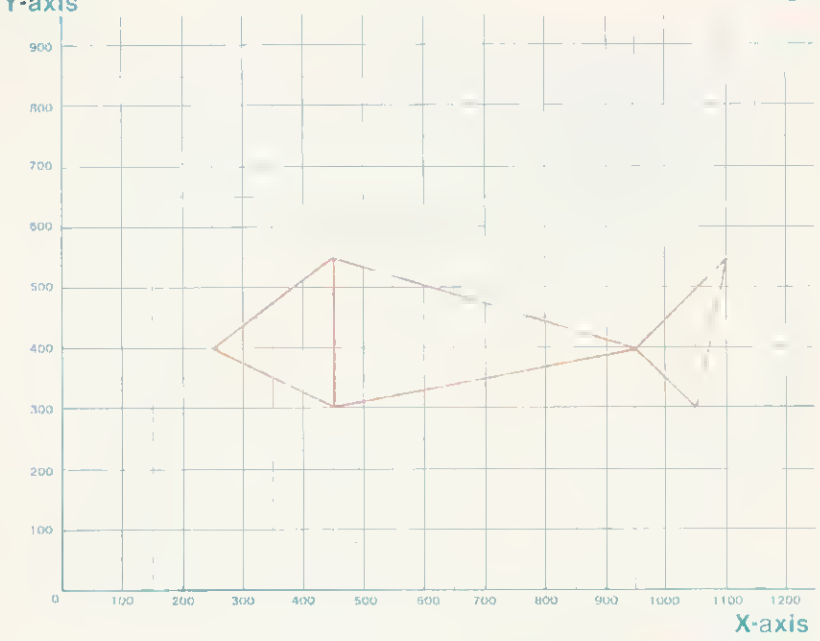
This means move to the screen position (100,250), and fix the apex of a triangle there.

PAINT eg P,500,100

This means move to the screen position (500,100), fix the apex of a triangle there, and paint the triangle formed by the last 3 positions given – whether these three were MOVE or PAINT did not matter.

NEXT means pause for five seconds to see the finished picture then clear the screen for the next one.

fig I



DATA ANTHEA, FREDDY FISH, M,250,400,M,450,300,P,450,550,P,950,400,M,1050,300,P,1100,550,NEXT

Figure 1 shows one of the simpler pictures with its DATA line. Each child worked out his or her own data, with help when needed, and we had half a dozen volunteers who typed them in to save time. It's very important to leave no trailing spaces after string DATA items – it is easy to do, especially after the final NEXT, and it spoils the pictures. Leading spaces are ignored, and so are those after numbers.

A backing program was obviously needed to convert the DATA lines into the instructions to make the BBC do what we wanted and it is shown here. You might like to add a title frame but don't use up too much of your precious RAM, which is in short supply in mode 5 on a model A.

Integer variables have been used throughout to save RAM – the program has room for about a dozen pictures, but you can save it on tape as often as you like with different sets of pictures. If you get bored with the colours, you can change them at will (or at random) by using the VDU 19 statement.

It was an enjoyable exercise and we got a lot from it by using the simple triangle – to make patterns and pictures.

We also had a lot of practice in working out X and Y co-ordinates. The computer made it very obvious – by drawing silly pictures – where we had got them wrong.

And seeing how a computer can use a series of pairs of co-ordinates to draw a picture on the screen (the basis of all TV pictures) was extremely satisfying. Typing and editing the DATA lines was good practice and I had a ready-made PROC for drawing 'real pictures' (as opposed to random or mathematical patterns). I shall extend it to include a DRAW instruction for drawing lines and a bit more colour control.

It's not often that a maths teacher can honestly claim his pupils are enjoying their lessons, but our 'triangle project' for Open evening ensured fun and education for kids and staff alike – even if only for its duration.

And when the parents saw the masses of pretty pictures adorning the classroom wall they realised that we were actually doing something educational and different with the computer we had bought with their hard-earned cash!

This screen photograph was set up using data from the program above

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RECIPES FOR SUCCESS

A computer without software is no good in a classroom. But who can write the programs? Jane Whitwell solved the problem by sitting two mothers in front of a machine with a set of recipes, or procedures to use as building blocks

Our first Acorn Atom arrived on six-month loan last January, but of the eleven members of staff and more than 300 excited children, only I had any previous experience of computers. Yet the major problem was yet to come. The new machine had no accompanying software!

By July we had trained two mothers of children in the school to be part-time programmers and written more than 20 programs suitable for our full primary age range, covering both language and mathematics.

'Presentation on the screen is a major consideration'

We also had a computer club running every lunchtime and could boast proudly that almost every child in the school had used the machine – including the top two classes of our partner infant school.

This success was achieved by using a system we called 'recipe programming'. Here I produce short sections of code (usually in the form of subroutines) which perform a specific task – read in a child's name, draw a square, set up a two-dimensional array holding the days of the week, accompanied by a line by line 'explanation' and enough information, in the form of tables and charts to make alterations.

Our experience with children between the ages of six and twelve has shown that screen presentation is a major consideration in any program – particularly when dealing with the younger child whose reading ability may be restricted and whose memory span may be small.

We have been able to draw up a list of recommendations when using text on a TV screen:

- keep the text on the screen to a minimum.
- use short, concise messages, questions and answers.
- use plenty of spaces and delete old or superfluous text.
- do no write text too close to the screen edges as distortion effects can make it hard to read – especially when several children are gathered round a 14-inch screen.

Having had to return our first machine we are now looking forward excitedly to our very own BBC microcomputer and are eager to use the text/graphics window facility of this machine.

I have produced, therefore, a recipe which will produce a text window and a graphics window on a BBC model A micro. The window positions and dimensions were chosen to be suitable for even the youngest child when using a 14-inch screen:

```
10 MODE 5
20 VDU 24,5;5;500;500;
30 VDU 28,10,20,19,5
40 COLOUR 129
50 COLOUR 3
60 GCOL 0,130
70 CLS:CLG
```

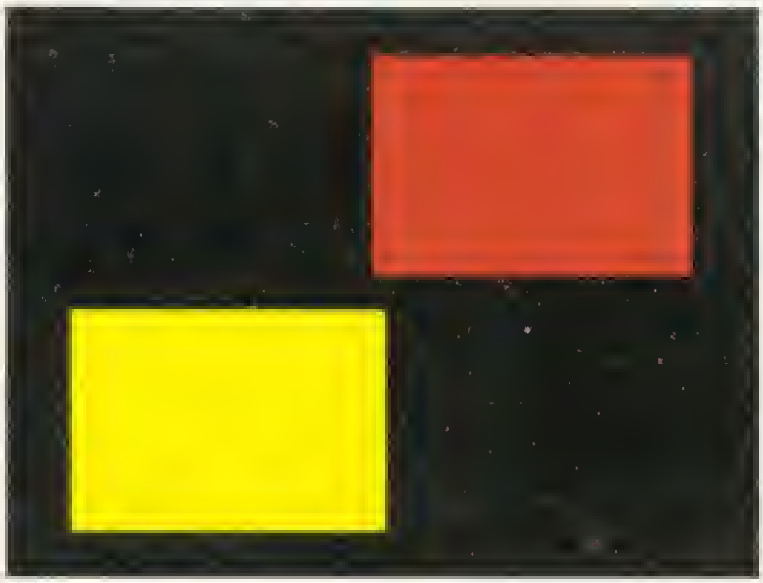
The program can be explained as follows:

Line 10: The model A provides two graphics modes – 5 or 4. If this line is changed to mode 4 the effect is interesting but useless in this context.
Line 20 sets up the graphics window in the bottom left of the screen. Refer to figure 1 for a full account of the dimensions.
Line 30 sets up the text window in the top right of the screen.

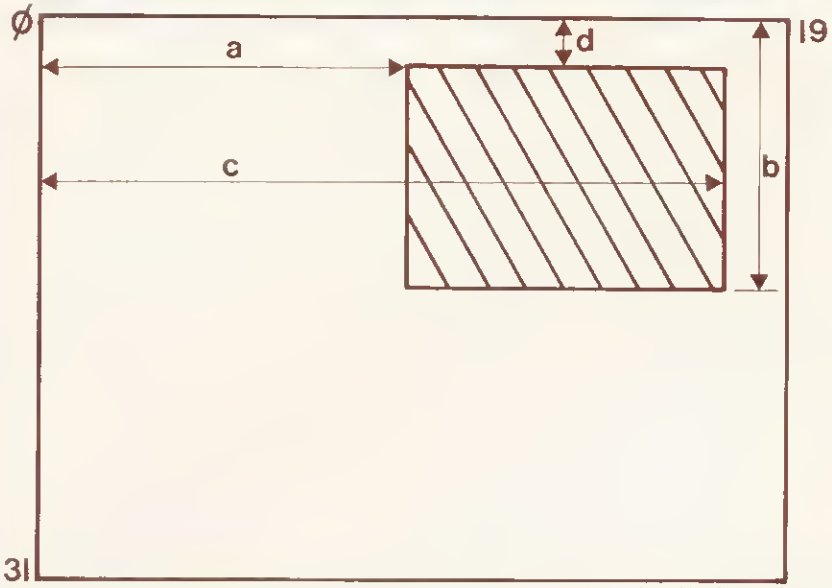
'Keep text to a minimum and avoid edge distortion'

Refer to figure 1 for a full account of dimensions.
Line 40 sets up the background colour in the text window – in this case red. Refer to figure 2 to change colour.
Line 50 sets up the foreground colour in the text window (the colour of the writing) in this case white. Refer to figure 2 to change colour.
Line 60 sets the background colour in the graphics window – in this case yellow. Refer to figure 2 to change colour.
Line 70 clears the text window (CLS) and the graphics window (CLG).

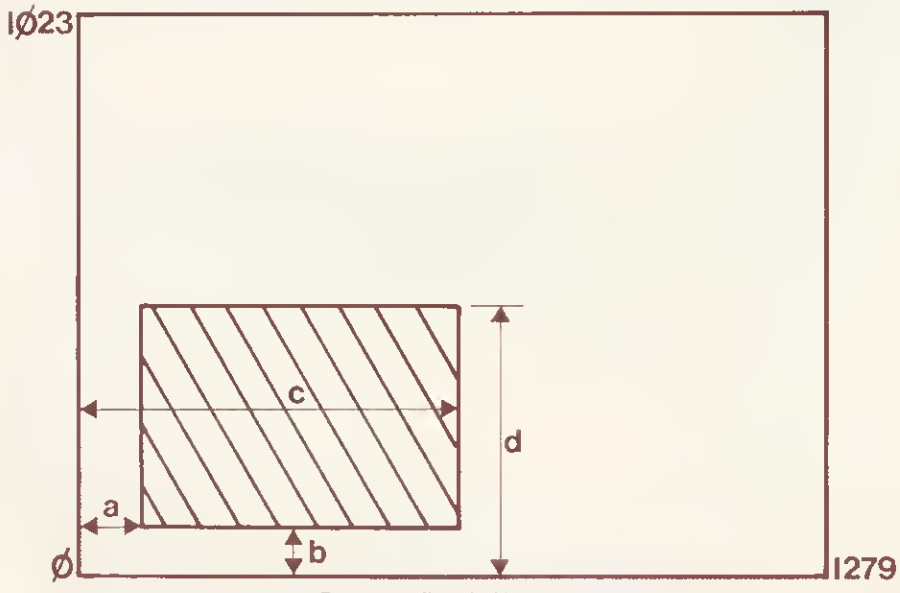
Figure 1. Relative size of windows in mode 5



(a) Representation of windows on screen



(b) Text window is (c – a + 1) characters wide by (b – d + 1) characters high. Program line is VDU28,a,b,c,d



(c) Graphics window. Program line is VDU24,a;b;c;d;

If typed in and run this recipe gives a red block and a yellow block on a black screen.

And if a one-colour printing loop is added to the window recipe:

```
 80 FOR N=1TO100
 90 PRINT "HELLO"
100 NEXT
```

the size and colour combinations can be seen in the text window. The white colour of the text (the foreground colour) was set by line 50 of the window receipe. To put up text in one colour and then another colour try:

```
 80 FOR N=1TO10
 90 PRINT "HELLO"
100 NEXT
110 COLOUR 2
120 FOR N=1TO10
130 PRINT "GOODBYE"
140 NEXT
```

and use figure 2 for changes to line 110.

Taking the window recipe (line 10 – line 70) a recipe can be added to draw a square within the graphics window:

```
180 MOVE 100,100
185 GCOL 0,0
190 DRAW 400,100
200 DRAW 400,400
210 DRAW 100,400
220 DRAW 100,100
```

Line 185 sets the colour of the lines of the square ie the 'graphics window foreground' colour – in this case black. Refer to figure 2 to change colour.

A useful recipe in this context is for the isosceles triangle which colours equal lines red and the base line black:

```
280 MOVE 100,100
285 GCOL 0,1
290 DRAW 200,400
300 DRAW 400,100
310 GCOL 0,0
320 DRAW 100,100
```

Figure 2 shows how to change line 285 and line 310 for other colour combinations.

'It is important that early experiences are successful'

	Text window		Graphics window	
	F'ground	B'ground	F'ground	B'ground
Black	COLOUR Ø	COLOUR 128	GCOL Ø,Ø	GCOL Ø,128
Red	COLOUR 1	COLOUR 129	GCOL Ø,1	GCOL Ø,129
Yellow	COLOUR 2	COLOUR 13Ø	GCOL Ø,2	GCOL Ø,13Ø
White	COLOUR 3	COLOUR 131	GCOL Ø,3	GCOL Ø,131

Figure 2. Recipe codes for various colour combinations

		Foreground (scores: 1 = poor contrast, 5 = good contrast)			
		Black	Red	Yellow	White
Background	Black	invisible	3	5	5
	Red	3 to 4	invisible	2 to 3	3 to 4
	Yellow	4	2	invisible	1
	White	4	2 to 3	1	invisible

Figure 3. Success of colour combinations

The square recipe can be used and then followed by the isosceles triangle with a CLG line inserted between the two. If this is omitted, the square is drawn first and the triangle is then inscribed.

Certain colour combinations give better results than others. If the window recipe (line 10 – line 70) is combined with the one-colour print loop (line 80 – line 100) and then the square recipe added (line 180 to line 220) a complete program can now be run to show all the effects. We have been able to draw up a combination table based on our results (figure 3).

Figure 4 gives the line numbers to be changed to produce dilferent colour combinations and figure 2 gives the code.

We are sure the text/graphics window of the model A will have many uses in the programs we produce for the classroom. I am working on other recipes which, in conjunction with those outlined above, will form the basis of a series concerning geometric shape discrimination.

I am also devising, in association with an infant teacher, an exercise in simple co-ordinate plotting designed for a top infant class. And want to produce a series of programs concerned with the teaching of time – a complicated task which lends itself well to implementation on the BBC micro.

We find this method of producing software is quick and efficient – and this is vital for a busy teacher with little programming knowledge. It also makes my job easier when called on to debug another person's program.

Now, with the ever-increasing introduction of computers into schools, it is important the early experiences be successful. The teacher must add software designer and programmer to an already crowded job description. And any system which can make this easier can only increase computer use in the classroom.

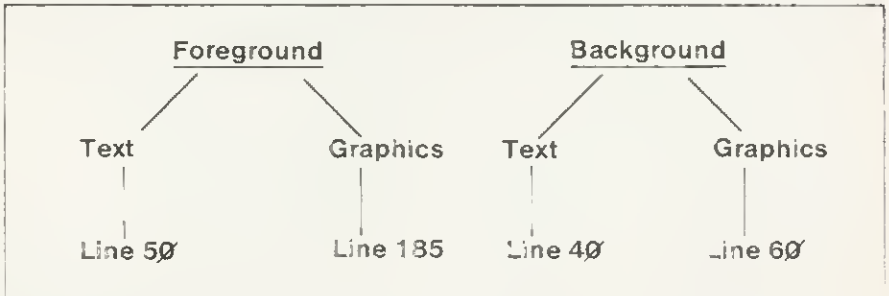


Figure 4. Line numbers to be changed for colour combinations

10 TEN PROGRAMS IN ONE MICRO

This isn't possible, you might think, but Michael Murray knows it can be done, and here he tells you how

The biggest handicap in mounting an effective micro-computer demonstration is the time taken to load programs from tape. For many, the simple solution – disc drives – is financially out of the question, so the only answer seems to be to have several programs in the machine at the same time.

The most obvious way to do this is to enter them as routines in one long program with a selection procedure, but this is both tedious and totally inflexible once the selection of programs to be combined has been decided. The other method involves entering a selection of different programs in separate sections of memory and jumping from one to another at will. The following procedures will enable this method to be carried out.

The basic principle is simple. After a program has been entered the page boundary is set above the top of it and the next program is then entered, and this may be repeated *ad infinitum* within the limits of the available memory.

However, in practice it is not quite so simple, so it is vital the procedures described are followed carefully or later programs will not function correctly. If an error is made it is likely that one or more of the programs will not function at all, or may run but be unable to list.

Once the programs have been correctly loaded it will appear to the user that the only program in the machine is the one being used, and in fact each program may be treated as if this is the case. Each program may be run, listed, or edited without affecting the others, as long as its length is not increased past the next page boundary, in which case it would corrupt the following program.

If NEW is used the machine will only forget the current program, and it may be restored by OLD as usual. The same applies to the BREAK, OLD procedure. However, if BREAK, OLD is used, the computer will return to the first program.

If any program is deleted or corrupted the others will not be affected and movement from one program to another can be achieved with a single function key.

Whether entering programs by keyboard or tape, it will be necessary between each program to determine TOP and set the new value of PAGE. So if many programs are to be entered it is easier to use a function key rather than entering similar instructions many times. This can be done by:

```
*KEY0"PAGE=TOP+&100|M
PRINT PAGE |M
```

The actual value of PAGE set will be the nearest page boundary above TOP. Page boundaries occur each Hex 100 ie &EOO, &FOO, &1000, &1100 and so on.

Before loading or entering the first program check that PAGE is at the default value of &EOO by entering:

```
PRINT~PAGE
```

If the answer is not EOO enter:

```
PAGE=&EOO
```

Load the first program in the usual way if you want to use tape. If the function key has been programmed correctly, press it and load the next program and repeat until all programs have been loaded. Each time the function key is pressed the new value of PAGE will be printed on the screen.

If the function key is not being used after each program has been loaded enter:

```
PRINT~TOP
```

Then determine and enter the new value of PAGE. For example, if TOP = 1E72 then the required new value will be PAGE = &1FOO. Whichever method is used, it is essential to keep a record of all the page boundaries.

To load from the keyboard, enter the first program in the usual way. Before loading a second program you must change the value of PAGE and then type NEW for the next program to be accepted.

This is most easily done be programming a function key as follows:

```
*KEY0"PAGE=TOP+&100 |M
PRINT PAGE |M NEW |M
```

Demonstration programs

```
*KEYØ"PAGE=TOP+&1ØØ¦M
PRINT~PAGE ¦M NEW ¦M"

Program 1
10 PRINT"PROGRAM 1, PAGE=";~PAGE
20 PRINT"LOMEM=";~LOMEM

Program 2
Press fØ (note new PAGE=&FØØ)
10 PRINT"PROGRAM 2, PAGE=";~PAGE
20 PRINT"LOMEM=";~LOMEM

Program 3
Press fØ (note new PAGE=&1ØØØ)
10 PRINT"PROGRAM 3, PAGE=";~PAGE
20 PRINT"LOMEM=";~LOMEM
OLD
```

After each program has been entered it is then only necessary to press f0 (or whichever key was programmed) before entering the next. Keep a note of all PAGE values printed when the function key is pressed.

Because the computer normally sets LOMEM = TOP, if a program produces any variables (which are stored starting at LOMEM) it is possible for them to run over the next page boundary and corrupt the next program. This can be avoided by setting LOMEM = TOP of the last program entered (type OLD).

To go from one program to another all that is needed is to set the value of PAGE to the start of the program required, which is why it was necessary to keep a note of the PAGE boundaries. LOMEM was set when OLD was typed after the last program was entered and will stay there as long as the computer's pointers are not reset in any way. If the pointers are reset, LOMEM will be set to the top of which ever program is being accessed after the reset. This may be overcome by returning to the last program and resetting the pointers with the OLD command. As a safeguard this may be done before each program is run.

It is recommended that function keys are used for going from one program to another, one for each program loaded, as follows:

```
*KEYnumber"PAGE=Hex Address of
last program ¦M OLD ¦M
PAGE=Hex address of program
wanted ¦M RUN ¦M"
```

To show these procedures work, try the demonstration programs given.

To run the programs, use the function keys thus:

```
*KEY1"PAGE=&1000 ¦M OLD ¦M
PAGE=&E00 ¦M RUN ¦M"
*KEY2"PAGE=&1000 ¦M OLD ¦M
PAGE=&F00 ¦M RUN ¦M"
*KEY3"PAGE=&1000 ¦M OLD ¦M
RUN ¦M"
```

The underlined commands are not necessary in all circumstances, but are included in case the computer's pointers are ever reset by ESCAPE, OLD or NEW. In this case they are not necessary because they reset LOMEM above the last program and these programs create no variables, but they are included as an example.

Programs 1, 2 and 3 may now be run simply by pressing f1, f2 or f3. (It will be seen that LOMEM always stays above program 3 even if ESCAPE or BREAK, OLD are used – try it.) If the programs were such that they did not end, but ran continuously, then it would be necessary to press ESCAPE before the function key. Any number of programs may be entered as described as long as there is sufficient memory available. In practice it has been found that when running small demonstration programs the limiting factor is often not memory but the number of function keys.

Another, neater, method than the one above will work if there is space at the beginning of each program to insert an extra line, and none of the programs use the resident integer variable chosen (see below). It is basically the same as that already described except:

- After each program is entered, add an extra line at the beginning:
  1 LOMEM=L% (or any other resident integer variable).
- After the last program has been entered and OLD has been typed, type:
  L%=LOMEM

When the function keys are programmed they will now require less programming than before:

```
*KEYnumber"PAGE=Hex address of
program wanted ¦M RUN ¦M"
```

This is because each program itself will now set LOMEM above the last program, and the value they use, being held as resident integer variable, is protected from the effects of the commands that reset the computer's pointers.

Joe Telford sets up figures and landscapes for the BBC micro with the help of FOR NEXT loops to make your programs go . . .

FASTER AND FASTER

There are hardly any programs which have no use for a NEXT LOOP. Their value is that they allow a number of commands to be executed for a set number of times. When graphics in Basic seem slow because many parts of the screen are moving in different directions, FOR NEXT loops allow the programmer to speed up his programs.

Program 1 takes 1.28s to run (version 1.0 EPROMs) – which is slow for the BBC micro. Imagine taking this time to move a bullet up the screen! Although the colon lines and the REM line help to make the program understandable, they are executed 1000 times. Both a colon and a REM do nothing, but the computer has to interpret these lines.

To maintain readability the REMs should be placed outside the loop. Re-writing lines 30, 40, 50, will speed up the loop to take 0.64 seconds – twice as fast. This speed gain can be further increased, although the next step does reduce readability.

When the computer executes a FOR NEXT loop, it translates the NEXT line and looks for the variable at the end of the line – X, in Program 1. The program then checks that this variable matches the one in the corresponding FOR line. If it does match, the loop continues; if not, an error message is generated. This is because while nested loops are allowed:

```
10 FOR X = 1 To 10
20 FOR Y = 1 TO 5
120 NEXT Y
130 NEXT X
```

crossed loops are not:

```
10 FOR X = 1 TO 10
20 FOR Y = 1 TO 5
30 NEXT X
40 NEXT Y
```

```
10Z=TIME
20FOR X=1 TO 1000
30:
40REM THIS LOOPS AROUND 1000 TIMES
50:
60NEXTX
70PRINTTIME-Z;" /100 SEC"
```

Program 1. Points out crossed loops

But, if we lose the variable from the NEXT lines, the computer automatically assumes that each NEXT line belongs to the last incompleted FOR line. This clears the way for a further speed increase because no check needs to be made.

Altering line 60 to read 60 NEXT reduces the execution time to 0.5s. The final stage is to alter the control variable in line 20 to 20 FOR X% = 1 TO 1000. X% is an integer variable, and integers – whole numbers – are stored in a representation which allows addition to be performed speedily. Integer loops, though, cannot handle

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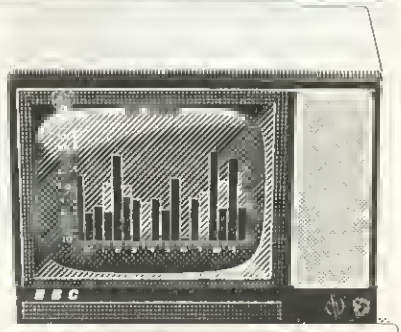

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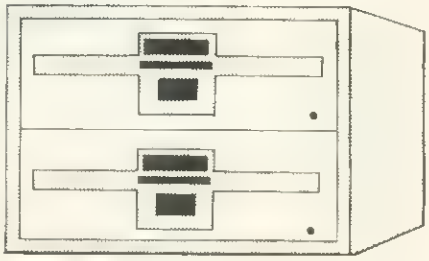

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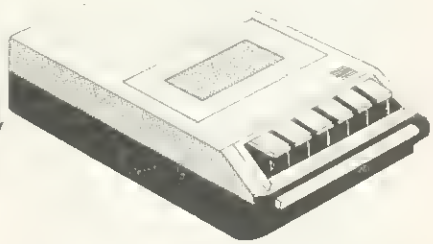

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```
 5DIMTT$(5Ø,8,5)
1ØZ=TIME
2ØFOR T=1 TO 5Ø
25REM FOR 5Ø TEACHERS
3ØFOR D=1 TO 8
35REM FOR 5 DAYS
4ØFOR P=1 TO 5
45REM FOR 8 PERIODS
5ØREM INITIALISE EACH TT LOCATION
8ØTT$(T,D,P)="ØØØØ"
1ØØNEXT P
11ØNEXT D
12ØNEXT T
13ØPRINTTIME-Z;" /1ØØ SEC"
```

Program 3. Same function, but faster

```
 5DIMTT$(5Ø,8,5)
1ØZ=TIME
2ØFOR T%=1 TO 5Ø
3ØFOR D%=1 TO 8
4ØFOR P%=1 TO 5
8ØTT$(T%,D%,P%)="ØØØØ"
1ØØNEXT:NEXT:NEXT
13ØPRINTTIME-Z;" /1ØØ SEC"
```

Program 2. Simulates teaching timetable

decimals. For example:

FOR X% = 1 TO 10 STEP.1

will not work.

The loop is now reduced to 0.19 seconds – about one-seventh of the original loop speed. Programs 2 and 3, which simulate initialising a timetable for 50 teachers over a week of eight lessons per day, put this saving into perspective. Program 2 executes in 9.5 seconds.

Applying the techniques suggested so far gives us Program 3 – which runs in half the time, and has a larger memory.

The BBC computer can load spaces in program lines.

Type 20 _ _ _ _ _ _

The _'s are single spaces. List the program and you will notice line 20 appears. Spaces use up memory and waste time. To look for spaces in a long program simply load the program, enter mode 4, and type

VDU23,32,255,255,255,255,255,255,
255,255

Now list the program. All spaces will be shown in white, and it is up to you whether or not to remove them. White spaces before line numbers cannot be removed.

As I illustrated last month, printing and moving shapes across the screen, is easy, provided characters are rationed to one square per shape. But there are many applications where shapes need to be built around more than one character.

Two techniques can be used, which both rely on defining characters that can be printed together to form the compound shape. Once these characters have been defined the first method prints them sequentially line by line. The second works in the same way as for single characters – printing the whole shape at once. This has the edge over the first method because it is quicker and affords control of printing position.

Figure 1 shows the compound shape for a figure made up of nine squares incorporating five different characters. These characters, must first be defined in VDU 23 statements, with the exception of the space character which already exists.

Figure 2 illustrates how the figure is redrawn before being coded into a string. The gaps and extensions to the right are for control characters which organise the layout of a string into the two-dimensional picture of figure 1.

Figure 3 is the final representation for moving the figure left or right. It has the extra spaces at the edges to erase the character in whichever direction it moves. Note that because spaces are not added above and below, the shape will leave an assorted scattering of links if moved up or down.

Program 4 creates a little figure which scampers across the screen at a touch of the > and < keys. Lines 100 to 150 define the separate squares. Line 160 contains the control codes to print the shape as a two-dimensional figure.

MAN1$ and MAN2$ are two version of the figure. Once the

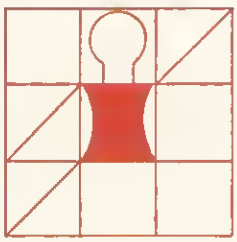


Figure 1. Compound shape

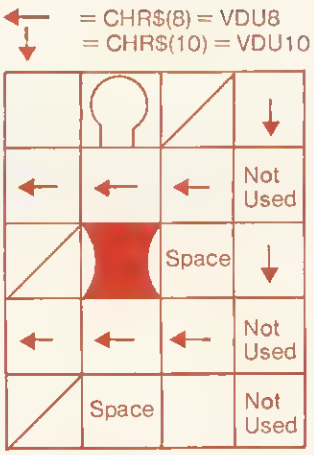


Figure 2. Shape redrawn for string

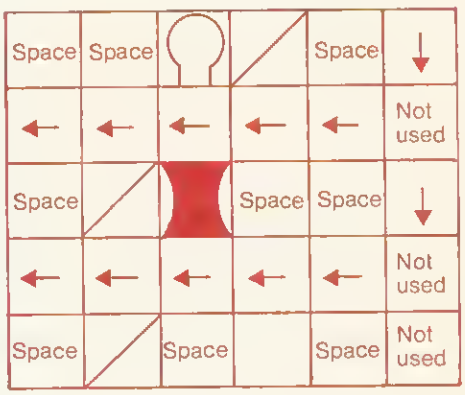


Figure 3. Final version for moving shape

Program 4. Scampering character

```
  10ØVDU23,224,1,2,4,8,16,32,64,128
  11ØVDU23,225,128,64,32,16,8,4,2,1
  12ØVDU23,226,24,1Ø2,129,129,129,1Ø2,2
4,24
  13ØVDU23,227,255,255,126,6Ø,6Ø,126,25
5,255
  14ØVDU23,228,1,1,1,1,1,1,1,1
  15ØVDU23,229,128,128,128,128,128,128,
128,128
  16ØDB$=CHR$(1Ø)+STRING$(5,CHR$(8))
  17ØMAN1$="  "+CHR$(226)+CHR$(224)+" "
  18ØMAN1$=MAN1$+DB$+" "+CHR$(224)
  19ØMAN1$=MAN1$+CHR$(227)+"  "
  2ØØMAN1$=MAN1$+DB$+" "+CHR$(224)
  21ØMAN1$=MAN1$+" "+CHR$(229)+" "
  23ØMAN2$=" "+CHR$(225)+CHR$(226)+"  "
  24ØMAN2$=MAN2$+DB$+"  "+CHR$(227)
  25ØMAN2$=MAN2$+CHR$(225)+" "
  26ØMAN2$=MAN2$+DB$+" "+CHR$(228)+" "
  27ØMAN2$=MAN2$+CHR$(225)+" "
  29ØMODE4:CLS
  3ØØX=1:Y=16:PROC_FWD
  31ØA$=GET$
  32ØIFA$=">" OR A$="."THEN PROC_FWD
  33ØIFA$="<" OR A$=","THEN PROC_BWD
  34ØGOTO31Ø
  35ØDEFPROC_FWD
  36ØIF X+1=34THEN ENDPROC
  37ØPRINTTAB(X,Y);MAN2$
  38ØPROC_DELAY
  39ØX=X+1
  4ØØPRINTTAB(X,Y);MAN1$
  41ØPROC_DELAY
  42ØENDPROC
  43ØDEFPROC_BWD
  44ØIF X-1=ØTHEN ENDPROC
  45ØPRINTTAB(X,Y);MAN1$
  46ØPROC_DELAY
  47ØX=X-1
  48ØPRINTTAB(X,Y);MAN2$
  49ØPROC_DELAY
  5ØØENDPROC
  51ØDEFPROC_DELAY
  52ØLOCAL Z
  53Ø Z=TIME+1Ø
  54ØREPEAT UNTIL TIME>Z
  55ØENDPROC
```

program is run, use > or < to move the figure. This is done via the two procedures 'FWD' and 'BWD' at lines 350 and 430 respectively.

To print such a figure on the screen, simply PRINT TAB the string containing the shape to the new position.

Movement must be one square at a time,

```
PRINT TAB(10,15);MAN1$
PRINT TAB(11,15);MAN2$
```

is fine but

```
PRINT TAB(10,15);MAN1$
PRINT TAB(12,15);MAN2$
```

is not. Aan assortment of links would be scattered in the wake of the figure.

Program 5 is a more efficient routine for creating the figures. It simply replaces the lines 160 to 270 in Program 4.

My preference is for the first version, although as I become better at saving space I shall probably move to the Program 5 routine.

Program 6 in its subsections is a complete game using sound, colour and moving graphics. The procedures are REMed, and so require little explanation. The aim of the game is to destroy the yellow building placed at random on the surface. Simply press the space key to drop the one bomb allotted to each flight.

Program 7 draws three circles in flashing colours, so that the finished pattern pulsates. It must be run in mode 2. Program 8 converts Program 7 to be used as the background to an advertising board. The name of the advertiser fits into A$ in line 370 and the products being sold follow on from line 820.

Flashing colours are the first step to animated graphic shapes. To achieve this effect, the shape required is plotted; using DRAW, MOVE, and PLOT 85 commands, but is coded by a VDU 19 command to be the same colour as the background.

The shape can then be plotted in several positions, and because the plotting is all in the background colour, the screen is left clear.

To move the shape simply use a VDU 19 command to alter the colour of the shapes in turn, making each stand out from the background, and making the last shape the same colour as the background.

The number of shapes depends on the number of colours available. In mode 2, there are eight non-flashing colours, so seven shapes could be plotted identically – although coded to be background colours.

The shapes would then flash into existence immediately on execution of a VDU 19 command. One of the most useful areas for this facility is in the apparent expansion/contraction of a shape on the screen. ► page 40

Program 5. More efficient technique for program 4

```
17ØDATA32,32,226,224,32,1Ø,8,8,8,8,8
18ØDATA32,224,227,32,32,1Ø,8,8,8,8,8
19ØDATA32,224,32,229,32
2ØØMAN1$="":FORX%=1TO27
21ØREAD J:MAN1$=MAN1$+CHR$(J)
22ØNEXT
23ØDATA32,225,226,32,32,1Ø,8,8,8,8,8
24ØDATA32,32,227,225,32,1Ø,8,8,8,8,8
25ØDATA32,228,32,225,32
26ØMAN2$="":FORX%=1TO27
27ØREAD J:MAN2$=MAN2$+CHR$(J)
28ØNEXT
```

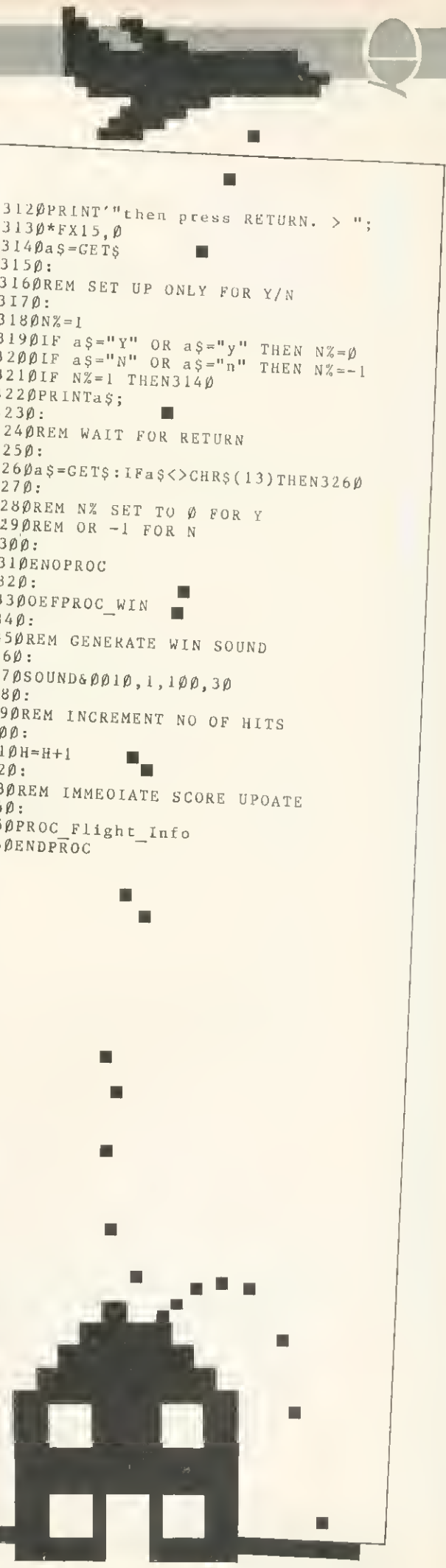
Program 6. The aim of the game is to destroy the yellow building using a bomb. It is well REM'd and explained in sections

```
  100REM BOMBER
  110REM J.TELFORD
  120REM SIMPLE DEMO OF
  130REM MOVINC GRAPHICS
  140REM IN A GAME FORMAT.
  150:
  160REM MAIN GAME
  170:
  180ON ERROR GOTO360
  190PROC_TITLE
  200PROC_INITIALISE
  210REPEAT
  220H=0
  230REM** START GAME**
  240MODE5
  250FOR Plane = 1 TO NF
  260PROC_Setupflight
  270PROC_Drawland
  280PROC_Flight_Info
  290PROC_Early_Warning
  300PROC_Move_Plane
  310NEXT Plane
  320MODE7
  330PROC_RESULTS
  340PROC_AGAIN
  350UNTIL N%
  360MODE7:PRINT''"Bye":END
  370:
  380:
  390:
  400DEFPROC_DROP
  410:
  420REM BOMB FALLS FROM PLANE
  430REM TO GROUND.
  440:
  450FORBD=3TO24
  460PRINTTAB(PP+1,BD);B$
  470:
  480REM WITH SOUND
  490:
  500PROC_WHISTLE
  510:
  520REMEMBER TO ERASE IMAGES OF BOMB
  530:
  540PRINTTAB(PP+1,BD);" "
  550NEXT
  560:
  570REM SET UP EXPLOSION COLOUR
  580REM FLASHING RED/CYAN
  590:
  600VDU19,1,9;0;:COLOUR1
  610:
  620REM AND PRINT EXPLOSION
  630:
  640PRINTTAB(PP,25);EX$
  650:
  660REM SET NORMAL COLOUR
  670REM BEFORE I FORGET
  680:
  690COLOUR3
  700:
  710REM CHECK FOR A YELLOW TARGET
  720REM IF IT HAS A DIFFERENT COLOUR
  730REM THEN TARGET IS HIT.
  740:
  750IFPOINT(LONGIT,UPIT)<>3 THEN PROC_
WIN ELSE SOUND &10,1,107,30
  760:
  770REM ONLY 1 BOMB PER FLIGHT
  780:
  790BOMB=0
  800ENDPROC
  810DEFPROC_WHISTLE
  820SOUND&0011,(-3+(BD/2*-1)),150-BD,1
  830SOUND&0012,(-3+(BD/2*-1)),150-BD,1
  840ENDPROC
  850DEFPROC_INITIALISE
  860:
  870REM SET FAST FLASHING RATES
  880:
  890*FX10,2
  900*FX9,2
  910:
  920REM SET COLOURS UP
  930:
  940VDU19,0,7;0;
  950VDU19,1,9;0;
  960VDU19,2,2;0;
  970VDU19,3,7;0;
  980VDU19,128,4;0;
  990:
 1000REM SET EXPLOSION ENVELOPE
 1010:
 1020ENVELOPE1,1,0,0,0,0,0,0,5,126,0,-5
,40,126
 1030COLOUR128
 1040:
 1050REM SET 10 FLIGHTS
 1060:
 1070NF=10
 1080:
 1090REM DEFINE GRAPHICS FOR THE
 1100REM 4 MAIN PROGRAM SHAPES.
 1110:
 1120PROC_PLANE
 1130PROC_BOMB
 1140PROC_LANDSCAPE
 1150PROC_EXPLOSION
 1160ENDPROC
 1170:
 1180DEFPROC_PLANE
 1190:
 1200REM DEFINE SINGLE CHR GAPHICS
 1210REM TO MAKE UP PLANE
 1220:
 1230VDU23,224,192,224,240,248,255,129,
255,255
 1240VDU23,225,0,0,0,0,255,240,255,255
 1250VDU23,226,0,0,24,60,255,3,255,255
 1260VDU23,227,0,0,0,0,192,240,240,192
 1270:
 1280REM PUT TOGETHER INTO A$
 1290:
 1300A$=" "+CHR$(224)+CHR$(225)
 1310A$=A$+CHR$(226)+CHR$(227)
 1320ENDPROC
 1330:
```

```
1340DEFPROC_BOMB
1350:
1360REM DEFINE BOMB SHAPE
1370:
1380VDU23,228,65,42,28,8,28,62,28,8
1390:
1400REM PUT INTO B$ FOR EASY USE
1410:
1420B$=CHR$(228)
1430ENDPROC
1440:
1450DEFPROC_LANDSCAPE
1460:
1470REM DEFINE SINGLE CHR GRAPHICS
1480REM TO MAKE UP LANDSCAPE
1490:
1500VDU23,229,0,0,0,0,255,255,255,255
1510VDU23,230,0,0,0,0,0,0,0,0
1520VDU23,231,255,255,255,255,255,255,
255,255
1530VDU23,232,8,28,42,8,28,42,8,8
1540VDU23,233,192,192,192,192,255,255,
255,255
1550VDU23,233,192,192,192,192,255,255,
255,255
1560VDU23,234,7,7,7,7,255,255,255,255
1570:
1580REM MAKE THEM AVAILABLE IN AN
1590REM ARRAY CALLED LS$( )
1600:
1610DIMLS$(6):FORX=1TO6:LS$(X)=CHR$(22
8+X):NEXT
1620ENDPROC
1630:
1640DEFPROC_EXPLOSION
1650:
1660REM DEFINE SINGLE CHR GRAPHICS
1670REM TO MAKE UP EXPLOSION
1680:
1690VDU23,235,255,255,255,0,0,0,0,0
1700VDU23,236,4,2,41,24,70,49,12,255
1710VDU23,237,28,28,28,62,62,190,127,2
55
1720VDU23,239,28,28,28,28,28,28,28,28
1730VDU23,240,28,127,127,255,255,127,6
2,28
1740VDU23,241,28,126,255,255,255,255,1
26,60
1750VDU23,242,28,254,254,255,255,254,6
2,28
1760VDU23,238,16,32,74,140,48,198,24,2
55
1770:
1780REM PUT SINGLE CHR GRAPHICS
1790REM TOGETHER TO FORM EXPLOSION
1800:
1810EX$=CHR$(236)+CHR$(237)+CHR$(238)
1820EX$=EX$+CHR$(11)+CHR$(8)+CHR$(8)
1830EX$=EX$+CHR$(239)+CHR$(11)+CHR$(8)
1840EX$=EX$+CHR$(239)+CHR$(11)+CHR$(8)
1850EX$=EX$+CHR$(239)+CHR$(11)+CHR$(8)
1860EX$=EX$+CHR$(8)+CHR$(240)
1870EX$=EX$+CHR$(241)+CHR$(242)
1880ENDPROC
1890DEFPROC_TITLE
1900:
1910REM YELLOW, DOUBLE HEIGHT
1920:
1930CLS
1940PRINT TAB(14,10);CHR$141;CHR$131;"
Bomber"
1950PRINT TAB(14,11);CHR$141;CHR$131;"
Bomber"
1960PROC_SPACE
1970ENDPROC
1980DEFPROC_Setupflight
1990BOMB=-1:REM THERE IS A BOMB
2000:
2010REM BLUE SKY
2020:
2030VDU19,128,4;0;
2040COLOUR128:CLS
2050:
2060REM LAND WILL BE GREEN
2070:
2080VDU19,2,2;0;
2090COLOUR2
2100ENDPROC
2110DEFPROC_Drawland
2120:
2130REM RANDOM SHAPES IN GREEN
2140REM DRAWN ACROSS SCREEN
2150:
2160FORX=0TO19
2170PRINTTAB(X,25);LS$(RND(6))
2180PRINTTAB(X,26);CHR$(235)
2190NEXT
2200:
2210REM RANDOM POS. FOR TARGET
2220:
2230PT=RND(14)
2240:
2250REM TARGET IS YELLOW
2260:
2270VDU19,3,3;0;:COLOUR3
2280:
2290REM PRINT TARGET
2300:
2310PRINTTAB(PT+3,25);CHR$(231)
2320:
2330REM FIND POS. OF TARGET
2340REM IN GRAPHICS NUMBERS
2350:
2360LONGIT=1280/20*(PT+3)+32
2370UPIT=1024/32*(32-25)-16
2380ENDPROC
2390:
2400DEFPROC_Flight_Info
2410PRINTTAB(1,28);"FLIGHT NO: ";Plane
2420PRINTTAB(1,30);"HITS:-      ";H
2430ENDPROC
2440:
2450DEFPROC_Early_Warning
2460FORWT=1 TO 1000:NEXT
2470VDU7:REM READY TO FLY
2480FORWT=1 TO 2000:NEXT
2490ENDPROC
2500:
2510DEFPROC_Move_Plane
2520:
2530REM PLANE IS YELLOW
2540:
```

▶ page 42

```
 255ØCOLOUR3
 256Ø:
 257ØREM ANTICIPATION NOT ALLOWEO
 258Ø:
 259Ø*FX15,Ø
 26ØØ:
 261ØREM MOVE PLANE POSITION (PP)
 262ØREM ACROSS SCREEN
 263Ø:
 264ØFORPP=1TO15
 265ØPRINTTAB(PP,2);A$
 266Ø:
 267ØREM GET A KEY
 268Ø:
 269ØBO$=INKEY$(Ø)
 27ØØ:
 271ØREM TEST FOR DROP BOMB COMMAND
 272ØREM AND FOR A BOMB TO DROP
 273Ø:
 274ØIFBD$=" "ANO BOMB THEN PROC_OROP:G
OTO28ØØ
 275Ø:
 276ØREM IF NOT OROPPED WAIT THEN
 277ØREM CONTINUE.
 278Ø:
 279ØFOR WT=1TO1ØØ:NEXT
 28ØØNEXT
 281Ø:
 282ØREM BLANK LAST PLANE IMAGE
 283Ø:
 284ØPRINTTAB(PP,2);"    "
 285Ø:
 286ØREM RELAX AT END OF A FLIGHT
 287Ø:
 288ØFOR WT = 1 TO 2ØØØ:NEXT
 289ØENDPROC
 29ØØ DEFPROC_SPACE
 291Ø PRINTTAB(3,24);"Press the SPACE B
AR to continue";:*FX15,Ø
 292Ø REPEAT UNTIL GET$=" "
 293Ø ENOPROC
 294Ø:
 295ØOEFPROC_RESULTS
 296ØCLS
 297ØPRINT''''"You had ";H;" hits,";
 298ØPRINT" from ";NF;" flights."
 299ØIF H = NF THEN PRINT'" Excellent w
ork"
 3ØØØIF H = NF-1 OR H = NF-2 THENPRINT'
" Very good work"
 3Ø1ØIF H = NF-3  OR H=NF-4 THENPRINT'"
 Good work"
 3Ø2ØIFH=NF-5 OR H=NF-6 THENPRINT'" Ave
rage!!!"
 3Ø3ØIFH=NF-7 OR H=NF-8 THENPRINT'" You
 need practice"
 3Ø4ØIFH=NF-9 OR H=NF-1Ø THEN PRINT'" P
oor...give up!"
 3Ø5ØPROC_SPACE
 3Ø6ØENOPROC
 3Ø7Ø:
 3Ø8ØDEFPROC_AGAIN
 3Ø9ØCLS
 31ØØPRINT''''"Do you want another go?"
 311ØPRINT'"Type Y or N"
 312ØPRINT'"then press RETURN. > ";
 313Ø*FX15,Ø
 314Øa$=GET$
 315Ø:
 316ØREM SET UP ONLY FOR Y/N
 317Ø:
 318ØN%=1
 319ØIF a$="Y" OR a$="y" THEN N%=Ø
 32ØØIF a$="N" OR a$="n" THEN N%=-1
 321ØIF N%=1 THEN314Ø
 322ØPRINTa$;
 323Ø:
 324ØREM WAIT FOR RETURN
 325Ø:
 326Øa$=GET$:IFa$<>CHR$(13)THEN326Ø
 327Ø:
 328ØREM N% SET TO Ø FOR Y
 329ØREM OR -1 FOR N
 33ØØ:
 331ØENOPROC
 332Ø:
 333ØOEFPROC_WIN
 334Ø:
 335ØREM GENERATE WIN SOUND
 336Ø:
 337ØSOUND&ØØ1Ø,1,1ØØ,3Ø
 338Ø:
 339ØREM INCREMENT NO OF HITS
 34ØØ:
 341ØH=H+1
 342Ø:
 343ØREM IMMEOIATE SCORE UPOATE
 344Ø:
 345ØPROC_Flight_Info
 346ØENDPROC
>
```



Program 7. Throbbing colours

```
100REM THROBBINC COLOURS
110:
120REM START WITH COLOUR 16
130:
140COL=16
150:
160REM USE MODE 2 FOR MAX COLOURS
170:
180MODE2
190REM BACKGROUND TEXT COLOUR IS RED
200COLOUR129:CLS
210:
220REM DRAW 3 MULTICOLOURED CIRCLES
230REM WHICH INTERLOCK
240REM USE THE FLASHING COLOURS
250:
260REPEAT
270COL=COL-1
280GCOL 0,COL
290PROC_CIRCLE(312,512,COL*20,"F")
300PROC_CIRCLE(612,512,COL*20,"F")
310PROC_CIRCLE(912,512,COL*20,"F")
320UNTIL COL =9
330:
340END
9300DEFPROC_CIRCLE(X,Y,R,F$)
9305LOCAL Z
9310 IF F$="F"THEN 9335
9315MOVEX+R,Y
9320 FOR Z = 2*PI TO -.2 STEP-.2
9325DRAW X+(R*COS(Z)),Y+(R*SIN(Z))
9330NEXT:ENDPROC
9335 MOVEX,Y
9340DRAWX+R,Y
9345 FOR Z = 2*PI TO -.2 STEP-.2
9350PLOT85,X+(R*COS(Z)),Y+(R*SIN(Z))
9355MOVEX,Y
9360NEXT:ENDPROC
```

```
10REM ADVERTISING BOARD
340REM NOW POP NAME INTO A$
350REM NO MORE THAN 14 CHARACTERS
360:
370A$="HAYES DECOR"
380:
390REM CYCLE FOREVER THROUGH THE ADS
400:
410REPEAT
420:
430REM GET PRODUCT INTO B$
440:
450READ B$
460:
470REM IF NO MORE GOODS - RESTART
480:
490IF B$ ="END" THEN RESTORE:GOTO450
500:
510REM NOW GET COST
520:
530READ C$
540:
550REM SET COLOURS:-
560REM FORGROUND FLASH BLUE/YELLOW
570REM BACKGROUND FLASH RED/CYAN
580REM THIS FITS IN WITH
590REM COLOUR OF LAST CIRCLE
600:
610COLOUR11:COLOUR137
620:
630REM NOW CENTRE TEXT ON SCREEN
640:
650PRINTTAB((10-LEN(A$)/2),13);A$
660PRINTTAB((10-LEN(B$)/2),15);B$
670PRINTTAB((10-LEN(C$)/2),17);C$
680:
690REM 10 SECS PER ADVERT
700:
710WT=TIME+1000:REPEAT UNTIL TIME>WT
720:
730REM RUB OUT TEXT FOR NEXT AD.
740:
750PRINTTAB(2,15),STRING$(15," ")
760PRINTTAB(3,17),STRING$(14," ")
770:
780REM NEVER STOP
790:
800UNTIL FALSE
810:
820REM DATA IN PAIRS...
830REM PRODUCT NAME THEN COST
840REM WITH 'END' AT THE END
850:
860DATA "BATHROOM SUITES"
870DATA"FROM `70"
880DATA"COPPER PIPING"
890DATA"97p per Foot"
900DATA"GUTTERING"
910DATA"80p per Metre"
920DATA"WASH BASINS"
930DATA"FROM `25"
940DATA"GARDEN TOOLS"
950DATA"Low Prices"
960DATA END
```

Program 8. Uses program 7 as background for an advertising display

Next month Joe Telford's tips sound a festive note

'Whether your interests lie in business, educational, scientific, control or games applications, this system provides a possibility for expansion which is unparalleled in any other machine available at present,' comments Paul Beverley in the July 1982 edition of *Personal Computer World*.

The BBC Microcomputer can genuinely claim to satisfy the needs of novice and expert alike. It is a fast, powerful system generating high resolution colour graphics and which can synthesise music and speech. The keyboard uses a conventional layout and electric typewriter 'feel.'

You can connect directly* to cassette recorder, domestic television, video monitor, disc drives, printers (dot matrix and daisy wheel) and paddles. Interfaces include RS423, inter-operable with RS232C equipment, and Centronics. There is an 8-bit user port and 1MHz buffered extension bus for a direct link to Prestel and Teletext adaptors and many other expansion units. The Econet system allows numerous machines to share the use of expensive disc drives and printers.

BASIC is used, but plug-in ROM options will allow instant access to other high level languages (including Pascal, FORTH and LISP) and to word processing software.

A feature of the BBC Microcomputer which has attracted widespread interest is the Tube, a design registered by Acorn Computers. The Tube is unique to the BBC Microcomputer and greatly enhances the expandability of the system by providing, via a high speed data channel for the addition of a second processor. A 3MHz 6502 with 64K of RAM will double processing speed; a Z80 extension will make it fully CP/M** compatible.

The BBC Microcomputer is also at the heart of a massive computer education programme. The government has recommended it for use in both primary and secondary schools. The BBC Computer Literacy Project includes two series of television programmes on the use and applications of computers.

There are two versions of the computer. Model A, at £299, offers 16K of RAM and Model B at £399 has 32K of RAM.

For technical specification and order form, send stamped addressed envelope to P.O. Box 7, London W3 6XJ and for details of your nearest stockist ring 01-200 0200.

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*Model A has a limited range of interfaces but can be upgraded to meet Model B specification
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The BBC Microcomputer System

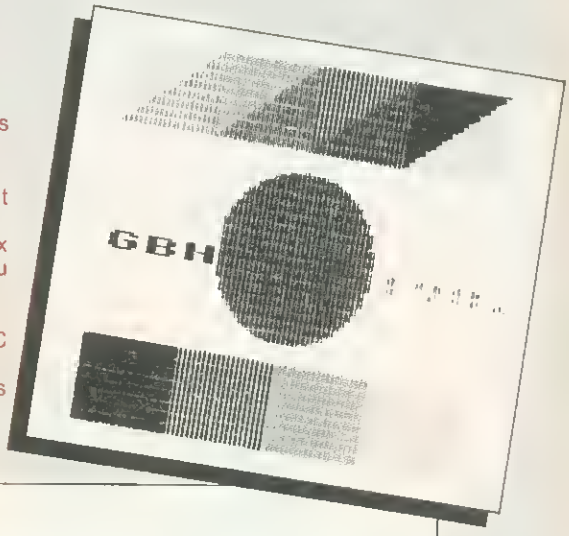
EPSON MX80

In the October issue of *Acorn User*, George Hill explained the workings of the Epson MX80 F/T2 printer, and gave listings of single colour and two-tone dumps from the BBC micro.

Here is the final listing, to print a seven-tone picture, as in the 'testcard' shown on the right. The program is in Basic, but uses the fast VDU drivers to reproduce a complete screen in less than 30 minutes.

Having stored the program, numbered from 1000, proceed as follows:

- LOAD your graphics program
- RENUMBER it to ensure that it ends before line 1000
- PRINT~TOP-2 (this returns a hex number, "hexnumber", which you now use to merge the programs)
- *LOAD "BITPRINTn" hexnumber
- Type OLD to reset the BASIC pointers
- Replace the END of your graphics program by GOTO 1000
- RUN and hope!




```
1000 REM * * BITPRINT2 * * MODE 2 * *
1010  REM * Copyright G.B.Hill June 1982 *
1020  REM Seven tone picture dump for EPSON MX-80 F/T2

1030 REM ***variable declaration***
1040  REM X%,Y% screen coordinates
1050   REM P1,P2,P3,P4, stores for screen readout data
1060   DIM C(8,6) :REM C(I,J) used to define characters sent to printer
1070  FOR I=1 TO 6:C(0,I)=0:NEXT
1080  C(1,1)=0:C(1,2)=2:C(1,3)=0:C(1,4)=0:C(1,5)=1:C(1,6)=0
1090  C(2,1)=0:C(2,2)=1:C(2,3)=2:C(2,4)=1:C(2,5)=2:C(2,6)=0
1100   C(3,1)=1:C(3,2)=2:C(3,3)=2:C(3,4)=1:C(3,5)=1:C(3,6)=0
1110    C(4,1)=0:C(4,2)=3:C(4,3)=1:C(4,4)=3:C(4,5)=0:C(4,6)=3
1120  C(5,1)=0:C(5,2)=3:C(5,3)=3:C(5,4)=3:C(5,5)=3:C(5,6)=0
1130  C(6,1)=3:C(6,2)=3:C(6,3)=1:C(6,4)=2:C(6,5)=3:C(6,6)=3
1140  FOR I=1 TO 6:C(7,I)=3:NEXT
1150 REM set up printer,clear print buffer,restore screen 0
1160 PROCPRINTER
1170  REM scan screen and send data to printer
1180  PROCSCAN
1190  REM finishing routine
1200   PROCDONE
1210  END
1220  DEFPROCPRINTER
1230  MODE 0:REM zero graphics cursor
1240  *FX 5,2
1250  REM select RS423
1260  *FX 8,4
1270  REM 1200 baud
1280  VDU2:PRINT:VDU3,1,10,1,10,1,10 :REM clear print buffer
1290  VDU1,27,1,65,1,8 :REM linefeed setting,ESC,A,8
1300  ENDPROC
1310  DEFPROCSCAN
1320   FOR Y%=1023 TO 0 STEP -16
1330    VDU1,27,1,76,1,192,1,3
1340        FOR X%=0 TO 1279 STEP 8
1350      P1=0:P2=0:P3=0:P4=0
1360                P1=POINT(X%,Y%-12):P1=P1+8:P1=P1 MOD 8
1370                P2=POINT(X%,Y%-8):P2=P2+8:P2=P2 MOD 8
1380                P3=POINT(X%,Y%-4):P3=P3+8:P3=P3 MOD 8
1390                P4=POINT(X%,Y%):P4=P4+8:P4=P4 MOD 8
1400            FOR J%=1 TO 6
1410          VDU1,(C(P1,J%)+4*C(P2,J%)+16*C(P3,J%)+64*C(P4,J%))
1420          NEXT
1430        NEXT
1440    VDU1,10 :REM linefeed
1450     NEXT
1460  ENDPROC
1470   DEFPROCDONE
1480  VDU1,27,1,50 :REM Normal linefeed
1490  VDU 1,27,1,70 :REM Cancel condensed characters
1500  VDU1,12,1,7 :REM formfeed and beep
1510  VDU5
1520    PLOT 4,200,224
1530   PRINT"Picture complete."
1540   PLOT 4,560,160
1550   PRINT"BYE"
1560    VDU4,26 :REM separate graphics cursor, restore windows
1570   VDU31,0,31 :REM text cursor to bottom of screen
1580  ENDPROC
```

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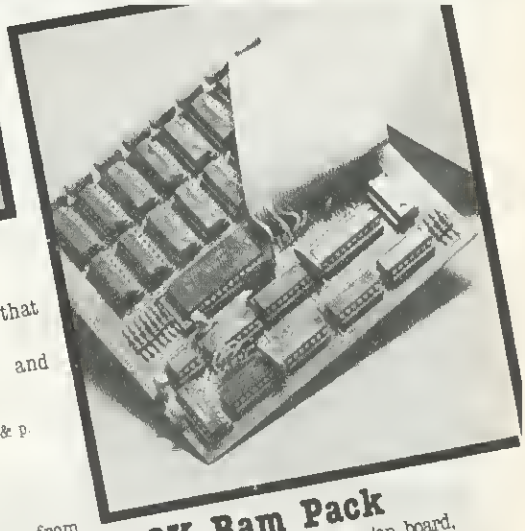

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Scouse micros

The *BBC Microgroup Liverpool* holds meetings on the third Thursday of each month at Stem, 117 Grove Street, Liverpool (by the corner with Myrtle St) from 7.30 to 9.30 pm. Acorn Atoms are welcome. The group is affiliated to the *Merseyside Microcomputer Group c/o Fred Shaw, 14 Albany Avenue, Eccleston Park, Prescot, Merseyside, L34 2QW, to whom enquiries should be vectored.*

Preston Poly

The *Preston Area BBC Micro User Group* has recently been set up and aims to start a software library and a newsletter. Members' software will be evaluated by the club!

Meetings take place at Preston Polytechnic in room F2 at the moment, although this may change. The next meeting is 24 November. Anybody wishing to contact the group should send for details from: Mr D. Coulter, Preston Area BBC Microcomputer User Group, 8 Briar Grove, Ingol, Preston PR2 3UR

Micros for leisure

Caterham Leisure Centre has started a Computer Club. Meetings are held on Thursday nghts at 8.00 pm. The centre has a model B BBC computer available. For details ring the centre manager Mr M. Goldsbrough on Caterham 48304 or Mr. J. Hodges on Caterham 43316. The address is Godstone Road, Caterham, Surrey CR3 6RE.

Brum Beeb radio

Recently the *West Midlands Computer Group* was established with a monthly magazine – Databus. Meetings are being planned, which will be held in the centre of Birmingham and the group is to be represented on a monthly radio programme to be broadcast on Radio WM – the local BBC station.

For details, contact the membership secretary, 12 Apsley Road, Oldbury, West Midlands B68 0QZ.

Databus is edited by Mr D.J. Thompson at 130 Golden Cross Lane, Catshill, Bromsgove, Worcs.

Anybody else out there? Contact Acorn User, 53 Bedford Square, London WC1

CLUB CONTACTS

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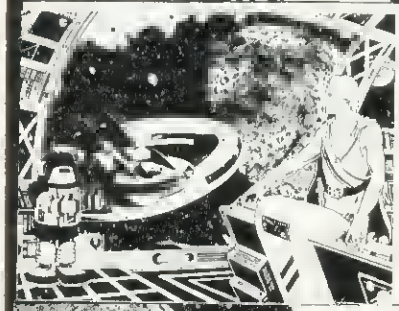

HITCH-HIKER

MODEL B

'Hitch-Hiker' is a great adventure game based on characters from the book 'Hitch-Hikers Guide to the Galaxy'. A fascinating game to test your skill and wits whilst trying to collect five objects scattered around the Universe located in such places as the 'Restaurant at the end of the Universe', 'Arthur Dents House' and Belteguese Spacedrome'. Directions can be found in the clues. An intriguing game that can create hours of fun.

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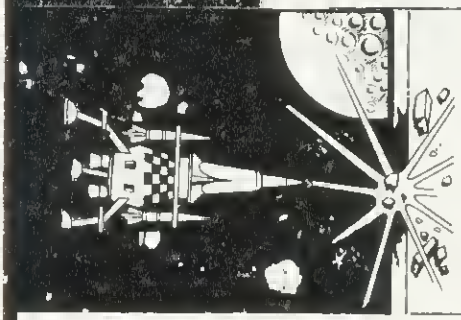

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MODEL A OR B

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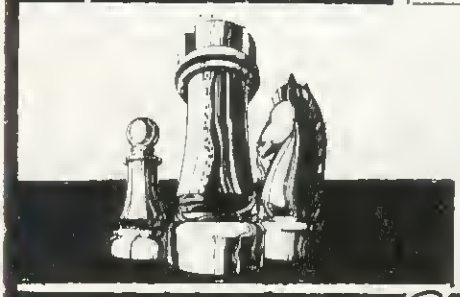

CHESS MODEL B

Another machine code program for the Model B. This game has a host of facilities.
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GRAPHICS ROUTINES

Up, down, left, right, change colour – these machine code routines by **Paul Beverley** make it all possible. Just type them in and follow the instructions

This article describes a series of machine code routines for manipulating Atom graphics – both colour and black and white. They provide rotations (up, down, left and right), inversions (up/down and left/right), global colour changes, and block moves of memory for exchanging views.

Machine code has the advantage over Basic because it lets you work fast enough to achieve reasonable animation effects – but don't panic if you have never used machine code before. To use these routines, you only need to be able to type them in and follow the instructions!

The routines are written in what are called assembler mnemonics (program 1). In this form they are vaguely readable, but they occupy over 3½k of memory. Once run, the assembler routine is turned into the machine code which the computer understands, and only uses just over ½k (589 bytes) leaving a reasonable space for the program which is going to use the routines.

However, there is no need to load and run this every time you want to use the routines. They can be saved in machine code form by saying

*SAVE "M-CODE" 39B0 3BFF

and then re-loaded when you want to use them again by saying

*LOAD "M-CODE"

Program 2 complements the explanations of the routines by showing how they can be used. It would take too long to explain fully the operation of this program, but it is laid out in sections which should

Table 1. Summary of single key commands available after the initial display in zero mode of program 1

A Set the starting page of the data to be worked on.
C Clear one of the graphics modes. Press one of keys 0 to 8 to specify mode (as shown in table 2).
D Move down. (SHIFT D for continuous motion until CTRL is pressed.)
E Exchange pictures. Press either key 0 to allow input of the page addresses from the keyboard, or keys 1 to 6 to select two of the six 1k pictures (mode 1a) to be exchanged.
F Repeats the zero mode demonstration which was shown at the start of the program.
Change graphics mode without clearing. Press one of keys 0 to 8.
H Change height of picture being worked on by routines.
I Invert the picture.
L Move left. (SHIFT L for continuous motion until CTRL is pressed.)
M Mirror image = lateral inversion = left-right inversion.
P An example of animated graphics.
Q Colour changes – press key 1, 2 or 3.
R Move right. (SHIFT R for continuous motion.)
S Save a view into another area of memory – uses same format as exchange routine.
T Draw a train.
U Move upwards. (SHIFT U for continuous motion.)
W Change width of picture.
X Horizontal colour bars in mode 1a.
Y Vertical colour bars in mode 1a.
Z Coloured squares in mode 1a.

SHIFT S – automatically standardises the height and width of the current graphics mode.

Table 2. Parameters associated with graphics modes

Graphics mode	?#B000 (=?N)	Height (bytes)	Width (bytes)	Memory (k) (x 1024)	Memory (pages) (x 256)	Number used by program
0	0	16	32	½	2	0
1	#30	64	16	1	4	2
2	#70	96	16	1½	6	4
3	#B0	192	16	3	12	6
4	#F0	192	32	6	24	8
1a	#10	64	16	1	4	1
2a	#50	64	32	2	8	3
3a	#90	96	32	3	12	5
4a	#D0	192	32	6	24	7

aid readability. The operating instructions are given in table 1.

The Atom has more different graphics modes than a model B BBC microcomputer – and this can cause problems. It has a total of nine – five in black and white and four in colour.This means you have to provide information on the current mode for the routines to refer to.

The routines could find out directly which is the current mode of graphics by reading memory location #B000 – port A of the 8255 interface adaptor. As can be seen from table 2, it is the upper four bits of this port which determine the mode.

However, to make the routines more flexible, it was decided to use a location in zero page (# 87) to store this number. In other words, to use the current mode, you copy #B000 into #87 (?#87 = ?#B000) and the routines then look at #87.

So by changing the contents of #87, the routine can perform as if the Atom were in a different mode altogether.

Similarly, various other parameters are stored in zero page. The number of horizontal lines on the screen (16 to 192) is stored at #85, and the width of the screen in terms of bytes (16 or 32) is stored at #84.

For routines which move whole chunks of memory around, the start addresses of the two areas of memory are stored at #80, #81 and #82, #83, in the usual 6502 notation – ie low byte followed by high byte.

But since we will only be dealing with whole multiples of 256 bytes, the low byte will always start at zero. The high bytes (#81 and #83) therefore contain the initial page numbers of the blocks of memory being manipulated.

The other parameter necessary for some of the routines is stored at #88, and is the initial page number of the memory on which the routine is to act. This would normally be #80 since the active screen memory always starts at #8000, but sometimes you might want to manipulate a different part of memory and exchange it with the current screen memory.

Program 1

```
10 T=#80;F=#82;W=#84;H=#85;Q=#86;N=#87;B=#88;V=#89;K=#90
20 OIM LL37;FORJ=0TO37;LLJ=-1;N.
30 P.$21;FORJ=1TO2;P=#39B0;[
40\
50\COLOUR CHANGES  ?Q=#FF or 55 or AA
60\
70:LL0 JSRLL33;JSRLL36
80:LL1 LDA(T),Y;EORQ;STA(T),Y;OEY;BNELL1
90      INCT+1;OEX;BNELL1;RTS
100\
110\BLOCK EXCHANGES (SET F?1 & T?1)
120\
130:LL2 LOY@0;STYF;STYT;JSRLL36
140:LL3 LOA(F),Y;PHA;LOA(T),Y;STA(F),Y;PLA;STA(T),Y
150     INY;BNELL3;INCF+1;INCT+1;OEX;BNELL3;RTS
160\
170\LOAO/STORE (SET T?1 & F?1)
180\
190:LL4 LOY@0;STYF;STYT;JSRLL36
200:LL5 LOA(F),Y;STA(T),Y;INY;BNELL5
210     INCF+1;INCT+1;DEX;BNELL5;RTS
220\
230\ROTATE RIGHT
240\
250:LL6 JSRLL33;LOAH;STAQ
260:LL7 LOYW;DEY;LDA(T),Y;PHA;OEY
270:LL8 LOA(T),Y;INY;STA(T),Y;OEY;OEY;BPLLL8
280     INY;PLA;STA(T),Y;JSRLL34;BNELL7;RTS
290\
300\ROTATE LEFT
310\
320:LL9 JSRLL33;LOAH;STAQ
330:LL10LDY@0;LOA(T),Y;PHA;INY
340:LL11LDA(T),Y;OEY;STA(T),Y;INY;INY;TYA;CMPW;BNELL11
350     OEY;PLA;STA(T),Y;JSRLL34;BNELL10;RTS
360\
370\LATERAL INVERSION
380\
390:LL12JSRLL33;LDAH;STAQ;LOYW;OEY;STYV
```

```
400:LL13LDAV;LSRA;TAY
410:LL14LDA(T),Y;JSRLL15;TAX;TYA;EORV;TAY
420      LDA(T),Y;JSRLL15;PHA;TXA;STA(T),Y;TYA;EORV;TAY
430      PLA;STA(T),Y;DEY;BPLLL14
440      JSRLL34;BNELL13;RTS
450\COLOUR OR B & W?
460:LL15PHA;LDAN;BEQLL17;ASLA;ASLA;BMILL16\ COLOUR OR B&W?
470\INVERT A COLOUR BYTE
480      PLA;RORA;RORA;ROLK;ROLA;ROLK;RORA
490      RORA;RORA;ROLK;ROLA;ROLK;RORA
500      RORA;RORA;ROLK;ROLA;ROLK;RORA
510      RORA;RORA;ROLK;ROLA;ROLK;RORA
520\INVERT A B&W BYTE
530:LL16PLA;RORA;ROLK;RORA;ROLK;RORA;ROLK;RORA;ROLK
540      RORA;ROLK;RORA;ROLK;RORA;ROLK;RORA;LDAK;RTS
550\IN ZERO MODE - IS IT A GRAPHICS CHARACTER?
560:LL17PLA;ROLA;BMILL18;RORA;RTS
570\IF SO INVERT IT
580:LL18RORA;RORA;ROLK;RORA;PHP;ASLA;ASLA;PLP;RORA;RORK;RORA
590      RORA;ROLK;RORA;PHP;ASLA;ASLA;PLP;RORA;RORK;RORA
600      RORA;ROLK;RORA;PHP;ASLA;ASLA;PLP;RORA;RORK;RORA
610      RORA;PHP;ASLA;PLP;RORA;RORA;PHP;ASLA;PLP;RORA;RTS
620\
630\UP DOWN INVERT
640\
650:LL19JSRLL33;LDA@0;SEC;SBCW;
    STAF;JSRLL36;DEX;STXQ
660      LDAB;CLC;ADCQ;STAF+1;
    LDAH;LSRA;STAQ
670:LL20LDYW;DEY
680:LL21LDA(T),Y;JSRLL23;TAX;LDA
    (F),Y;JSRLL23;STA(T),Y;TXA
690      STA(F),Y;DEY;BPLLL21;
    LDAF;BNELL22;DECF+1
700:LL22SEC;SBCW;STAF;JSRLL34;
    BNELL20;RTS
710\ZERO MODE?
720:LL23PHA;LDAN;BEQLL24;PLA;RTS
730\GRAPHICS CHARACTER?
740:LL24PLA;ROLA;BMILL25;RORA;RTS
750\INVERT CHARACTER
760:LL25RORA;PHA;AND@3;ASLA;ASLA;
    ASLA;ASLA;STAK
770      PLA;PHA;AND@48;LSRA;LSRA;
    LSRA;LSRA;STAK+1
780      PLA;AND@#CC;ORAK;
    ORAK+1;RTS
790\
800\ROTATE UPWARDS
810\
820:LL26JSRLL33;STAF+1;LDYW;STYF;DEY
830:LL27LDA(T),Y;STAK,Y;DEY;BPLLL27;INY
840      JSRLL36;JSRLL5;LDXW;DEX;DEY;DECT+1
850:LL28LDA K,X;STA(T),Y;DEY;DEX;BPLLL28;RTS
860\
870\ROTATE DOWNWARDS
880\
890:LL29JSRLL36;DEX;STXQ;LDAB;CLC;ADCQ
900      STAT+1;STAF+1;LDY@0;STYT;STYF;DEY;LDXW;DEX
910:LL30LDA(T),Y;STAK,X;DEY;DEX;BPLLL30;LDAW;STAT;JSRLL36
920:LL31LDA(F),Y;STA(T),Y;DEY;BNELL31
930      LDA(F),Y;STA(T),Y;DEY;DECF+1;DECT+1;DEX;BNELL31
940      INCT+1;LDY@0;STYT;LDYW;DEY
950:LL32LDAK,Y;STA(T),Y;DEY;BPLLL32;RTS
960\
970\INITIALISE VARIABLES
980\
990:LL33LDAB;STAT+1;LDY@0;STYT;STYF;RTS
1000\
1010\MOVE DOWN TO NEXT LINE
1020\
1030:LL34LDAT;CLC;ADCW;STAT;BCCLL35;INCT+1
1040:LL35DECQ;RTS
1050\
1060\CALC. NO. OF BLOCKS
1070\
1080:LL36LDAW;ASLA;ASLA;STAV
1090      LDAH;LSRA;LSRA;LSRA;BITV;BMILL37;LSRA
1100:LL37TAX;RTS
1110]:N.:P.$6
1120 @=1:P.$12"FOR ROUTINE...  LINK..  =#"&LL0"+"''
1130 P."COLOUR CHANGES        #"&LL0"    ",0'
1140 P."EXCHANGE VIEWS        #"&LL2"    ",(LL2-LL0)'
1150 P."LOAD/STORE VIEWS      #"&LL4"    ",(LL4-LL0)'
1160 P."ROTATE RIGHT          #"&LL6"    ",(LL6-LL0)'
1170 P."ROTATE LEFT           #"&LL9"    ",(LL9-LL0)'
1180 P."LEFT-RIGHT INVERT     #"&LL12"   ",(LL12-LL0)'
1190 P."UP-DOWN INVERT        #"&LL19"   ",(LL19-LL0)'
1200 P."ROTATE UPWARDS        #"&LL26"   ",(LL26-LL0)'
1210 P."ROTATE DOWNWARDS      #"&LL29"   ",(LL29-LL0)''
1220 P."ASSEMBLY ENDED AT     #"&P"      ",(P-LL0)'
1230 END
```

Table 3. Effects on different colours of EORing with different numbers

?#86=	change (and vice versa)
#FF	colour 0 to colour 3 colour 1 to colour 2
#AA	colour 0 to colour 2 colour 1 to colour 3
#55	colour 0 to colour 1 colour 2 to colour 3

An example of this is the animated graphics in the demonstration program where three different views of a train are shown on the screen in turn, each one being rotated to the left while in an area of memory not being displayed.

Having digested all this, let's look at the individual routines.

Colour changes: This routine simply goes through an area of memory doing an "exclusive OR" (a particular logical manipulation) on each byte with another parameter held in zero page (stored at #86). The three possible numbers to put at #86, and their effects, are shown in table 3.

Block exchanges: The size of the data blocks involved is first calculated (= ?#84 * ?#85 bytes) and the starting page numbers of each block have to be stored at #81 and #83.

Load/Store Data: This is set up in a similar way to the exchange routines, but here the contents of pages ?#81 and following are overwritten by the contents of pages ?#83 and following.

Rotations: Up, down, left, right. These four routines take ?#84 by ?#85 bytes of data, starting from page ?#88 and rotate them by one whole byte in the relevant direction.

Inversions: Lateral or up/down. These routines invert the view as specified by the same parameters used in the rotation routines, but they also have to check which mode of graphics is being used. The routines will be modified automatically according to whether the view is in colour or black and white, and if it is full graphics or, in zero mode, semi-graphics (pixels)/or text.

Program 2

```
 10 T=#80;F=#82;N=#87;K=#91
 20 B=#B000;?N=?B;F?6=T;A=#8000;H=#3FF
 30 C=#39B0;E=C+21;S=C+51;R=C+75;L=C+108;M=C+143
 40 I=C+321;U=C+429;D=C+469
 50 DIMLL1,P-1;G=P;P.$21;[JSR#FFE3;STAK;RTS
 60:LL0 LDA@T;STAT+1;LDA@T+4;STAT+3;JSRE;JSRL;JSRL;RTS
 70:LL1 JSRLL0;LDAB+1;CMP@#FF;BEQLL1;RTS;]
 80 P=#55;Z=4;Y=64
 90 P.$6;G.a
100mLI.G
110 IF?K=65 GOS.i;IN."START FROM PAGE"X;F?6=X;GOS.j
120 IF?K=67 G.x
130 IF?K=68 LI.D
140 IF?K=69 GOS.n;LI.E;G.m
150 IF?K=70 G.a
160 IF?K=71 G.g
170 IF?K=72 GOS.i;IN."HEIGHT"X;F?3=X;GOS.j;G.m
180 IF?K=73 LI.I
190 IF?K=76 LI.L
200 IF?K=77 LI.M
210 IF?K=80 G.c
220 IF?K=81 LI.G;T?6=(?K%3+1)*P;LI.C;G.m
230 IF?K=82 LI.R
240 IF?K=83 GOS.n;LI.S;G.m
250 IF?K=84 GOS.t;G.m
260 IF?K=85 LI.U
270 IF?K=87 GOS.i;IN."WIDTH"X;F?2=X;GOS.j;G.m
280 IF?K=88 FORJ=0TOH;A?J=J/Y%Z*P;N.
290 IF?K=89 FORJ=0TOH;A?J=J%Z*P;N.
300 IF?K=90 G.z
310 IF?K=100 DO LI.D;U.B?1=191
320 IF?K=108 DO LI.L;U.B?1=191
330 IF?K=114 DO LI.R;U.B?1=191
340 IF?K=115 G.s
350 IF?K=117 DO LI.U;U.B?1=191
360 G.m
370
380 CHANGE GRAPHICS MODE
390
400gLI.G;J=?K-48;IFJ<0ORJ>8 P.$7;G.g
410 J=32*J-16;IFJ<0 J=0
420 ?B=J;?N=J;G.m
430
```

```
440 INPUT PAGE NUMBER
450
460nGOS.o;IF J>-1 F?1=T+4*J;GOS.o;T?1=T+4*J;R.
470eGOS.i;IN."FROM"J;F?1=J;P.$30"          "$30
480 IN."TO"J;T?1=J;GOS.j
490 IF T?1<#28 ORF?1<#28 P.$7;G.e
500 R.
510oL1.G;J=?K-49;IFJ<-1 OR J>5 P.$7;G.o
520 R.
530
540 MOVE IN & OUT OF ZERO MODE
550
560iFORJ=0TO25;K?J=A?J;N.;?B=0;P.$30;R.
570j?B=?N;FORJ=0TO25;A?J=K?J;N.;R.
580
590 DRAW A TRAIN
600
610tCOLOUR1;FORJ=0TO4;MOVE0,J;DRAW63,J;N.
620 COLOUR2;MOVE15,5;GOS.v;MOVE30,5;GOS.v
630 COLOUR3;FORJ=8TO16;MOVE13,J;DRAW37,J;N.
640 MOVE15,17;PLOT1,0,6;PLOT0,1,0;PLOT1,0,-6
650 FORJ=17TO24;MOVE28,J;DRAW37,J;N.
660 COLOUR1;FORJ=16TO20;MOVE31,J;PLOT1,3,0;N.;R.
670vPLOT1,3,0;PLOT0,1,1;PLOT1,-5,0;PLOT0,0,1;PLOT1,5,0;R.
680
690 SET HEIGHT & WIDTH OF GRAPHICS
700
710sJ=?B;?N=J;IFJ=0 F?2=32;F?3=16;G.m
720 IFJ<#50 F?2=16;F?3=64
730 IFJ=#70 F?2=16;F?3=96
740 IFJ=#B0 F?2=16;F?3=192
750 IFJ=#50 F?2=32;F?3=64
760 IFJ=#90 F?2=32;F?3=96
770 IFJ>#90 F?2=32;F?3=192
780 G.m
790
800 CLEAR OESIREO GRAPHICS MOOE
810
820xLI.G;J=?K-48;IFJ<00RJ>8P.$7;G.x
830 X=(J+1)/2;CLEARX;IFJ%2 COLOUR0
840 ?N=?B;G.m
850
860 SQUARES IN MODE 1A
870
880zFORJ=0TOH;IFJ%Y=0 X=X+1
890 A?J=(J+X)%Z*P;N.;G.m
900
910 ANIMATED TRAIN
920
930cCLEAR3;?B=16;?N=16;F?6=#84;F?2=16;F?3=64
940 GOS.t;COLOUR2
950 J=4;MOVE19,29;GOS.d
960 J=6;MOVE24,35;GOS.d
970 T?1=T;F?1=T+4;LINKE;LINKL
980 GOS.t;COLOUR2;J=3;MOVE17,27;GOS.d
990 J=5;MOVE21,32;GOS.d
1000 J=7;MOVE28,40;GOS.d
1010 00 LI.LL0;U.B?1<255;F?6=T;G.m
1020dFORX=1TOJ;PLOT1,J,0;PLOT0,-J,0;PLOT0,0,1;N.;R.
1030
1040 PICTURE IN MODE ZERO
1050
1060aP.$12;?#E1=0;CLEAR1;?B=0;?N=0;F?6=T
1070 P."@G>=K@@?<<<<@?<<<?@?<<<?@?K@@@@?"
1080 P."@8@@4/@?@@@@@?@@@?@?@@@?@?4/B@@?"
1090 P."?0000?@?@@@@@?@@@?@?@@@?@?4/B@@?"
1100 P."?@@@@?@?@@@@@?@@@?@?000?@?@P=K@?"
1110 P."?@@@@?@?0000@?@@@?@?P=K@@?@@@4/?"
1120 P."@@@@G>=K@@<<?<<@?<<<?@?/B@A@?@@@"
1130 P."@@@@8@@4/@@@?@@@?@@@?@?P=O> ?@@@"
1140 P."@@@?0000?@@@?@@@?@@@?@?@@@@@?@@@"
1150 P."@@@?@@@@?@@@?@@@?@@@?@?@@@@@?@@@"
1160 P."@@@?@@@@?@@@?@@@?000?@?@@@@@?@@@"
1170 A?32=31;A?#0B=31;A?#E3=31
1180 F?2=32;F?3=16;T?6=64;LI.C;GOS.b
1190 FOR J=1TO5;WAIT;LI.O;N.;GOS.b
1200 WAIT;LI.I;GOS.b;WAIT;LI.M;GOS.b
1210 T?6=128;LI.C;GOS.b;WAIT;LI.I;GOS.b;WAIT;LI.M;GOS.b
1220 WAIT;LI.U;GOS.b;WAIT;LI.U;GOS.b
1230 FOR J=1TO128;LI.L;N.;P.$30"READY"
1240 FOR J=1TO59;T?6=128;WAIT;WAIT;WAIT;LI.C;N.;G.m
1250bFOR J=1TO60;WAIT;N.;R.
```

Do you want control of text size in all graphic modes?

Do you want text written up-side down or on its side?

Do you want a user-defined character in several colours?

If so, read on.

TEXT VARIATIONS

Although the *User Guide* states that only in mode 7 can you have double height characters, there is a simple routine which allows an increase in text size for all graphic modes from normal until a single letter fills the screen. This is particularly useful if you want a larger text size with the highest resolution graphics in mode 0.

And it works equally well with user-defined characters and allows you to use all the colours available in the mode you are in to within one character.

The following Basic routine shows how (program 1). It uses the function POINT to examine the letter to be magnified which is placed at TAB(0,0). This is converted to a graphics routine which draws the character in a larger size elsewhere on the screen.

This is sufficiently fast for headings and static displays but for a rapid display a short machine code programme is needed. In this the OSWORD call with A=9 should be used to examine the pixels that make up the printed character. The equivalent of the Basic PLOT routine for drawing the magnified characters by filling triangles is entered via

```
VDU25,85;X;Y
```

Returning to program 1, insert line

```
125 Y%= -Y%
```

This will produce text upsidedown! Now use

```
LIST 190,220
```

Use the copy facility to reverse the position of the X axis and Y axis in each statement. The text should now be written on its side from bottom to top. Simple routines thus allow any size of text to be placed in position on the screen.

A boon from abbreviations

Abbreviations can be a boon for loading, saving and running machine code programs. "*SAVE", for example, shortens to "*S." – though it must be followed by a filename and various addresses and so is not much of a saving.

Much more useful is knowing that "*LOAD" and "*RUN" can be shortened to "*L." and "*R.". And if you are using cassette files but do not want to specify the filename, there is no need to follow these commands with double quotation marks. In fact "*R." can be abbreviated still further to "*/".

The equivalent abbreviations for Basic programs are "LO.", "SA." and "CH." which, since they have to be followed by a filename, or at least double quotation marks, are hardly worth bothering with. Two other abbreviations worth knowing are "*E." for "*EXEC", and "*SP." for "*SPOOL". but both must have either a filename or a pair of quotes, except when "*SPOOL" is being used to close a spool file.

It is also handy to know that "*CAT" can be entered as "*.". This is useful in its own right, but especially so when you realise it can be used as an equivalent of "*MOTOR1" to switch on the cassette rewind motor. The equivalent of "*MOTOR0" is then just ESCAPE, since this turns the motor off again.

Program 1

```
10  MODE 7
20  INPUT TAB(0,5) "What mode do you want?" r

30  IF NOT (r=0 OR r=1 OR r=2 OR r=4 OR r=5)
    THEN PRINT "Not GRAPHICS MODE":GOTO20

40  MODEr
50  INPUT TAB(0,5) "How much bigger do you want
    text?"n
60  P% = 0 : O% = 900-32*n
70  CLS
80  REPEAT
90  VDU30

100 R$ = GET$ : PRINT R$

110 FOR H% = 991 TO 1023 STEP 4
120 Y% = H% -991
«/) FOR G% = 1 TO 16 STEP 2
140 X% = G% : M% = 2
150 IF r = 1 OR r= 4 THEN X% = G%*2: M% = 4
160 IF r = 2 OR r= 4 THEN X% = G% *2: M% = 4
160 IF r = 2 OR r = 5 THEN X% = G%*4 :M% = 8
170 A= POINT (X%, H%)

180 GCOL 0,A
190 MOVE (P% + (X%*n)), ((Y%*n)+O%)
200 MOVE (P%+(X%*n)+(M%*n)),((Y%*n)+O%)
210 PLOT85, (P%+(X%*n)),((Y%*n)+W%+4*n)
220 PLOT85,(P%+(X%*n)+(M%*n)),((Y%*n)+O%+4*n)
230 NEXT G%
240 NEXT H%
250 P%=P%+X%*n
260 IF P%+X%*n>1280 THEN P% = 0:O%=O%-32*n

270 IF O% > 1 THEN UNTIL FALSE

280 VDU31,0,31

290 FOR B% = 1 to n
300 VDU 10
310 NEXT B
320 O% = O% + 32*n
330 UNTIL FALSE
```

Notes

30 Checks value r is a valid graphics mode. If not valid returns to Line 20

40 Enters graphics mode

50 n will be the multiplication factor

60 P% locates character on X axis, Q% on Y axis. Q%=900-32*n ensures sufficient space above the starting point to draw the full height of the character

90 This is used to home cursor so that the next PRINT will place a character in TAB(0,0) – in Line 100

100 GET$ holds the programme until you type a key. If you type more than one key they will be stored in sequence until the programme returns for them.

110-160 Will locate in turn each pixel that makes up the character

140-160 This depends on which mode you are in. X% and H% are the X axis and Y axis reference for each pixel
X% and Y% are the axis references for each pixel
where the bottom left pixel is X%=1 and Y%=1

170 A now becomes the foreground colour of the pixel being examined.

180 Use the same colour as found in line 170

190-220 This routine draws the magnified pixel starting at position P%, Q%. The position references X% and Y% from lines 120 and 140 are multiplied by the magnification factor n from line 50

230-240 Repeat this process for each pixel in the printed character

250 Calculate where the next enlarged character should start.

260 If there is not enough room to draw the next character start a new line: move down enough to fit the height of the magnified character

270 If this new line is on the screen go to line 80. REPEAT to repeat the whole sequence for the next character

280 Move cursor to bottom left corner to initiate screen scroll. (NB. The *User Guide* suggests VDU31 should use graphic X and Y values. My computer EPROM 0.1 responds to TAB values)

290-310 Scroll the screen until the next character will fit

320 Reset value of Q%

330 Go to line 80. REPEAT, to repeat the whole sequence for the next character

DUMB TERMINALS

by Paul Beverley

If you want to use the BBC microcomputer as a dumb terminal to link up to a mainframe computer, you will probably have seen R.C. Rand's program in the July issue of *Acorn User*.

It was intended for use with the 0.1 operating system and there are a number of FX/OSBYTE calls which make it easier to write a dumb terminal program using the 1.0 system.

The program given below uses OSBYTE calls throughout and works when the Tube is fitted.

It uses the simplex mode – anything typed on the keyboard is not only sent down the RS423 but also echoed to the screen.

If you want it to work in the duplex mode where the device with which you are communicating echoes all the characters sent to it, simply delete lines 240 and 250.

A choice of OSWRCH or OSASCI at lines 180 and 250 determines whether a linefeed character is generated with each carriage return.

Program

```
 10 REM Dumb Terminal Program
 20 REM P.E.Beverley  6/8/82
 30 REM Only works on O.S. 1.0
 40 REM Works even if Tube fitted.
 50 OSASCI=&FFE3
 60 OSBYTE=&FFF4
 70 OSWRCH=&FFEE
 80 DIM CODE 50
 90 FOR J=0 TO 2 STEP2
100   P%=CODE
110   [OPT J
120   .RS423
130   LDA #&91
140   LDX #1
150   JSR OSBYTE\character in RS423 buffer?
160   BCS keyboard
170   TYA
180   JSR OSWRCH\or OSASCI for CRLF
190   .keyboard
200   LDA #&91
210   LDX #0
220   JSR OSBYTE\character in keyboard buffer?
230   BCS RS423
240   TYA
250   JSR OSWRCH\or OSASCI for CRLF
260   LDA #&8A
270   LDX #2
280   JSR OSBYTE\Put character in RS423 output buffer
290   JMP RS423
300   ]
310   NEXT
320 *FX 7,7
330 *FX 8,7
340 *FX 2,1
350 CLS
360 CALL CODE
```

FIREWORKS


```
 LOAD"8SPRL"
>L.
  100REM CATHERINE WHEEL
  110REM J.TELFORD.
  120:
  130ON ERROR GOTO1300
  140MODE7
  150mode=5
  160colours=3
  170:
  180REM CHECK FOR MODEL A
  190:
  200IF HIMEM = 31744 THEN mode=2:colou
rs=7
  210:
  220REM USE BEST MODE+COLOURS
  230:
  240MODE mode
  250:
  260REM SET UP SPEED,RADIUS,
  270REM CURVE FACTOR AND
  280REM INITIAL ANGLE OF TURN
  290:
  300S%=200
  310R=896
  320CF=10
  330turn=0
  340:
  350REM TURN OFF CURSOR
  360:
  370VDU23;8202;0;0;0;
  380:
  390REMEMBER TO CENTRE THE ORIGIN
  400REM ON THE SCREEN.
```

```
  410:
  420VDU29,640;512;
  430:
  440REM MOVE TO START OF CURVE
  450REM WITHOUT UGLY LINES
  460:
  470MOVE R*COS turn,R*SIN turn
  480:
  490REM WE NEED 351 SEGMENTS
  500:
  510FOR C%= 0 TO 351
  520:
  530REM CHANGE COLS FOR EACH SEGMENT
  540:
  550GCOL0,C% MOD colours+1
  560DRAWR*COS turn,R*SIN turn
  570DRAW(R-50)*COSturn,(R-50)*SINturn
  580turn=turn+PI/CF:R=R-CF/4
  590PLOT85,R*COS turn,R*SIN turn
  600PLOT85,(R-50)*COS turn,(R-50)*SIN
turn
  610NEXT:REM SPIRAL DONE NOW
  620REM PRESS ANY KEY TO SPIN WHEEL
  630:
  640a$=GET$
  650FOR G= 1 TO colours
  660FOR F=1 TO colours
  670:
  680REM CHECK FOR SPEED UP OR DOWN
  690:
  700PROC_SPEED
  710:
  720REM CHECK FOR REVERSE DIRECTION
```

```
  730REM AND CLOSE LOOPS BEFORE EXIT
  740REM IF FOUND
  750:
  760IF speed$="R" THEN G=colours:F=G:G
OTO890
  770:
  780REM H MUST BE GREATER THAN 0
  790REM TO KEEP COLOURS RUNNING
  800:
  810H=F
  820GCOL0,F
  830IF F-G<1 THEN H=F+colours
  840:
  850REM CHANGE EACH LOGICAL COLOUR
  860REM CONSECUTIVELY
  870:
  880VDU19,F,H-G,0,0,0
  890NEXT
  900:
  910REM DELAY FOR EFFECT REQUIRED.
  920:
  930FOR WT=1 TO S%:NEXT
  940NEXT
  950REM IF NO REVERSE KEEP SPINNING
  960IFspeed$<>"R"THEN650
  970:
  980REM REVERSE SPIN
  990REM LINES 610 TO 730
 1000REM PREFORM AS 380 TO 590
 1010REM BUT COLOURS 'MOVE'
 1020REM IN OPP. DIRECTION.
 1030REM HENCE NOT REMed.
 1040:
```

```
 1050FOR G=colours TO 1 STEP-1
 1060FOR F=colours TO 1 STEP-1
 1070PROC_SPEED
 1080IF speed$="R"THEN G=1:F=1:GOTO1130
 1090H=F
 1100GCOL0,F
 1110IF F-G<1 THEN H=F+colours
 1120VDU19,F,H-G,0,0,0
 1130NEXT
 1140FOR WT=1 TO S%:NEXT
 1150NEXT
 1160 REM IF NO REVERSE KEEP SPINNING
 1170IFspeed$<>"R"THEN1050
 1180REM REVERSE SPIN
 1190GOTO650
 1200DEFPROC_SPEED
 1210speed$=INKEY$(0)
 1220IFspeed$=">"AND S%>0 THEN S%=S%-10
 1230IFspeed$="<"ANDS%<400THENS%=S%+10
 1240IF speed$="="THEN S%=200
 1250ENDPROC
 1260:
 1270REM MODE 7 TO RESET RANDOMISED
 1280REM COLOURS, AND READABLE TEXT.
 1290:
 1300MODE7:REPORT:PRINT" at line ";ERL
 1310END
 1320REM USE KEYS.....
 1330REM >    TO SPEED UP.
 1340REM <    TO SLOW DOWN.
 1350REM =    TO RESET SPEED.
 1360REM R    TO REVERSE SPIN.
 1370REM HOLD R DOWN TO FREEZE WHEEL
>
```

The multiple picture show

Picture this – being able to store four independent graphics screens in 32k, and switch between them. Peter Goode explains the principle

Imagine the advantage of being ables to switch instantly from one picture to another on your BBC microcomputer.

Many games require a complex, high-resolution playing field, for instance, and drawing one takes an annoyingly long time – even with the BBC machine's fast graphics.

How pleasant, then, for your program to be able to draw a complex maze while you are busy reading – or understanding the instructions for the game. And it is possible, on both model A and B machines, for two effectively independent screens to exist side by side, and for the program to choose which one the user can see.

No incomprehensible machine code or peek and poke routines are necessary. Standard graphics commands can be adapted to provide complete control over two screens, or up to four on the model B machine.

First let me explain how the BBC computer stores graphics information.

In mode 5, the only mode which can provide two screens on the model A, each of the screen's 40960 dots can be assigned one of four colours.

Table 1. Binary code for colours

A	B	
0	0	= Colour 0, default black
0	1	= Colour 1, default red
1	0	= Colour 2, default yellow
1	1	= Colour 3, default white

Two binary bits per dot are needed to store this much information.

Each of these bits can be either 0 or 1, and only two are necessary to give one of four colours.

The binary numbers to represent the four colours are shown in table 1. The two bits have been assigned arbitrary labels, A and B.

If we choose colour 1 as 'screen 1 foreground colour' and colour 2 as 'screen 2 foreground colour', ignoring bit A allows us to draw in colour 1 on a background of colour 0. We can ignore bit A quite simply by executing the command:

```
VDU 19,2,0,0,0,0
```

This tells the computer to set colour 2 to black, ie the background

```
1000 DEFPROCSCREENONE
1010 VDU 19,3,C1,0,0,0:VDU 19,2,C0,0,0,0:VDU 19,1,C1,0,0,0
1020 S=1:PROCPLOT
1030 ENDPROC

1040 DEFPROCSCREENTWO
1050 VDU 19,3,C2,0,0,0:VDU 19,1,C0,0,0,0:VDU 19,2,C2,0,0,0
1060 S=2:PROCPLOT
1070 ENDPROC

1080 DEFPROCPLOT
1090 GCOL 1,S
1100 ENDPROC

1110 DEFPROCERASE
1120 GCOL2,3-S
1130 ENDPROC

1140 DEFPROCINIT
1190 MODE 5
1200 C0=0:C1=7:C2=3
1210 PROCSCREENONE:PROCPLOT
1220 ENDPROC
```

colour, thus making all lines previously drawn in colour 2 invisible. The command:

VDU 19,1,0,0,0,0

followed by

VDU 19,2,3,0,0,0

will blank out lines drawn in colour 1 and restore those drawn in colour 2 to their original colour (yellow). Colour 2, of course, can be set to any colour desired.

To go into further detail would probably confuse. Nothing beats hands-on experience with computers so here are some working routines and examples. All require the procedures shown in program 1, so type them in before advancing any further.

The procedures perform the following tasks:

- PROCSCREENONE will display screen one and enable plotting on screen one.
- PROCSCREENTWO will perform the same task but for screen two.
- PROCPLOT will turn on plotting on the screen selected by S.
- PROCERASE will turn on erasing on the screen selected by S.
- PROCINIT switches to mode 5, screen one and enables plotting on that screen.

Try the following:

PROCINIT

The computer will switch to mode 5 graphics and text. You can now draw on screen one. Try entering:

MOVE 0,0
MOVE 1000,1000
PLOT 85,1000,0

This will cause the computer to draw and fill a triangle, in white.

PROCSCREENTWO

'No machine code or peek and poke routine necessary'

The triangle has vanished.

PROCPLOT
MOVE 0,0
MOVE 0,1000
PLOT 85,1000,0

A new triangle has appeared.

PROCSCREENONE

the old one appears again,

PROCSCREENTWO

the new one again.

The background and two foreground colours can be set to any colour (0–15) at any time by changing the values of C0, C1 and C2. For example, try:

C0= 1
C1 = 11
PROCSCREENONE

The first triangle re-appears but in flashing yellow and blue on a red background.

The screen one and screen two procedures work well for this, but if we want to draw on the invisible screen, and not the one the user can see, we simply use

S = 1
PROCPLOT

to draw on screen one, and

S = 2
PROCPLOT

to draw on screen two.

Erasing can also be done in this way using PROCERASE instead of PROCPLOT. For example:

```
PROCSCREENONE: S=2: PROCPLOT
MOVE 0,0:MOVE 1000,1000:
PLOT 85,0,1000
PROCSCREENTWO:REM make it visible.
```

If you are lucky enough to have 32k of RAM try adapting the procedures to create two screens of four colours or four of two.

Beeb link to second micro

Sir. Is it possible to link my ITT computer up to a BBC micro via the RS232 interface, and will the Tube or 1MHz extension bus allow this?

I am also using a disc and printer with my ITT system.

Mr J. Hughes
Liverpool

The BBC micro has an RS423 interface which is compatible with RS232C equipment, and will transmit over greater distances. The RS423 allows you to transmit or receive serial data, ie, to act as a dumb terminal with a larger computer transferring serial ASCII data. It also allows you to use a serial RS232C type printer.

The information the micro gives is as follows:

1 START BIT
8 BITS OF DATA
1 STOP BIT
NO PARITY

Some printers require either even or odd parity. therefore they will not work with the micro, however, there may be internal links which will give the printer the above format.

With the 0.1 machine operating system the micro will not receive serial data from another micro, using the simple *FX commands, but it will transmit. (See July *Acorn User* for which will allow the user to receive this information).

The version 1.0 will allow you to transmit and receive using the single FX commands which are available.

Serial data will consist of ASCII code which can be placed in either machine's RAM, therefore programs will only run on one of the machines because the basic and memory maps will be different.

The Tube will be a high speed data link from a second processor to the BBC micro. It probably won't allow you to connect another computer to this, but fuller details will be available shortly.

The 1MHz extension bus will allow you to connect Acorn's euro-cards to the micro. It will then be possible to add extra RAM cards to the micro without having to purchase a second processor.

Atom packs up on Basic

Sir. About 18 months ago I purchased an Atom micro, which after about three months of disuse refused to enter Basic on power up.

The display was a seemingly random collection of characters, and repeated depression of break did not produce a reset, neither did powering down and up repeatedly.

Examination of the break circuit shows no abnormality, and the PSU shows no unusual fluctuations. I have not tried directly manipulating the 650Z reset line (mainly as I'm not sure which pin carries it!)

Mr S. Calsy
Herts

Your machine will have to be returned to Acorn's service department, as with problems like this quite a bit of circuitry is used.

The actual break key could be at fault, the 8255 I/O chip could be at fault, ie, not accepting input from break key, or giving an incorrect clock frequency for 6502 (1MHz). If readers have any problems with their Acorn micros, the first port of call is the local dealer (see page 72).

Retail control systems take care of faults dealers cannot handle. The address is Gresham House, Twickenham, Road, Feltham, Middlesex TW13 6HA. If you need advice telephone TCS on 01-898 4761.

User group news – page 48

Computer theft in the night

Sir, Could you find room to tell readers that my BBC model B microcomputer, serial number ICL 006847 has been stolen. It disappeared during the night along with other goods when thieves broke into my home.

If anyone knows of its whereabouts, would they contact their local police, or let me know through the magazine.

To lose the computer when I had only had it four weeks is most upsetting. I was just beginning to enjoy it.

Roger Bishop
Kent

String errors

Sir, I have a program that inputs 10 series of 10 strings, 10 integer variables and ten floating point variables.

However, when the computer reads the data, it misses something in the sixth series, seventh string and gives an error message.

String number seven then contains peculiar things. How can I stop this happening?

Mogens Johannsen
Denmark

Entering the following few lines at the beginning of your program should make it work.

```
5 !&70 = &F5212048
6 !&74 = $6068
7 ?¾218 = 0
8 ?&219 = &70
```

Hot stuff

Sir, I have a model B BBC micro which gets hot from the power supply. Will this affect my micro, and will the power supply allow for the addition of a disc unit?

D. Hill
Birmingham

Sir, After running my BBC model B, which I have had for about a week, for several hours it began to give off the smell of warmed plastic. These fumes were obviously caused by the heat of the power supply unit, and the computer's ventilation holes were not obstructed in any way.

What I would like to know is whether this is just a temporary problem because of the newness of the machine, or if not, what can be done.

Mr D. Short
Cheshire

The linear power supply by its very nature gets hot, but this should not effect the running of your machine.

If it gives off fumes, there must be something wrong with the machine and it should be returned to your nearest dealer for checking.

When the micro is upgraded to take a disc interface at an approved service centre, the power supply unit is changed free of charge to a switched mode unit at the same time.

Pascal ROM

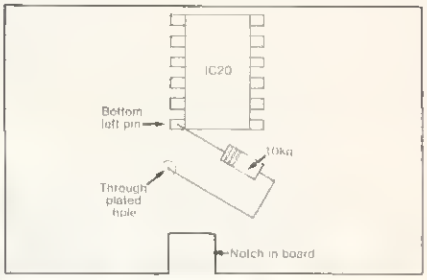
Sir, Is the Pascal ROM available yet? How much is the ROM, which dialect will it be?

Certain dealers have offered a model A with a 32k RAM. Am I right in believing that this computer will carry out any of the graphics and any other capabilities (other than the bus etc)? Would this run Pascal?

Mr C. Smith
Kent

We have no details on Pascal at present, but Acorn will be releasing a version probably in ROM. The exact date is not known, but it should be in spring next year. The cost has yet to be fixed.

With the additional RAM you will be able to obtain the extra graphics modes 0-3.



Buzz off

Readers who are fed up with a buzzing BBC micro can solve the irritation by connecting a 10kΩ resistor to IC20 as shown above. This chip is found on the main board near the front of the micro under the keyboard.

This alteration is only recommended for people who are used to working with electronics, as it will invalidate Acorn's guarantee. Dealers can also make this change.

Teachers with an urge to program

Sir, First of all, thank you for September's excellent *Acorn User* – I hope you can maintain the high standard you have set yourselves.

I am convinced that when the Department of Industry scheme for primary schools gets under way there will be a large number of teachers who will wish to involve themselves, in no matter how modest a way, in programming on their newly-acquired computers, rather than rely solely on commercial software.

As a primary school teacher with a BBC micro, I am interested in contacting other teachers (or parents) who would like to develop and exchange short, simple programs (simple from a programming point of view, that is) suitable for children aged 5 – 11. These would complement the more complex programs that will become available.

In addition, there could be an exchange of teaching suggestions, sample worksheets etc. for these programs, and for other, professionally-produced programs.

How formal and structured a group we might become would obviously depend on numbers interested and their views.

J.A. Sheard
31 Glen Court
Avenue Rd
Wolverhampton
WV3 9JN

It is the policy of *Acorn User* to publish such programs, and the Editor will give whatever support he can to encourage communication between teachers.

Musical micros

Sir, I am writing to ask whether BBC micros can be connected to conventional synthesisers to trigger sequences or store note and chord progressions. Most synthesisers now have sockets to trigger drum machines etc, and 'programmable' synthesisers with tape storage capability are astronomically expensive.

Brett Jordan
Middx.

Can anybody out there help? Mr Jordan added a p.s. to his letter. Apparently video game addicts in the US are known as 'vidiots'. We like it!

ELECTRONIC ARMS

Simon Dally experiences first-hand how computers help the long arm of the law reach further and faster to beat crime

Last month we looked at the growth area of computer crime. But the computer also has proved more than a match for many criminals and is now in the forefront of today's fight against crime.

The most common felonies involve motor vehicles: stolen cars, drunken driving, speeding, bald tyres and so on. Most vehicle information is stored on the infamous Swansea computer, run by the Department of the Environment.

In spite of the widespread criticism it attracted when first installed in the early 1970s – it cost several times the original estimate and the delays were appalling – it now seems to function very efficiently at least in one respect as I recently discovered.

One night as I was driving over Battersea Bridge I passed a police car and was waved down by a second on the other side. I was astonished to be greeted by the police officer in his 'just a routine check, sir' voice by my own name!

In the course of the 30 seconds it had taken to cross the bridge, my car number had been radioed to the computer and the details had been radioed back! Well, that's my story and I'm sticking to it . . .

From the police point of view, the most impressive technological advance in recent years has been the computerisation of the National Fingerprint Collection at New Scotland Yard.

Six years ago the system was entirely manual. The collection comprised more than 2½ million prints, being added to at the rate of 200,000 a year and dealing with about 2000 inquiries a day from around the country.

Since the average inquiry entailed making comparisons with 50 other prints – all stored on paper – the clerical effort involved was immense. Moreover, the prints could be consulted only by one officer at a time and the possibility of filing errors was all too likely.

The system the police have now adopted is Videofile and comes

page 70 ▶

▶ *from page 67*

from California. In essence it combines video techniques with sophisticated computer process control.

The computer stores the information in a digital database and keeps track of where each set of prints is on tape. The visual display uses a split-screen which magnifies the picture many times, and provides a resolution more than twice that of a standard TV screen. This enables suspects' prints to be shown simultaneously with the possible matching sets, enabling comparisons to be made quickly and by several officers at once.

The computerisation of fingerprints and criminal records has clearly saved a vast amount in terms of manpower and physical space. It is, however, no panacea – as the mounting crime figures and relatively low detection rates testify.

'Computerisation is, however no panacea'

But the police are understandably reticent when it comes to discussing their use of computers. Every few months a story seems to break in the popular press of a breach of security in their system which gives an unauthorized person access to confidential information. The press likes to imagine sinister computers 'chatting' to each other.

On the other hand, the press put up a tremendous howl about police incompetence during the hunt for the Yorkshire Ripper – and after his capture. But while the police have since conceded the investigations did become bogged down in paperwork, they point out that they tried to use the police national computer and found it too difficult to put all the information on to it.

And there are the real and more worrying fears of what the security services and Special Branch get up to with their computers. This familiar and very serious problem will not be easily resolved.

SEPTEMBER QUIZ RESULTS

We received over 150 correct entries for our codebreaking competition in the September issue The solutions, for those who tried and failed, are printed on the right.

In the second example, the keyword was 'JANE AUSTEN' and the text was from 1 *Corinthians* XIII.

We apologise for the widespread gremlin who slipped in a misprint and inserted two wrong spaces – this didn't seem to put any of you off and in the real world coding operators make errors too! Our thanks to Brian Gill of Oldham for a most entertaining discourse on the nature of *Gremlinus Substituens*.

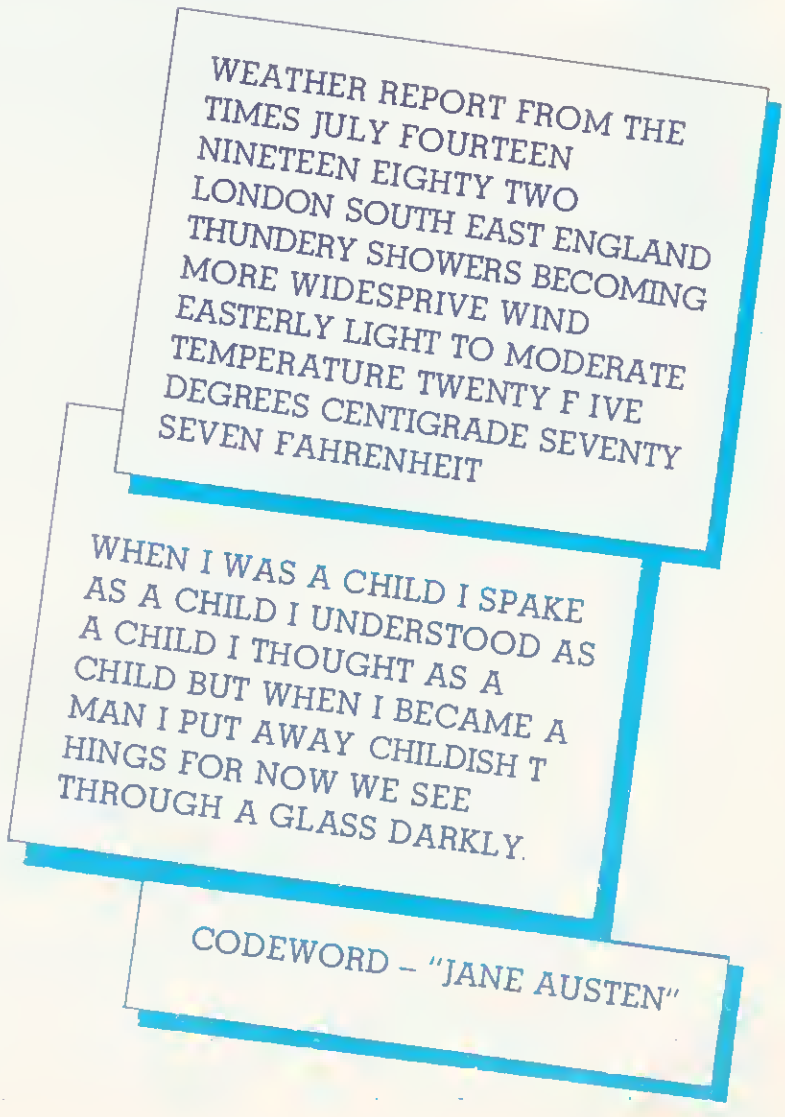
The winners, chosen at random, were

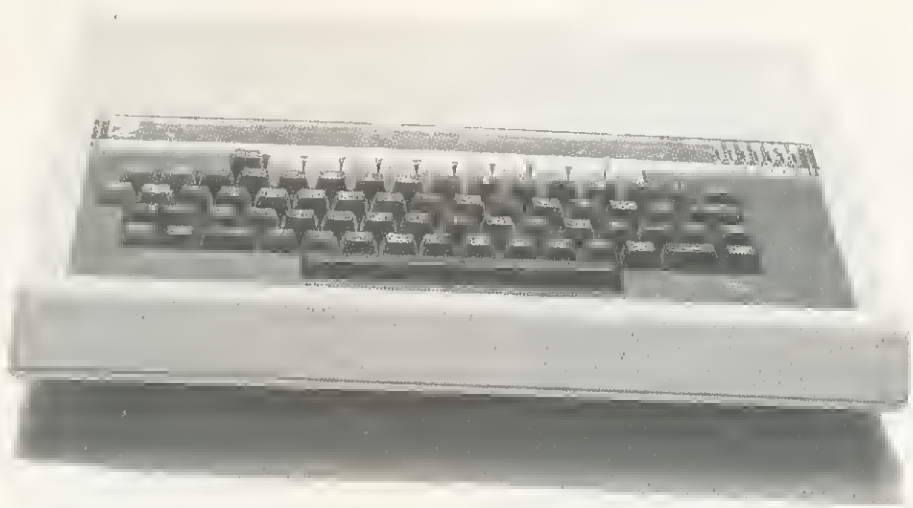
Anna Rose Surguy of Reading, Berks
Dave Woolcock of Preston, Lancs
Peter Gordon of Currie, Lothian

They all win £20-worth of programs for the BBC micro from Acornsoft.

To those snivelling wretches who complained about the competition being too easy, please bear in mind that we have to try to strike a balance for our readers, many of whom are totally new to microcomputers and have relatively modest mathematical abilities: we aren't trying to run the house journal of Mensa.

However, please stay with us: we are planning something which should silence all your carping noises for a while!





WIN A BBC MICRO

A BBC microcomputer worth £299 is the prize in this month's competition set by Simon Dally

A puzzle editor once set a problem as follows: find a nine-digit-number which contains all digits from one to nine inclusive. The full number is exactly divisible by nine; knock off the right-hand digit and the number is exactly divisible by eight; knock off another digit and the result is exactly divisible by seven, etc – until you are left with one digit which is, of course, exactly divisible by one.

Pleased with his research, our editor declared that there was only one number which satisfied these conditions. But to his horror, a stream of abuse landed on his desk claiming there were several solutions. Your task is to check the puzzle out. Was the editor right, in which case what is the solution? Were the readers right, in which case how many solutions are there?

Entries should be sent to the Competition Editor, Acorn User, 53 Bedford Square, London WC1B 3DZ, to arrive by December 1

Official Acorn Dealer List in the UK

Acorn dealers stock and service the Atom computer, Acorn systems and Acornsoft software. Many also offer service facilities for the BBC micro and these are marked with an asterisk. The Acorn dealer not only sells computers and peripherals but provides vital customer support. Most have recently attended technical seminars in Cambridge to ensure that they deal effectively with customers' enquiries. In addition, Acorn supply dealers with specific test and diagnostic equipment to speed fault finding.

LONDON
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01-247 3453
Canonbury Radio
01 226 9392
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0223 358757

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*First Byte Computer
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96 365280

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Paignton
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*Arden Business
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Emprise Ltd Chelmsford
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Emprise Ltd Clacton-on
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*Emprise Ltd Colchester
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0632 761168

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021-550 8036
Richard Morris
(Electrical) Ltd Walsall
021-429 1161
*Taylor Wilson Systems
Ltd Solihull
05645 5192
Typewriter Centre
Coventry
0203-78783
Typewriter Centre
Walsall
92-27589
Typewriter Centre Sutton
Coldfield
021 355 6789
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Systems Ltd
Stourbridge
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*Customised Electronics
Ltd Leeds
0532-792332
*Dalton Computers &
Supplies
Sheffield S10
0742 755105
*Dalton Micro Centre
Sheffield S7
0742 585490
*Elec Services Ltd
Bradford
0274 481371
Gwen's Telecom
Barnsley
0226 5031
Micro Power Leeds LS7
0532-683186
*Superior Systems Ltd
Sheffield 1
0742-755005

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*Cardiff Microcomputers

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Ltd Leven
0333-21870
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McQueen Systems Ltd
Galashiels
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Blairgowrie
A. Dundee
0382 2436/7

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*C.E.M. Microcomputer
Services Belfast
0232 44171 4/5/6

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*Channel Data
Processing Jersey
St Helier
0534-24333/72897

ISLE OF MAN
*Typestyle Ltd Onchan
0624 25890/24650

ISLE OF WIGHT
Excell Bembridge
098 387 2578

Function key programs

```
 10 *KEY0MODE6|MVDU19;4;0;|M|N|ML.|M
 20 *KEY1RUN|M
 30 *KEY2LIST07|M
 40 *KEY3LISTOO|M
 50 *KEY4$&DF0="
 60 *KEY5SAVE$&DF0|M
 70 *KEY6LOAD"";M
 80 *KEY7CHAIN"";M
 90 *KEY8VDU12,23;12;0;0;0;|M
100 *KEY9AUTO
110 *KEY10LD|M
120 INPUT N$
130 IF N$="" THEN N$="PROG"
140 $&DF0=N$
```

Ten ideas for function keys

When developing programs on the BBC microcomputer it is helpful to have the function keys programmed to give frequently used commands. Everyone has their own favourites, such as RUN, LIST07 LISTOO, LOAD"", CHAIN"", AUTO, and for the break key, OLD – but some are not.

Above key 0 on my computer it just says LIST, but this is actually composed of a number of commands. Select mode 6, change the background colour to blue – giving the effect of individual lines being separated by black lines as seen on BBC's *Computer Programme* – set paged mode (CTRL N), add an extra carriage return and then list the program.

The extra carriage return gives a total of three lines above the first line of the program so if you want to look at the first page of a long program and press ESCAPE, you do not lose the first line off the top of the screen.

Some explanation is also needed for keys 4 and 5, and along with those you will need to refer to lines 120 to 140 of the setting-up program. When you want to SAVE a program you need to specify a filename (unlike LOAD and CHAIN) which makes using a function key a little awkward.

My first idea was to put SAVE" on to a function key and then add the name and close the quotation marks from the keyboard. I then tried having SAVE N$M on a key and declaring the name by typing N$ = "FRED" or whatever. The problem here is that N$ is a dynamic variable and disappears as soon as you play around with the program.

I finally hit on the idea of storing the name in a free chunk of memory in the workspace below the program and accessing it by using string indirection.

So from the initialisation program or from the keyboard you can set up the filename and leave it until you move on to another program.

Thus to save a program twice and then rewind the tape consists of: press key 5, start the recorder, press RETURN, key 5, RETURN, and then do a "*. RETURN" (an abbreviation for *CAT).

Having rewound the tape it is possible to do a catalogue to verify the program, and when finally rewound, press ESCAPE to turn off the motor.

This explains the lack of *MOTOR1 and *MOTOR0 from the function keys – it is so easy to type in "*.RETURN" and then press ESCAPE, that it is not worth using up function keys on it.

But a word of warning. Since I have chosen &DFO which is just below the program at &E00, if you try to use a filename of more than 15 letters you will overwrite the beginning and get a "Bad Program" prompt!

The only other key that needs any explanation is key 8. This clears the screen (VDU12) and then you can use the advanced graphics call VDU 23, 0 to tell the VDU driver chip, which is programmable, that video RAM starts at page zero.

This has the effect of displaying a 'bit-map' of zero page, all the workspace and some of the program area depending on which mode of graphics you are in. But it only works effectively in a two-colour mode (not mode 7) and is most easily visible with white on a blue background.

It can be set up by pressing key 0, ESCAPE (if it's a long program to be listed) and then key 8. This view of the computer workings is not only fascinating ut also a useful diagnostic aid.

Paul Searle

EDITING FROM TOP TO BOTTOM

Editing programs on the BBC microcomputer is easier if you remember that when the text cursor is at the bottom of the screen and you want to edit a line in the upper half, it is quicker to move the cursor down rather than up.

As it goes off the bottom of the screen it reappears at the top. Indeed if you have three or four consecutive lines to edit it is worth pressing the RETURN key until the first line to be edited is at the top of the screen. To reach it then only requires a single press on the cursor down key.

Having finished editing, you press RETURN, and this brings the next line to the top of the screen and again only needs a single cursor down to reach it.

FIGHTING BACK

Struggling with a family of computer maniacs is no joke, but **Mrs Ronnie Rowsell** finally gets some joy

The day after the micro had arrived, a man came to repair the television. The rest of the family were greatly cheered, but I wasn't bothered, because the mono set was the only one I had access to.

A few days later the tribe organised some sort of rota system for using 'Brains' (the chosen name). The system and the machine seemed to both work smoothly. I was secretly becoming interested in joining in – my curiosity was getting the better of me. But I couldn't use the thing because I didn't know how to and it would take too long for a 'thick' housewife to learn.

During the day I would often dust the keyboard. That may sound rather boring, but at least I had no one telling me that it wasn't my turn, or that they wanted to show me something.

I noticed that the keys were positioned in exactly the same way as the typewriter I had tried so hard

to master when I was at college. So I spent the rest of the week pretending to type 'Now is the time for all good men to come to the aid of the party', the only thing I had ever managed to type at speed.

While having breakfast a week later it dawned on me that everyone in the house knew how to work the computer but me. They had such bags around their eyes from programming all night long that they looked like a family of pandas. It was time I did something to learn.

I thought about this computer problem a great deal, and it wasn't until I was saying goodbye to the girls at the school gate that I decided what had to be done. By 9.15, I was back at home sitting in front of Brains, saying in a very determined voice: 'To hell with the washing up, cleaning, cooking, shopping, ironing and other such mundane chores'.

I was going to do something completely different today. I was going to teach myself how to use this dreaded computer. With all the confidence in the world, I cracked my fingers like a cinema safe-breaker, switched on the plug sockets, and turned on the television.

Then I hit snag number one. The screen was a mass of fuzz, with matching sound. I realised my task wouldn't be easy, so I did what every other stay-at-home housewife would and pressed all the buttons on the keyboard. Surprisingly, nothing happened. Being the level-headed, quick-thinking person that I am, I decided to read the instruction manual.

I had a slight problem here because all computer books look the same. So I started at the top of the pile and worked my way through the 20 or so books littering the floor around the computer. The first time through I had no success at all. I was expecting the book to have printed on the cover: 'I am the book you are looking for'. It didn't so I went through the pile again, more thoroughly, and hey presto: *User Guide*! I looked through the index and realised this was my kind of book. It even had a section on how to unpack it properly. But as it had already been unpacked I didn't read that section, but I made a note of the page number in case we ever bought another one.

The next section was called 'Getting going' and half way down the page I learned of the on/off switch on the back of the computer. I pressed it with some care and completely defuzzed the screen.

The I hit snag number two. What in the world did BBC Computer 32K mean? At this point I decided to stop to have a cup of coffee as it was now 10.30, the house was still a pigsty and all I had done was to switch the silly thing on.

Over coffee the guide began to give up its mysteries to me. I learned that any of the keys could be pressed while the computer was turned on without fear of my being struck by lightning. Things could be rubbed out by pressing the delete button, an important feature when the typist is me.

I spent the rest of the morning filling the screen with, you've guessed it, 'Now is the time for all good men to come to the aid of the party'. I had not lost my touch.

'What in the world did BBC Computer 32K mean?'

After a short break to flit through the house with the old vacuum cleaner and feed the starving children home for their lunch, I returned to the more interesting subject of the day.

Switching on was now a mere formality, and once again I was face-to-face with BBC Computer 32K. I wanted to load the *Welcome Tape* as I knew it held some nice programs illustrating the capabilities of this machine.

Following the instructions in the book I tried to get it to print on the screen. 'Adjust your volume control until a message is printed on the screen telling you that the setting is correct', said the guide. But I couldn't get it. I tried and tried but with no success and it was at this point that I realised I really did need the help of someone more qualified in operating computers.

I decided to, sadly, call it a day. But instead of admitting defeat to the others I would revel in my achievements.I would make myself a badge to tell the world that I switched on the BBC micro and lived. That way, if my husband had any heart, he would fall over himself to teach me the things he knew.

I went to pick the girls up from school and all my friends gathered round, intrigued by my badge. But I wasn't telling them anything about playing on computers all day and not having made the beds yet.

I approached the girls to ask them if they could help me learn in secret, then surprise Daddy at the end of the week. No, they said, they were too busy playing with their friends to stop and teach me anything. So it would have to be the great master himself.

The minute my husband arrived home from work the girls spilt the beans on the silly badge I was wearing and how I had tried to pursuade them to give me lessons in secret. So I threw the badge at him, followed by the burdens of my day.

He smiled a few times but never once called me a silly girl or any of those other things that loving husbands call their wives. When I finally wound up with 'and I haven't even had time to make the beds', he took me by the hand, turned on the computer, replaced a wire that he assured me was plugged in when he went to work that morning, and as if by magic there was the message I had nearly torn my hair out for earlier. Then he returned my slightly crumpled badge to its rightful place, and we went to eat dinner.

Things have definitely changed now. I have my own time on the computer in the evenings, with personal tuition from my husband. This enables me to practise during the day what I have learned the night before. And I still have time to make the beds!

I can take part in breakfast-time discussions. I feel part of the family once again. I read computer books in bed now instead of Catherine Cookson.

I have to admit that I do find some of them rather boring, but it makes living with a computer fanatic and his protégés that much easier.

Machine talk

▶continued from page 14

language programs, comments are essential. They help ensure that the programmer can return to a program later and understand what was designed.

In the program of figure 2 we might incorporate the following comments:

```
100 REM Assembly language program
110 REM sub 32134 on Model B for 15750
120 REM Put an 'A' on the screen
130 CLS
140 P%=&1500
150 [
160 LDA #65      \ ASCII for A
170 STA 15750    \ screen location
180 RTS          \ return to BASIC
190 ]
200 END
```

In a Basic program we often represent numeric values by giving them a variable name – more properly, we would say that we use named variables to which we assign specific values.

Labels can be used in assembly language programs to perform a corresponding function. In our simple program, a label might be used to refer to the screen location to which we shall write 'A'. This also provides a tidier solution to the problem of referring to the different locations required for the example to run on model A and model B machines. The program could then become:

```
100 REM Assembly language program
110 REM sub 32134 on Model B for 15750
115 SLOC=15750
120 REM Put an 'A' on the screen
130 CLS
140 P%=&1500
150 [
160 LDA #65      \ ASCII for A
170 STA SLOC     \ screen location
180 RTS          \ return to BASIC
190 ]
200 END
```

There are many more features of the assembler that are important to the assembly language programmer. Next month we will look at other features of the assembler, including positioning your program in memory.

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