

60p

YOUR COMPUTER

JANUARY 1983 BRITAIN'S BIGGEST-SELLING HOME COMPUTER MAGAZINE Vol. 3 No. 1

**How
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will turn today's
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**Reviews:
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tablets
Spectrum
software**

BBC turtle graphics

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JANUARY							1993
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YOUR COMPUTER

YOUR LETTERS

Acorn's Hermann Hauser accuses Sinclair of false claims; program gremlins.

NEWS

Casio's PB-100 personal computer; Vic double-Dutch memory; phoneme speech pack.

COMPUTER CLUB

Our man with the binoculars and spy camera visits Cheltenham's computerniks.

TOMORROW'S TECHNOLOGY

Meirion Jones traces the shape of computers to come which will put today's micros in the antique shop.

VIC ADD-ONS

Three ways of making the most of your Vic-20 reviewed by Ken Ryder.

GRAPHICS TABLETS

Now you can feed pictures straight into a BBC or Spectrum. Simon Beesley finds out if direct input is worth the money.

SPECTRUM SOFTWARE

Latest releases reviewed — including a Hobbit adventure which claims to use artificial intelligence.

VIC SPACE RUNNER

Can you escape cosmic oblivion and outrun the flying saucers?

SPECTRUM CROSS

If you can evade the juggernauts and man-eating spiders, Stuart Nicholls will still set his crocodiles on you.

FROGGER

The elusive last program of our ZX-81 games-writing series.

DRAGON MAZE

Enjoy this Keith and Steven Brain teaser on its own or incorporate it into your own labyrinth adventures.

BBC TURTLE GRAPHICS



Not only the first full Logo graphics listing published in a magazine but also on page 69 several turtle demonstration programs.

ATOM WORD PROCESSOR

Geoff Byrns presents yet another useful program for the Atom.

ZX-81 LIFE

A fast, machine-code version of the generation game.

ATARI CHARACTERS

The software to produce the games characters and alphabets of your choice.

ZX-81 CHESS

Part 2 of David Horne's series on writing a full chess program in 1K.

VIC MULTI-COLOUR GRAPHICS

Martin Howse looks at the Vic's potential for special graphics effects.

ZXTRA-WIDE TEXT

Add extra character to your ZX printouts.

BASIC DICTIONARY

Tony Edwards' Basic lexicon.

SPECTRUM ROM

David Horne shows you how to make real use of the disassembled ROM.

CONTROL

The attention focuses on standard interfaces in John Dawson's study of control.

RESPONSE FRAME

Your technical queries answered.

FINGERTIPS

Our pocket computer and calculator column.

SOFTWARE FILE

Ten pages packed with programs for the ZX micros, BBC, Atom, Vic and others.

COMPETITION CORNER

The result of November's puzzle and a new £15 competition. The Oric competition falls between pages 26 and 27.

Cover photograph by Stephen Oliver.

Editor

TOBY WOLPE

Assistant Editor

MEIRION JONES

Staff Writer

SIMON BEESLEY

Sub-editor

PAUL BOND

Editorial Secretary

LYNN COWLING

Editorial: 01-661 3144

Advertisement Manager

PHILIP KIRBY 01-661 3127

Advertisement Executives

BILL ARDLEY 01-661 8484

PETER RICE 01-661 8441

Midlands Office

KEITH SALT 021-356 4838

Northern Office

RON SOUTHALL 061-872 8861

Advertisement Secretary

JEANETTE MACKRELL

Publishing Director

CHRIS HIPWELL

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EDITORIAL

SO THAT WAS IT 82. If the most impressive failing of the Government's year-long £2 million crusade to promote new technology was that very few people were aware of its existence, at least we can rest easy in the knowledge that "information technology" — the woolly jargon coverall apparently invented for the occasion — never quite made it into everyday vocabulary either. The organisers claim that IT 82 was a success; after all, a recent MORI survey showed that 62 percent of the population had heard of IT. A similar proportion of the country may have heard of quantum mechanics but few will have any idea of its effects on current or future life.

That a few people did notice something going on can probably be put down to Information Technology year's incongruously low-technology methods for seeking publicity. Those whose memories have not been too badly shot away by machine code may recall, for example, the wind-powered yacht launched in the summer and symbolically named *Information Technology*, or perhaps with less of an effort remember last autumn's inordinately long postage stamps which made use of their extra length to fend off electronic mail and put over a brief hi-tech slogan.

In a few years time, when antique dealers are bidding fiercely at Sotheby's for a pristine ZX-80, certain professional historians will undoubtedly try to make a living out of computing as their specialist subject. One of these academics may well try to make out the case that IT 82 was responsible for the boom that took place in home computing the same year. It is the sort of mistake that historians should be forgiven for making — especially when one looks dispassionately at the astounding progress that has been made in the last year. A year ago home computers were silent, black and white, low resolution, twice as expensive, had half as much memory and — as a result of all that — were three times rarer than today.

Now home computers are something worth having and at a price that is within the reach of the ordinary person. In 1982 computing moved out of the hobbyists' domain and into the consumer market. That transformation has far more to do with the demystification of computing and the new technology than a whole decade of Information Technology years. The process of educating the public about the benefits and dangers of the new technology must continue indefinitely. If it does not, those historians of the future may remember IT 82 rather as they remember the Great Exhibition of 1851 — a magnificent display of all that was latest in science and technology followed by years of neglect and a rapid decline.



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Feb'83 approx. 120pp
0 8104 6279 6 approx. £8.20

CREATE WORD PUZZLES WITH YOUR MICRO-COMPUTER

by E.E. Mau.

A handy guide that enables home computer users to create their own acrostics, cryptograms, word-finds, quote-falls, fill-ins, and other word puzzles. There are 17 BASIC Programs for producing 25 puzzles - either blank puzzles with answer keys or printouts following puzzle magazine format.

Feb'83 approx. 180pp
0 8104 6251 6 approx. £12.35

CODES, CIPHERS AND COMPUTERS:

An Introduction to Information Security

by B. Bosworth

In addition to describing the fundamentals of secret communication, the book provides an understanding of computer security through computer cryptography. It details and illustrates traditional cryptography techniques developed before computers and discusses more recent concepts for the highest levels of information and data security, such as the NBS Data Encryption Standard and the Public Key Cryptosystem.

Nov'82 approx. 348pp
08104 51490 approx. £10.30

THE 8086/8088 PRIMER An Introduction to their Architecture, System Design, and Programming, 2nd Edition

by S.P. Morse

Written by the man responsible for the design of the 8086 microprocessor, this revised edition has been updated to provide novices and professionals alike with a thorough introduction to Intel's 8086 and 8088 microprocessors.

Sept'82
08104 6255 9

288pp
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by C.D. Sternberg

Designed for small businesses, micro-computer entrepreneurs, and independent consultants, this book provides an invaluable variety of application programs that will make your microcomputer pay for itself as soon as it enters your office. Includes over 70 complete programs that can be used on a daily basis for critical facets of a business operation. Each program can be easily modified to meet your business's specific needs.

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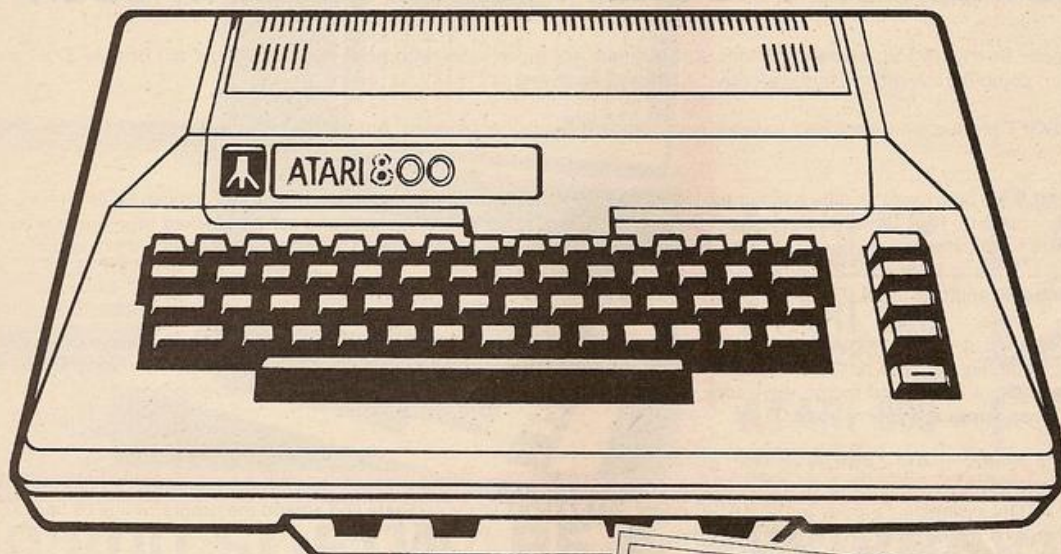
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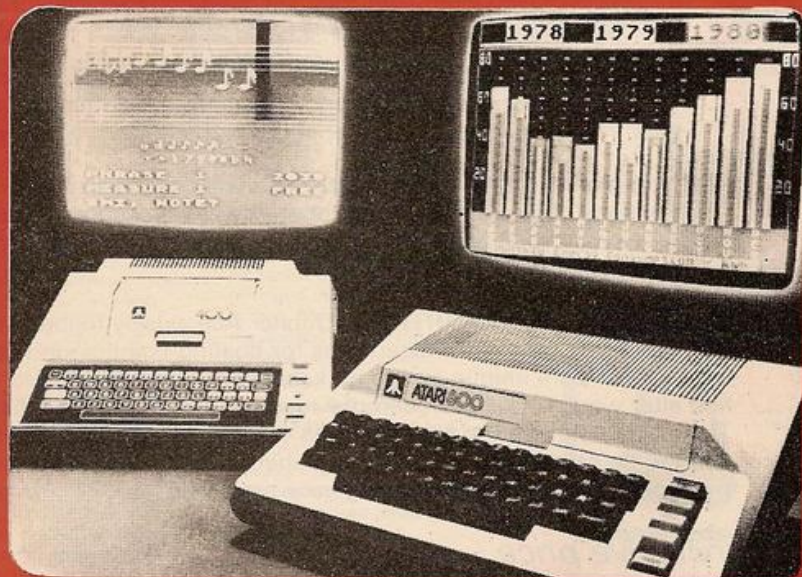
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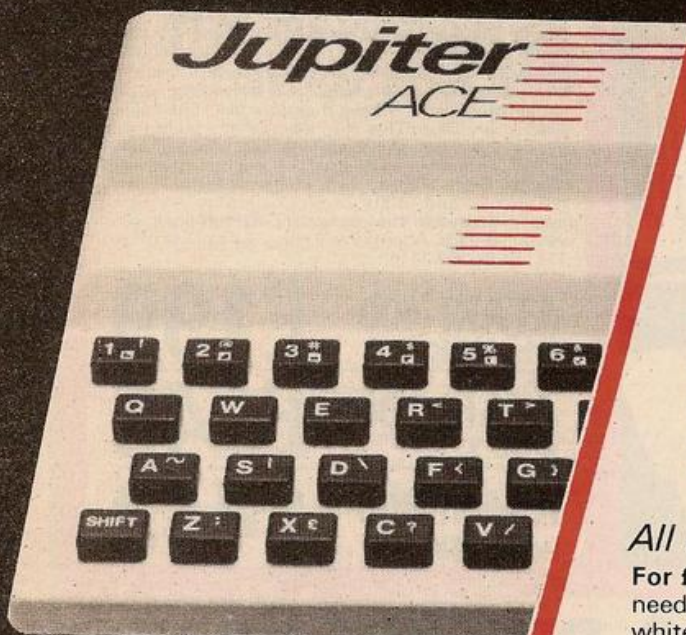
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YC0183 - Your Computer - January 1983

Jupiter ACE



"The Ace is
an excellent way
of using
FORTH"

Popular Computing Weekly

"FORTH is
an easy
language"

Byte

The Jupiter Ace personal computer runs in FORTH, an easily understood language, typically four times as compact and ten times as fast as BASIC. Before the Ace all personal computers used BASIC and FORTH was only available to a privileged few.

The Jupiter Ace also features a full-size moving-key keyboard, high-resolution graphics, sound, floating point arithmetic, a fast and reliable cassette interface and 3K of RAM.

If you own a personal computer you will be aware of the limitations of BASIC. You know how slowly your programs run and how quickly your computer's memory gets filled. The Jupiter Ace is your answer.

If you already know FORTH, the Jupiter Ace closely follows the FORTH 79 standard with extensions for floating point, sound and cassette. It has a unique and remarkable editor that allows you to list and alter words that have been previously compiled into the dictionary. This avoids the need to store screens of source, allowing the dictionary itself to be saved on cassette. Comprehensive error checking removes the worry of accidentally crashing your programs.

All inclusive price

For £89.95 you receive your Jupiter Ace, a mains adaptor, all the leads needed to connect to most cassette recorders and T.V.s (colour or black and white), a software catalogue and a manual.

The manual is a complete introduction to the world of personal computing and a course in FORTH programming on the Ace.

Even if you are a complete newcomer to computers, the manual will guide you step by step from first principles to confident programming.

The price includes postage, packing and V.A.T.

The Jupiter Ace is backed by a full 12 month warranty.

Available soon

Plug-on parallel printer interface.

For around £20.00 this will connect your Jupiter Ace to anything from high-speed dot matrix to letter-quality daisy wheel printers.

Plug-on 16K Memory Expansion

For around £30.00 you will increase the memory of your Jupiter Ace to 19K giving you instant access to enormous amounts of information.

Software

A catalogue will be sent with every machine, and includes, initially, programs for education and entertainment.

FORTH Finishes First!

Speed Comparison Chart showing times in seconds to perform one thousand operations.

Type of Operation	Jupiter Ace	BBC Micro	Vic 20	Spectrum	ZX81
Empty loop	0.12	0.67	1.3	4.2	17.7
Print a number	7.5	13.5	26	19	430
Print a character	0.62	1.3	3.1	7.5	24
Add two numbers	0.45	1.4	5.5	7.5	28
Multiply two numbers	0.9	1.6	6.5	7.5	32

Because of the difficulty in devising exactly equivalent programs, these measurements should only be taken as a guide.

only £89.95

Designed by Jupiter Cantab

Computer Designers Steven Vickers and Richard Altwasser played a major role in creating the ZX Spectrum and then formed Jupiter Cantab to develop advanced ideas in personal computing. The Ace is the result, another all-British computer to lead the world.

Technical Information

Hardware

Z80A running at 3.25 MHz.
8K bytes ROM
3K bytes RAM

Keyboard

40 Moving-key keyboard with auto repeat on every key and Caps Lock.

Screen

Memory mapped 32 column x 24 line flicker-free display with upper and lower case ascii character set.

Graphics

Chunky graphics (64 x 46 pixels) may be plotted, un-plotted or over-plotted (XOR operation). Also, the entire character set (128 characters and their video inverses) may be redefined allowing intricate shapes to be drawn with a resolution equivalent to 256 x 192 pixels.

Control Structures

IF-ELSE-THEN, DO-LOOP, DO-+LOOP, BEGIN-WHILE-REPEAT, BEGIN-UNTIL, all may be mixed and nested to any depth.

Cassette

Programs and data in the compact dictionary format may be saved, verified, loaded and merged. Blocks of memory can be saved, verified, loaded and relocated. All tape files are named. Running at 1500 baud, the Ace will connect to most portable tape recorders.

Expansion Port

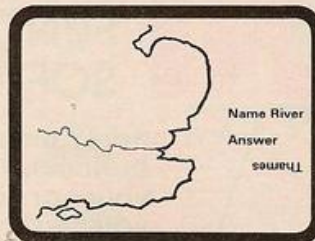
Contains D.C. power rails and full Z80 Address, data and control signals. May be used to connect extra memory and other peripherals. IN and OUT words allow port-based peripherals to be addressed.

Data Structures

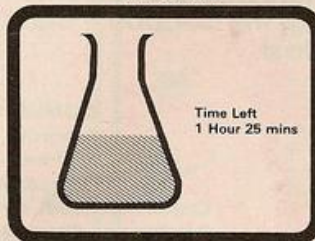
Integer, Floating point and String data may be held as constants, variables or arrays with multiple dimensions and mixed data types. There are no restrictions on names.

Sound

Internal loudspeaker may be programmed to operate over the entire audio spectrum.



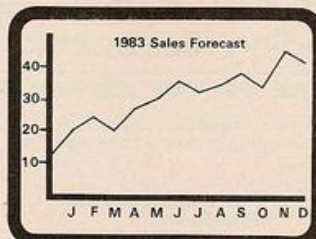
In Schools Teachers already know how quickly children take to computing, and the Jupiter Ace is an ideal introduction. FORTH is an easy and important language to learn and by making learning fun, the Ace can help to teach science, music and many other subjects.



In Laboratories For monitoring and controlling experiments, the Jupiter Ace has many advantages. The language is perfect, even the Jodrell Bank Radio Telescope is controlled in FORTH. The Ace expansion port enables it to be interfaced to almost anything, and the built in quartz timer allows experiments to run all weekend.



At Home The Jupiter Ace is powerful enough to play games as complex as Chess and with sound and high resolution graphics, action games written in FORTH will stretch your reaction speeds to their limits.



In the Office Stock control, Accounts and Financial forecasts are all possible on the Jupiter Ace. With a printer and extra memory attached you can do word processing as well.

"FORTH is very flexible"

"FORTH is compact"

Electronics and computing

"FORTH is in general very much faster than BASIC"

Computing Today

Programming in FORTH

Programming in FORTH

FORTH programs are constructed without line-numbers, as words which are defined in terms of other words that already exist. Consider the following definition of the word **STARS**. Comments are in parenthesis and have no action.

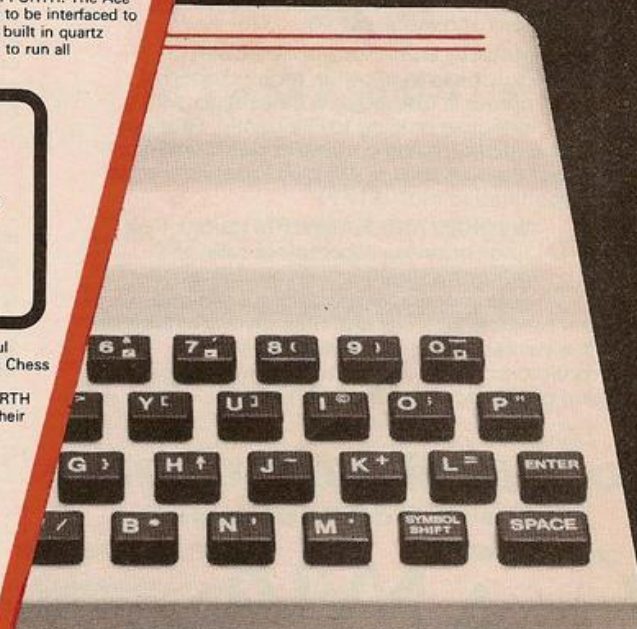
```
: STARS      (: starts word definition)
  " *** "    (print 3 asterisks)
  200 100 BEEP (play a note for
              100 mSecs)
;
```

The semi colon at the end finishes the word definition. Now, whenever you say **STARS** the computer will print out 3 asterisks and sound a short tone. (Notice how the word **BEEP** comes after the numbers it uses, 200 and 100. This characteristic occurs throughout FORTH so that you write, for instance, 28 76 + instead of 28 + 76.)

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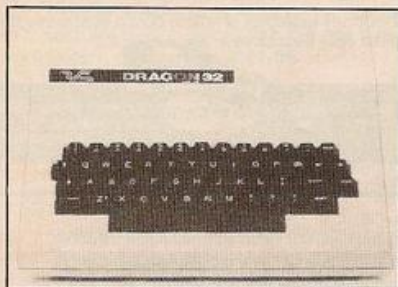
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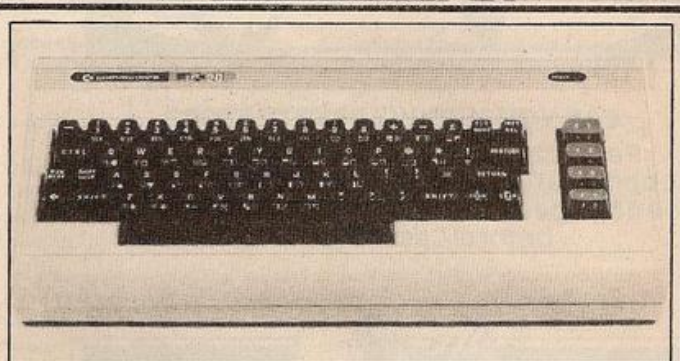
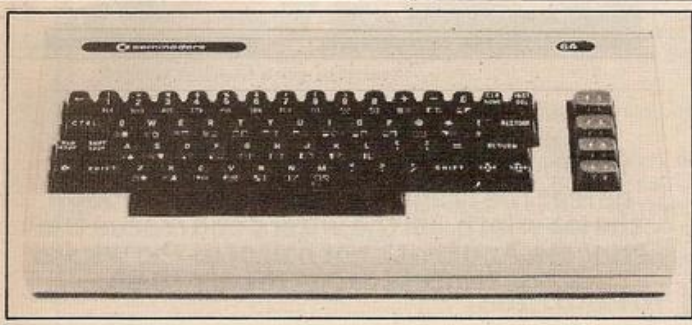
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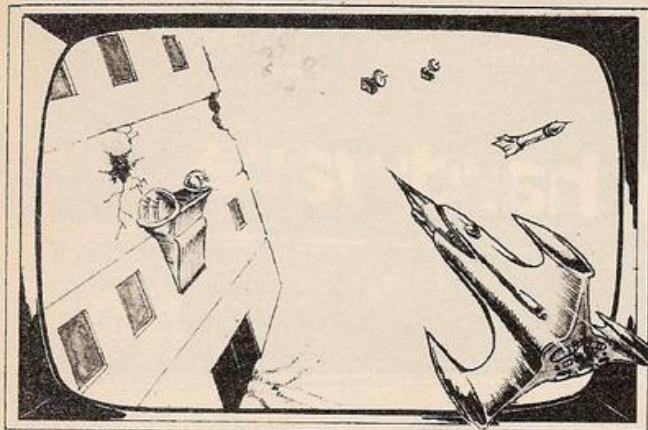
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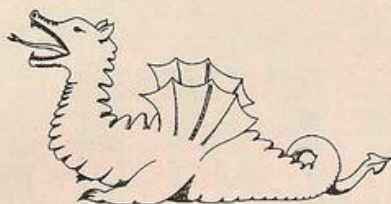
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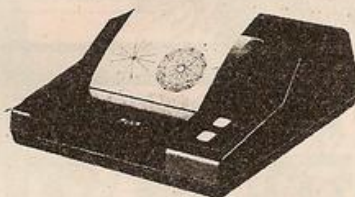
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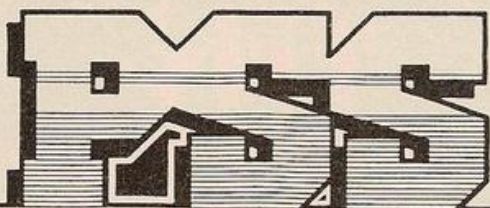
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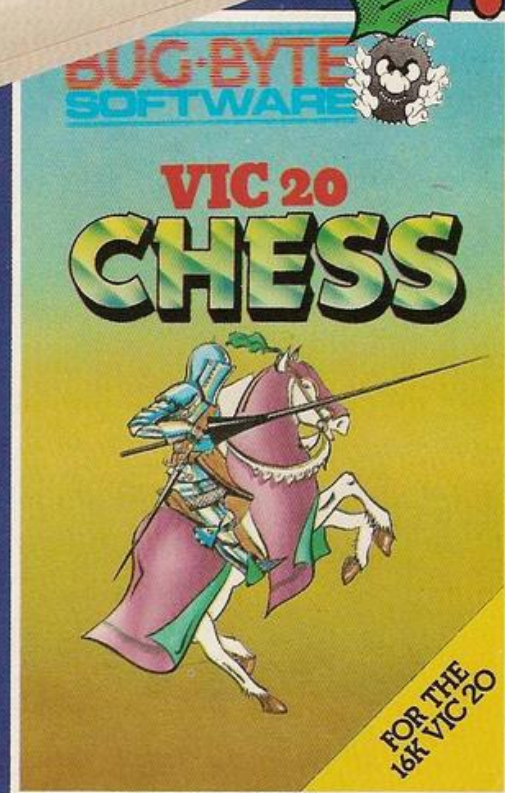
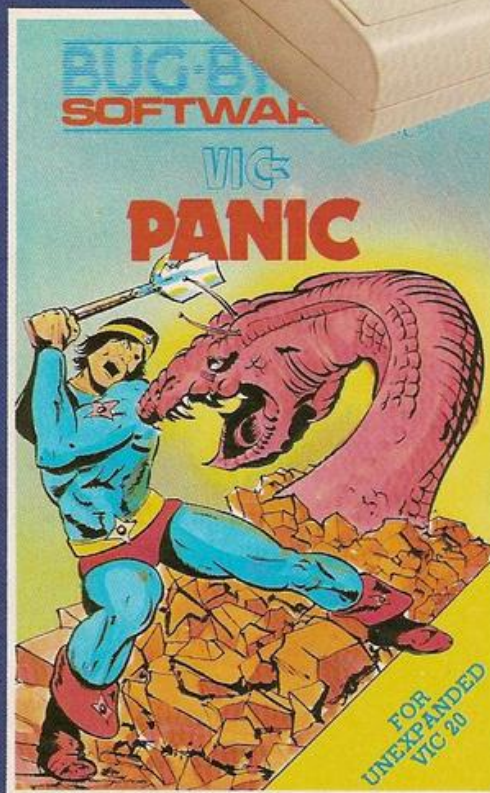
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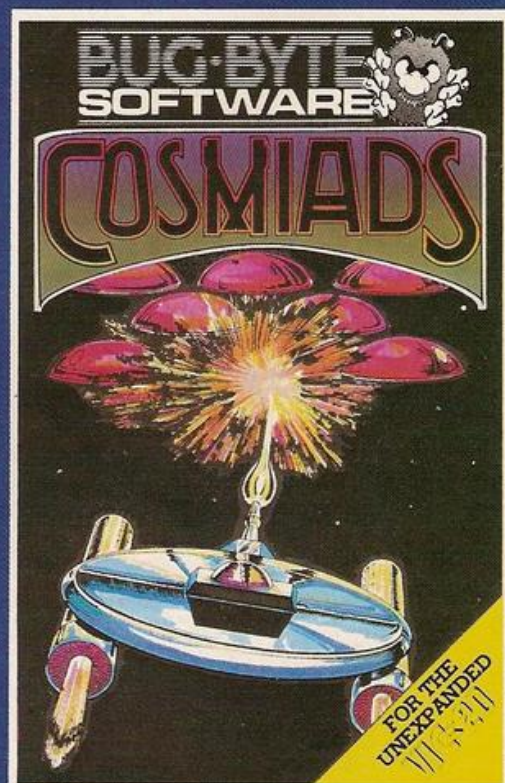
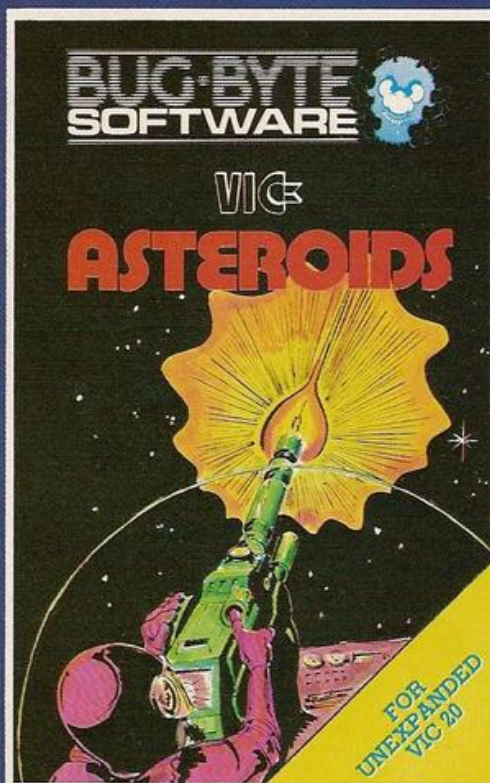
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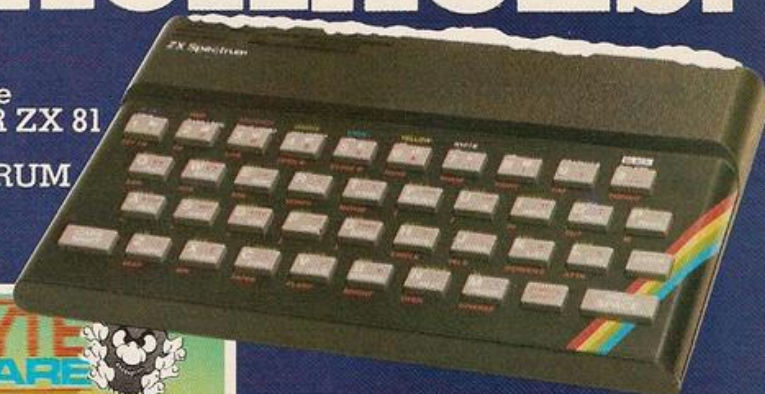
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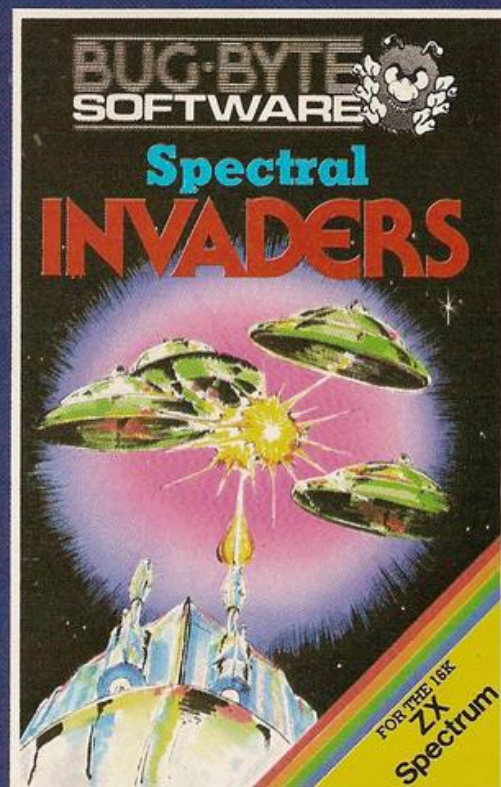
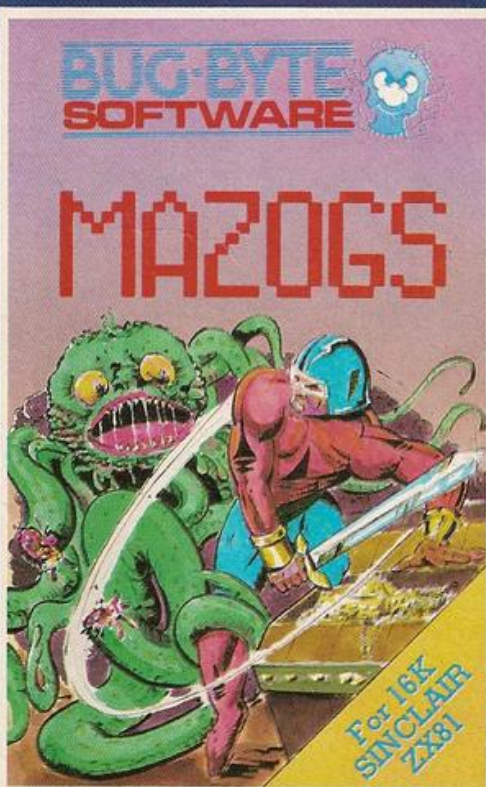
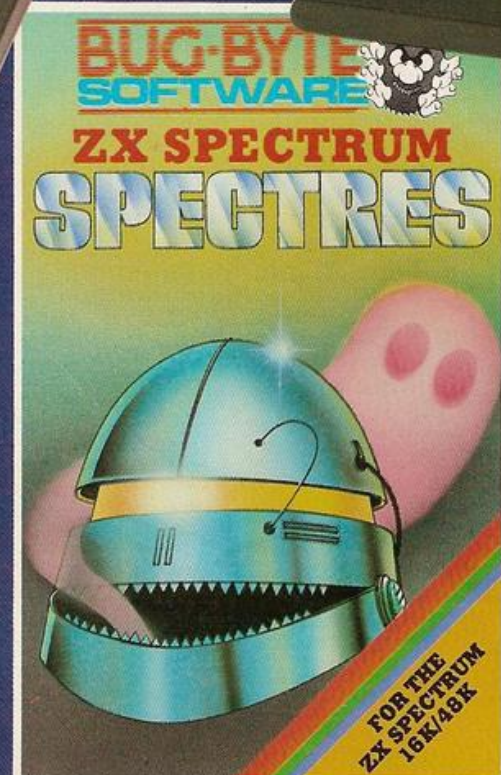
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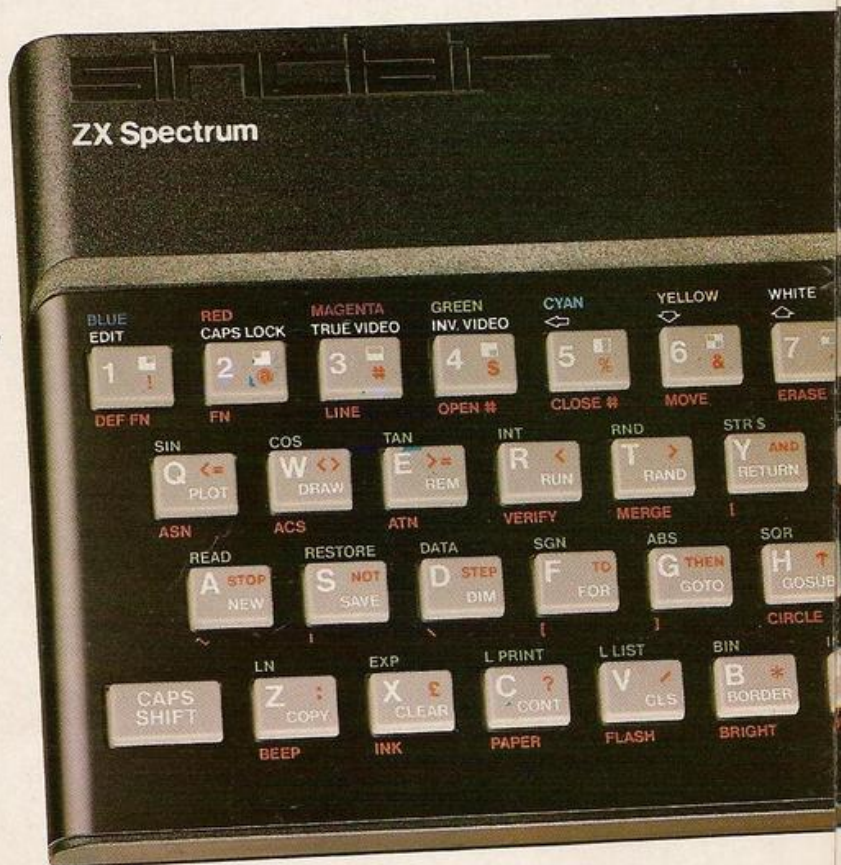
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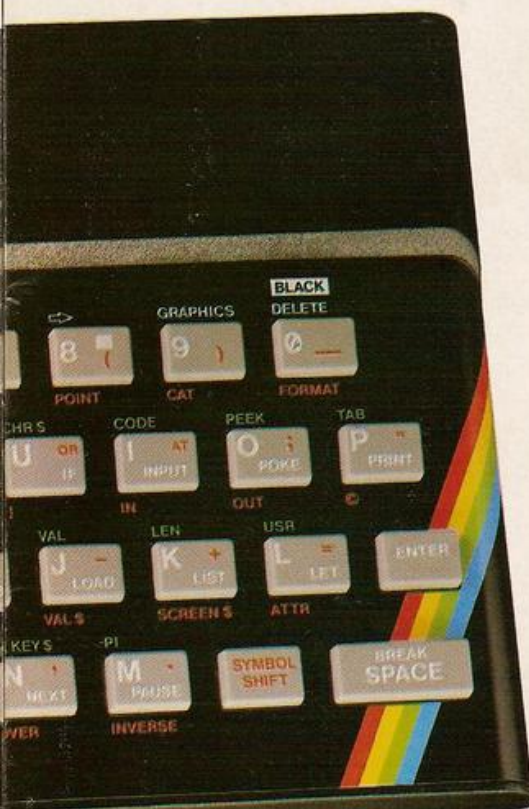
There's no need to stop there. The ZX Printer – available now – is fully compatible with the ZX Spectrum. And later this year there will be Microdrives for massive amounts of extra on-line storage, plus an RS232 / network interface board.



Key features of the Sinclair ZX Spectrum

- Full colour – 8 colours each for foreground, background and border, plus flashing and brightness-intensity control.
- Sound – BEEP command with variable pitch and duration.
- Massive RAM – 16K or 48K.
- Full-size moving-key keyboard – all keys at normal typewriter pitch, with repeat facility on each key.
- High-resolution – 256 dots horizontally x 192 vertically, each individually addressable for true high-resolution graphics.
- ASCII character set – with upper- and lower-case characters.
- Teletext-compatible – user software can generate 40 characters per line or other settings.
- High speed LOAD & SAVE – 16K in 100 seconds via cassette, with VERIFY & MERGE for programs and separate data files.
- Sinclair 16K extended BASIC – incorporating unique 'one-touch' keyword entry, syntax check, and report codes.

um

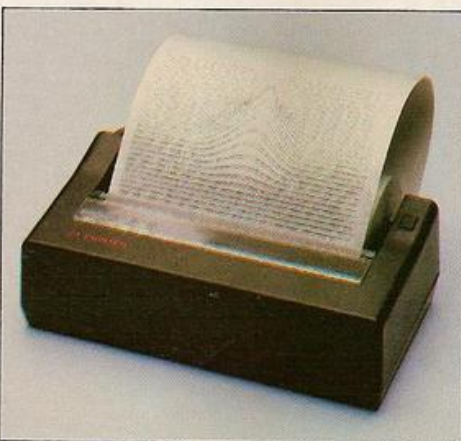


The ZX Printer—available now

Designed exclusively for use with the Sinclair ZX range of computers, the printer offers ZX Spectrum owners the full ASCII character set—including lower-case characters and high-resolution graphics.

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The new Microdrives, designed especially for the ZX Spectrum, are set to change the face of personal computing.

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All the BASIC commands required for the Microdrives are included on the Spectrum.

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The first 21 software cassettes are now available directly from Sinclair. Produced by ICL and Psion, subjects include games, education, and business/household management. Galactic Invasion... Flight Simulation... Chess... History... Inventions... VU-CALC... VU-3D... 47 programs in all. There's something for everyone, and they all make full use of the Spectrum's colour, sound and graphics capabilities. You'll receive a detailed catalogue with your Spectrum.

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This interface, available later this year, will enable you to connect your ZX Spectrum to a whole host of printers, terminals and other computers.

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	Sinclair ZX Printer	27	59.95	
	Printer paper (pack of 5 rolls)	16	11.95	
	Postage and packing: orders under £100	28	2.95	
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


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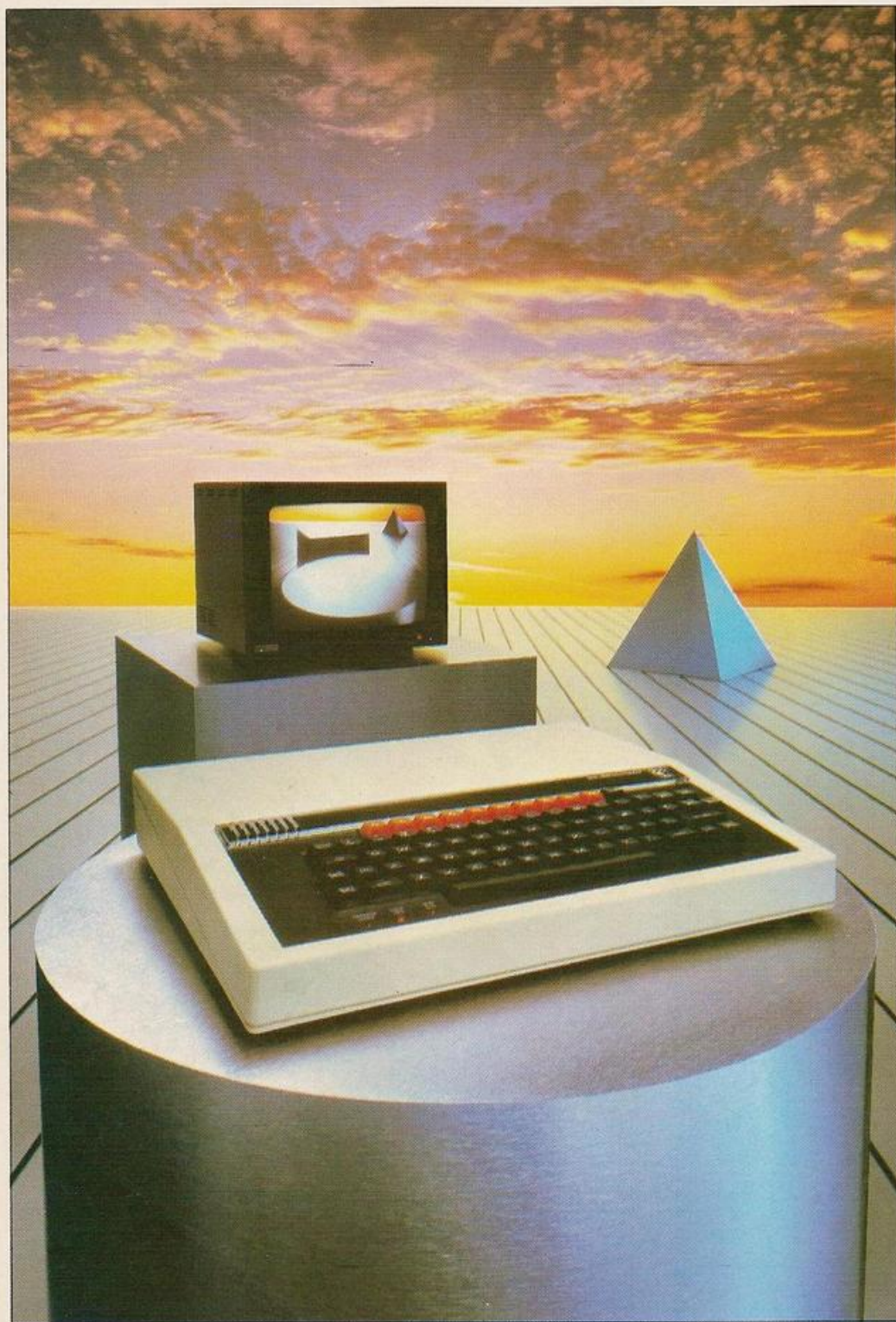
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Whether your interests lie in business, educational, scientific, control or games applications, this system provides a possibility for expansion which is unparalleled in any other machine available at present,' comments Paul Beverley in the July 1982 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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The BBC Microcomputer is designed, produced and

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The BBC Microcomputer System

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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 is designed, produced and

tributed in the UK by Acorn Computers Limited.

YOUR LETTERS

ZX GAMES

Several errors crept into my article ZX-81 Games Writing in the November issue of *Your Computer*. These are as follows:

1. Program 2 — an open brackets symbol is missing in the Line 1 Listing. This should be placed between Not and Clear.

2. Program 5 — the graphics character before the second RND should be CHR\$63h not a space.

3. Hexloader — line 60 should read:

```
60 PRINT AT 11,7;X;"spc.";A$(1 TO 2)
Text should read: "To save typing
both Rem statements type in line 1
Rem 255 0s".
```

4. Frogger program — to Run the display Line 10 should be changed to:

```
10 RAND USR 16701
not USR 16702, as stated.
```

Stuart Nicholls,
Keynsham,
Bristol.

GREMLINS

Here are some amendments to Rod Hopkin's Spectrum Flight Simulator — December issue — which other readers may find helpful. Most of them arise because the screen construction plotting commands do not correspond entirely with those of the main program.

Line 103: change address 23054 to 23086 and similarly change lines 8745 and 9521.

8710 DRAW 84,0 instead of 86,0

9657 DRAW 84,0 instead of 86,0

In line 9651 A\$="" should read

A\$="(12 graphic 5s)"

Add the following lines:

9658 PLOT 30,7: DRAW 28,0

9501 POKE 23200,0

There are also some errors in figure 3:

Line 24 FOR N=1 to 14
should be:

FOR N=1 to 16.

To tidy up the screen display, the following line may be added to figure 3:

1010 OVER 1

1020 PLOT 31, 17

1030 FOR Q=143 to 153: PLOT Q,

23:NEXT Q

1040 PLOT 143, 25: PLOT 152, 25:

PLOT 153,25

1050 PLOT 152,33: PLOT 153,33

1060 OVER 0

1070 PRINT PAPER 4; AT 18, 18; "O".

1080 PRINT PAPER 4; INK 7;

AT 19, 18;"O"

1090 FOR Q=143 to 152: PLOT INK 7;

Q, 31: NEXT Q

2000 OVER 0

S Rendall,
Abergavenny,
Gwent.

MACHINE CODE

I would like to make an amendment to figure 7, page 68 of the October issue. Lines 16540 to 16547 are missing — these can be seen in program 5c immediately above the erroneous program 7.

The code from address 16540 to 16546 has been omitted. It should

have been the same as in program 5 above it, that is:

```
16540 LD HL (NN) 42 12 64
LD DE NN 17 3 0
ADD HL DE 25
```

Perhaps I can add two further points to the series which may help readers list and edit the program.

We use 118 for the end-of-line marker and this, of course, will stop the printer and Rem from going beyond the point at which the number first occurs. You can get round this problem by using the following technique:

Required	Solution
LD A N 62 118	LD A N 62 117
or	INCA 60
LD C N 14 118	LD C N 14 117
	INCC 12

Only one point to watch. INC affects the flag variable. Also if you use the number 126 in your machine-code program, the five digits which follow it will not be shown on the screen.

Sinclair uses this code to indicate that a number follows, the number being stored in the next five addresses. If you now enter the code into the editor, parts will disappear. Solution — if you use the code 126 in your program, you must not edit the line. Try it, and see what happens.

Kathleen Peel,
Crowborough,
East Sussex.

HAUSER VIEW

I would like to point out a few factual errors in your interview with Clive Sinclair since it refers to an earlier interview with me. Sinclair's claim in paragraph 2, page 39 of your November issue that his display takes 8K to do exactly the same as Acorn's display does in 20K is incorrect. As some people know, our display has the following eight graphic modes:

Model B only	
0 640 × 256 2-colour graphics and 80 × 32 text	(20K)
1 320 × 256 4-colour graphics and 40 × 32 text	(20K)
2 160 × 256 16-colour graphics and 20 × 32 text	(20K)
3 80 × 25 2-colour text	(16K)
Models A and B	
4 320 × 256 2-colour graphics and 40 × 32 text	(10K)
5 160 × 256 4-colour graphics and 20 × 32 text	(10K)
6 40 × 25 2-colour text	(8K)
7 40 × 25 Teletext display	(1K)

The Sinclair display has only one mode, and it can only display 40 characters on the screen, giving neither the 80-character option necessary for word processing, nor the 20-character option needed for demonstration to a number of people gathered around the display.

The main shortcoming of the Spectrum display, however, is its lack of high-resolution colour graphics: since colour can only be assigned to character fields, as opposed to individual pixels as in the Acorn computer range, the colour resolution is only 32 × 44 = 1,408

colour fields, as opposed to 160 × 256 = 40,960 in the Acorn case.

The lack of a palette, which allows instant colour changes on the screen, is another difference between Sinclair and Acorn. A palette is vital for animated graphics.

I also found Sinclair's old advertisement in your November issue, which still compares the Spectrum board with the BBC board, claiming that the Spectrum "provides more power". In a recent test the BBC Computer was shown to be almost four times faster than the Spectrum.

Although I think the Spectrum is a reasonable computer, Sinclair's claims that it is "more powerful" than the BBC Computer and that it can do with 8K of memory what we need 20K for, cannot be substantiated and are simply false.

Hermann Hauser,
Managing Director,
Acorn Computers.

PROGRAM NAME

I have been very pleased with Mr Alan Went's Program Name for the ZX-81, November, page 110. However, some of your readers may have been having problems with it. It will work perfectly with the improved ROM, but with the original ROM — the one with the arithmetic bug — it will only work in Fast mode. In Slow mode it will print rubbish and sometimes crash. This is because it incorporates a call to the Fast routine and this was moved when the ROM was improved.

If you have the original ROM alter the beginning of line 10 to

```
LET A$ = "CD200F"
```

or use the program as it is, but then execute the instruction Poke 16515,32. In both cases the beginning of line 1 will then appear as

```
REM LN 47
```

It is also worth mentioning that the routine does not alter the print position and so can be embedded easily in a fancy presentation. For example:

```
10 PRINT "PROGRAM TITLE: ";
20 RAND USR 16514
30 PRINT
```

will produce:

```
PROGRAM TITLE: "NAME"
```

Finally, the program is not relocatable, as it incorporates calls to itself, but I will leave that up to the readers' intelligence.

G J W Cunliffe,
Horsham,
West Sussex.

BBC FACTS

In reply to G A Bobker's letter, November, there are some facts that I feel should be corrected. I own a BBC Micro and, although I do agree that it is expensive, I do not agree with his comments on BBC Basic.

Overall, the BBC Micro mixes the best of both worlds. G A Bobker also said it was preferable to buy cheaper computers, hence more. He

suggested a ZX-81 as an example of this idea, but I can tell you from personal experience that Sinclair Basic is even more non-standard than BBC Basic is supposed to be. An example of this is using X\$(...) instead of the standard Mid\$, Left\$ and Right\$, which the BBC uses, for string slicing.

P M Exell,
Great Missenden,
Buckinghamshire.

ZX LOAD

Many thousands of ZX-81 users are still plagued by the machine's inability to Load and Save regularly. The problem seems to be that the TV is emitting a very powerful mains hum, which interferes with both tape recorder and computer. Try this: first of all, type Save "Filename", then insert the Mic lead from the ZX-81 into the appropriate socket in the recorder. Next, insert a small earphone into the earphone socket on the recorder. Now, turn off the TV and allow it to cool down. Press Play/Record and Newline. You will know then the Saving is complete, from the sounds coming from the earphone.

This done, the program should Load back with little difficulty.

Robert Lazarus,
Harrow,
Middlesex.

ONE-LINER

Andrew Glaister's strange Spectrum One-Liner, page 25 November issue, creates its spectacular graphics by a software bug which can, however, produce several useful results. The fault stems from the angle portion of:

```
PLOT x,y: DRAW a,b,n*PI
```

if large odd values of n are used. But when n=63 an octagon is drawn, inscribed on an imaginary circle whose diameter is defined by the line joining (x,y) and (x+a, y+b).

If the value of n is altered to 189 an eight-pointed star is drawn. 24, 56 and 72-pointed stars can be drawn, using appropriate values of n. The following program shows the effect clearly by drawing a 3D view of an octagonal conic:

```
10 LET n=63
20 FOR a=120 TO 30 STEP -10
30 PLOT 55,27: DRAW a,a,n*PI
40 NEXT a
```

The list below shows the values of n that produce well-defined shapes. I have not yet been able to produce any sharp images of odd-sided polygons or stars.

n	
Octagon	63 441 567
8 side star	189 315 693 819
24 side star	105 147 273 357
56 side star	225 279 297
72 side star	301 343

Alan Marley,
Ruislip,
Middlesex.

Blank Hitachis greet Spectrum

SOME SPECTRUM OWNERS have found that they are unable to get a colour display on their colour televisions. The Spectrum's colour signal appears to be incompatible with certain makes of colour television built overseas. The problem has been reported with TVs from Hitachi, National Panasonic, Toshiba, Grundig and Telefunken, although it does not occur on every model in these manufacturers' ranges.

Sinclair says that although the Spectrum was tested on a variety of different makes, it could not have been expected to have covered all television manufacturers. However Sinclair is now considering publishing a list of recommended makes.

Sinclair gives fiction prize

WHEN THE SINCLAIR fiction prize was first announced many people wanted to nominate Clive Sinclair himself for promising 28 days delivery on the Spectrum.

Now, with machines available over the counter at large branches of W H Smith the real winner can be revealed. *Death is part of the Process* won Hilda Bernstein £5,000 for a piece of fiction based on the grim reality of her battle to win human rights for women and blacks in South Africa — the country she and her husband fled in 1964 after he was arrested with Nelson Mandela.

Mandela is still in the prisons of South Africa's apartheid regime.

Customised to public speaking

CHATTERBOX IS THE NAME of a new phoneme speech synthesiser for the ZX-81 and Spectrum microcomputers. Unlike speech packs which provide a number of already formed words, phoneme speech synthesisers supply the component sounds of a word — vowels, diphthongs and consonants. You need to be a skilful programmer to take advantage of phonemes but they allow you an unlimited vocabulary.

William Stuart Systems, the manufacturer, says that an average of six bytes will store the phoneme codes for a spoken word, so 10K bytes would store over 1,600 words.

The system includes an amplifier and a loudspeaker and has sockets for a speech recognition unit and a music synthesiser, also supplied by the manufacturer. It costs £56.53 from William Stuart Systems Ltd, Dower House, Herongate, Brentwood, Essex CM13 3SD. Tel: 0277 810244.

Casio's £80 light-weight PB-100 joins personal-computer club



CASIO insists that the PB-100 is a personal computer and not just a glorified calculator. A cheaper and slightly less powerful version of the FX-700P, the PB-100 runs Basic and can take up to 544 program steps. When a plug-in RAM pack is added it offers a maximum of 1,568 steps

which works out to be around 2K.

Like programmable calculators it allows up to 10 programs to be stored at a time and retained in memory when the power is shut off. Programs can also be held on tape if a cassette interface is bought as an extra.

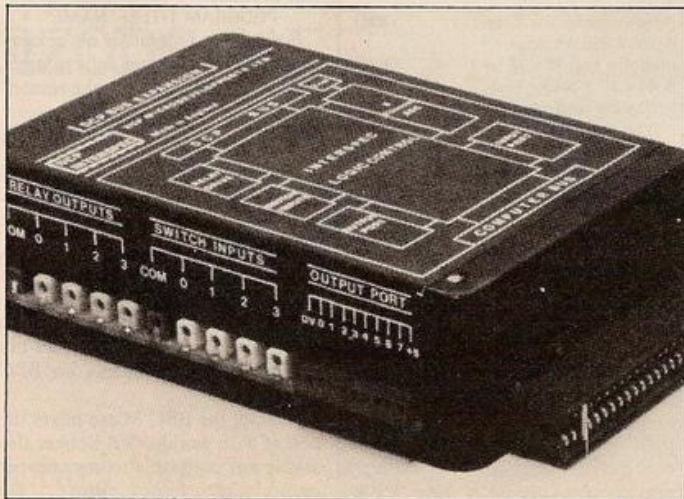
The PB-100 is remarkably light and compact, weighing just over 4 ounces measuring 9.8 by 16.5 by 0.7 cm. and costing less than £80. It has a 12 position LCD display and a 54 key alphanumeric keyboard, with single-key entries for Basic commands.

DCP Products who supply a range of accessories for the ZX-81 has developed this multiple interface pack for the Spectrum, the DCP Interspec. It includes an eight channel analogue to digital converter for joysticks or temperature sensors, eight-bit input and output ports, four relay outputs for high-current control and four buffered switch inputs.

There is also a 15-way connector at the rear of the pack which can control up to four more accessories as it stands or, with a few additional components, up to 255 other devices.

DCP's other new product is a Spectrum version of their speech pack for the ZX-81. This offers the letters of the alphabet, the numbers zero to a million, and a few other common words and sounds. By plugging in up to three Word Pack ROMs vocabulary can be extended to several hundred words.

The Interspec and Speech Pack, which cost £39.95 and £49.95 are available from DCP Products, 2 Station Close, Longwood, Norwich, NR13 4AX, and from many ZX dealers.



When in ROM, Oric EPROM



AT LAST ORICS are now streaming off the production line to start meeting the 250,000 orders already placed for the £99 colour micro.

The first few thousand do not have the final ROM chip but an EPROM instead. John Tullis, managing director of Oric Products International is confident that "users will not be able to tell the difference".

Oric decided to blow the EPROMs as soon as the design of the ROM had been finalised rather than have to wait another month for the production ROMs to be delivered.

At first Oric plans to concentrate production on the 16K and £175 48K models but a 32K machine at £140 is also planned.



High Street dealers to hold all the Aces

The Jupiter Ace has overcome initial production problems and is now being delivered in numbers. Aces are now beginning to appear in high street stores. Jupiter Cantab is producing 3,000 units a month. The Cambridge based company hopes to phase out mail-order deliveries and handing over distribution to several large chains, including Lasky's and Greens.

Software for the Ace is also on the way. Steven Vickers, who designed

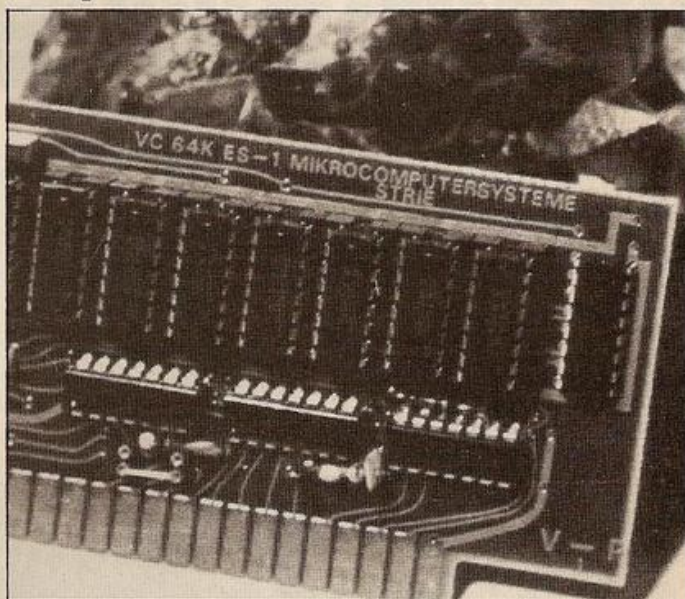
the fast Forth micro with Richard Altwasser, and three other software writers are developing a range of games and educational programs to be released shortly.

Meanwhile Remsoft has already released three tapes for the Ace. Programs include a disassembler, games, and a simple database with tape storage. They are available direct from Remsoft, 18 George Street, Brighton BN2 1RH. Telephone 0273 602354.

Stack Commodore Supercharger Lines, Circles and Fills



Double-Dutch RAM expansion for Vic-20



NORMALLY THE VIC-20 has a maximum memory capacity of around 28K and this requires an expansion board to take an 8K and 16K RAM pack together. Now a Dutch firm has produced a RAM pack which gives the Vic 64K RAM.

It uses the technique of bank selection to switch in different banks of memory into one area of the memory map. When the cartridge is plugged in 24K is directly visible to Basic; a further 40K can then be accessed by switching in blocks of memory, 8K at a time.

The cartridge has been developed by Electronic Supplies, Utrechtseweg 129, 6812 AA Arnhem, Holland. In this country it

will be sold through the Spectrum dealer chain for £100.

Accessing an 8K bank involves Poking the bank number into a single memory location. Should you feel cramped with 64K there is even a possibility of creating 152K RAM with two 64K cards, one mother-board and a few standard expansion cartridges.

YOUR COMPUTER TOP 20

Game	Company	Machine
■ Flight Simulation	Pision	ZX-81
■ Games Pack	Sinclair	ZX-81
■ Frogger	D.J.L.	ZX-81
■ Mazogs	Bug-Byte	ZX-81
■ Chess	Artic	ZX-81
■ Time Gate	Quicksilver	Spectrum
■ Escape	New Generation	Spectrum
■ Mazeman	Abersoft	Spectrum
■ Ground Attack	Siversoft	Spectrum
■ Arcade Pack	Control Technology	Spectrum
■ Spectres	Bug-Byte	Spectrum
■ Hoppit	Commodore	Vic-20
■ Bonzo	Audio-genic	Vic-20
■ Defender	Rabbit	Vic-20
■ Jumbo Pilot	Thorn EMI	Atari
■ Pac-Man	Atari	Atari
■ Star Raiders	Atari	Atari
■ Meteors	Acornsoft	BBC
■ Space Warp	Bug-Byte	BBC
■ Ghost Attack	Dragon	Dragon

STACK COMPUTER SERVICES has combined the facilities of the Vic-20 expansion units, Vickits 1 and 2, in one cartridge, the Supercharger Plus. Vickit 1 is Stack's version of Commodore's Programmer's Aid; Vickit 2, like Commodore's Super-Expander, supplies a high-resolution graphics mode with commands such as Line, Circle and Fill.

As well as incorporating all the commands from both kits, the Supercharger Plus includes an extra 3K RAM and allows 8K and 16K RAM packs to be connected. It costs £49, or £45 without the 3K RAM.

Also available from Stack is a 40/80 column board for the Vic-20. This gives a 40-column monochrome display on a TV or 80 columns on a monitor. It costs £115 from Stack Computer Services Ltd, 290-298 Derby Road, Bootle, Liverpool L20 8LN. Telephone 051-933 5511.

YOUR COMPUTER

BACK ISSUES

Just getting started in computing? Or perhaps you're already pretty knowledgeable and would like to extend your programming skills. Either way Your Computer back issues can help to fill your need for reliable and, above all, relevant information about home computing.

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February 1982

Survey: ZX Software. BBC Graphics. ZX81 Animated Graphics. Vic 20 Music. Game — Dominoes. How to write chess openings. Atom Programming. Rubik's Cube on ZX81. Interview — Kerr Borland.

April 1982

Survey: ZX Ports. Sorting on ZX-81. BBC Graphics. How to write an Adventure Game. Atom line labelling. Game — Nim for ZX81 and Apple II. Interview — John Baxter.

May 1982

Survey: ZX Software. How to write a chess program. Games — Vic 20 Tank Battle; Magic Squares. How to show off your ZX81. Joysticks for the ZX81. BBC Graphics. How to write a word processing package. Interview — Richard Turner.

June 1982

Reviews: Sinclair Spectrum; Vic 20 Software; ZX-81 Keyboards. Games Vic 20 Mars; Othello on Flexidisc. Atom Utilities. ZX81 machine code monitor. How to build a portable computer. Interview — Ron Bissell.

July 1982

Survey: Atom Software. Spectrum Graphics. ZX-81 Colour Board. Games — Dog Race; Genie Guessing Game; Simon Challenge. BBC Sound. ZX-81 Dis-assembler. Programs for ZX-80. Interview — Richard Altwasser.

August 1982

Review: Dragon 32. Survey: Vic memory expansion. Spectrum Sound Games — Demon's Domain; Vic Duck Shoot. ZX-81 machine code (Part 1). Atom file handling. Ecological modelling. BBC techniques. Interview — Tony Baden.

September 1982

Review: NewBrain. Spectrum Software. Sound on ZX-81. Games — Vic Dambuster; B-52 Bomb Run. Vic-20 Assembler. Spectrum Disassembler. ZX-81 Indexer. ZX-81 machine code (Part 2). Midwich MC control computer. Interview — Hermann Hauser.

October 1982

Reviews: Sanyo PHC range; MPF-II; Commodore 64; Colour Genie. Survey: BBC Software. Atom Forth. Pascal for Basic users. ZX word processing. Games — ZX-81 Pinball; Vic Catacombs. Atom text. BBC control Key. Spectrum Assembler. ZX-81 machine code (Part 3). Interview — Douglas Adams.



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Spying on the Cheltenham HQ



Just yards away Britain's top spies are hunting for moles but Simon Beesley finds Cheltenham's computerniks are still in league with the badgers.

CHELTEHAM AMATEUR COMPUTER Club meets at Prestbury Scout HQ along the road from GCHQ, the government's electronic eavesdropping centre and scene of the recent spy scandal. GCHQ is probably the largest employer of computer personnel in the district but hopes that some of them might make an appearance at the Scout HQ were frustrated — the centre has its own microcomputer club, a BBC users' group.

The Cheltenham club passed through a fallow period when they were uprooted from their normal premises in a local technical college. They tried to run weekly meetings from an annexe which closed at 8.30. Attendance flagged as a consequence.

Matters have improved now that they are securely lodged in the scout hall. A notice above the entrance to the hall bore the ominous legend: "Due to rain damage all members must keep off the roof". *Your Computer's* representative did not enquire whether this referred to the club's normal proceedings. Certainly at this month's meeting none of the 15 members attending showed any inclination to start climbing.

Peter Manolescue of The Business House, Gloucester demonstrated the Sirius, the 16-bit business micro. Computer clubs often invite dealers to demonstrate their machines. The drawback to this is that dealers are unlikely to take the most objective view of the machines they sell and usually cannot give as good a review of them as the experienced user.

Nonetheless Peter Manolescue gave a lively demo which developed into an informal discussion. Conversation ranged over the use of micros in schools, the merits of word processors and the future of keyboard input.

Members showed particular interest in the high quality graphics which the 800 by 400 resolution of the Sirius permits.

Also on show was the HX-20, Epson's very impressive portable computer. It had been brought down from Compec that morning and at the Prestbury Scout Hall was making one of its first public appearances in the provinces.

The Club's members display a range of computing interests. Steve Smith has built a home micro around a Z-80 processor which runs Tiny Basic in 2K. Although his attempt to make a teletext adaptor for the micro failed, he has successfully built a thermal printer for it using wood for some of the parts.



Vera Naumann, deputy head of a local primary school, bemoaned the lack of adequate software for schools. She had just written her first educational program on the BBC Micro, a music multiple-choice test. Her next move is to include sound in the program when she has mastered the complexities of the BBC's Sound and Envelope statements.

Club meetings are usually based around a talk or demo. They also hold meetings devoted to members' micros and programs. A BBC night is planned following the success of their Sinclair night held earlier this year. Further information from Mike Hughes (Cheltenham 75213).

Local society news

Harrogate ZX users

THE HARROGATE ZX Users' Club meets fortnightly at the PHAB Club in Mornington Terrace, Harrogate. Although they are primarily interested in Sinclair micros they welcome other users. Contact Peter Richmond, 7 Dragon Parade, Harrogate HG1 5BZ.

Bolton computer club

THE RECENTLY-formed Bolton Computer Club holds weekly meetings in Room E4/24 at the Bolton Institute of Technology. Membership is £1 per annum and there is a 20p admission charge at some meetings. The majority of members are home micro hobbyists, but anyone who has any computing interests can attend. Contact Roy Mumford on Bolton 493682 or Dave Atherton on 0942 876210.

Ribble Valley

THE RIBBLE Valley Computer Club is a new club in North Lancashire. They meet on the second and fourth Mondays of the month at Pemble Carpets, West Bradford. Further information from Ian on Clitheroe 25933.

North London

THE NORTH London Hobby Computer Club co-ordinates a number of different user groups and computing courses. These include Basic and machine-code programming courses, a Women's Computer Group, and meetings for novices, Vic and Sinclair users. Send for a prospectus to The Secretary, Department of Electronics and Communications Engineering, The Polytechnic of North London, Holloway Road, London N7 8DB.

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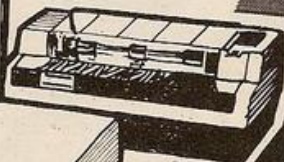
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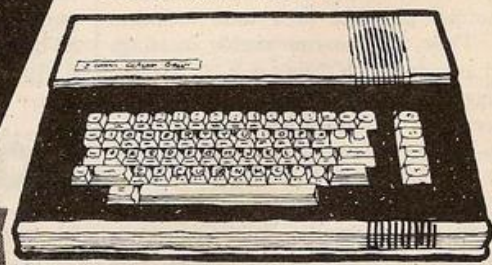


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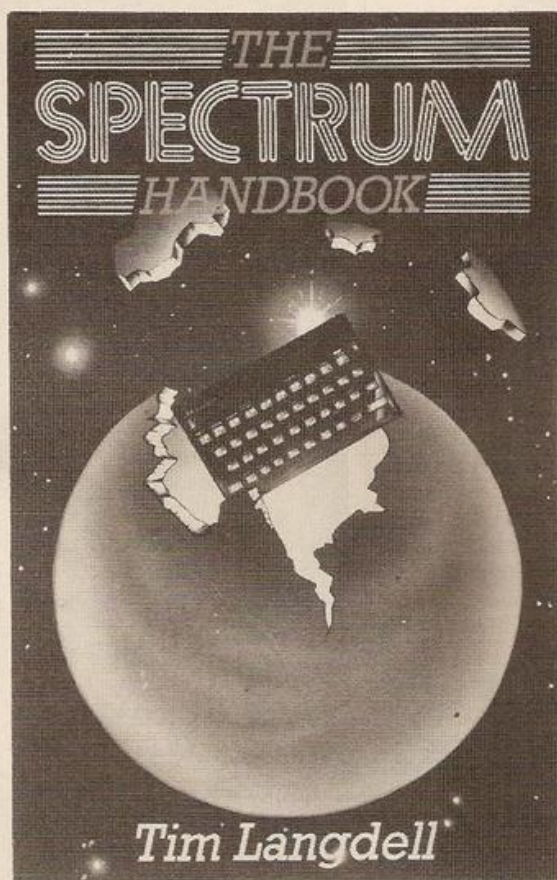
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I enclose cheque/postal order for £.....

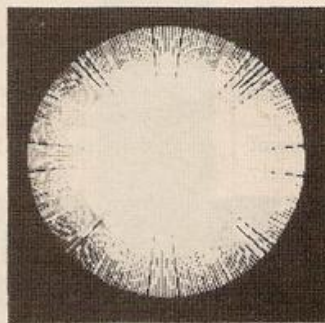
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RESOURCE



LOOK INTO the window. The year is 1993 and the only place you can find anything remotely like the micro you had in 1983 is an antique shop.

You pull out of your pocket a credit card-sized communications, information and resources centre and ask it why anybody bothered with home computers when the only way of communicating with the beast was to type in instructions by hand, or use a crude joystick.

After a discernible pause while the resource centre tries and fails to work out whether you were just being sarcastic, some archive film of the early days of home computing appears on the resource card's screen while a patronising commentary tells how the pioneers struggled against insufficient memory and bug-ridden programs back in the days when men were real men and RAM wobbles were real RAM wobbles.

1983 marks a turning point in the history of

WHAT'S ON THE FOR HOME COM

home computing. In February the number of micros in Britain will break the million barrier for the first time. Over the course of the year the introduction of cheap mass-storage systems and telecommunication links between micros and databases will make cheap home computers into useful working tools, while both the hardware and software to be introduced over the next 12 months will make today's computer games look positively stone age.

Now that home computers are here to stay, it is time to consider how they may develop over the next 10 years. Other than looking at tea-leaves there are three ways of assessing this. It is possible to extrapolate present design trends and combine them with what individual information companies are planning as their next products. Such is the speed of advance in microcomputing that this becomes impossible for time spans of more than a year ahead.

Secondly, if you examine the continuing improvements of silicon chips and the research into even faster and more compact computing units, organised in superior ways, you can make a reasonable estimate of the crude power of the home computers of the 1990s. Thirdly 10 years is roughly the timelag between the first laboratory experiments on a theme and its general introduction. Computer games were being played in laboratories in early 1960s but it was 1972 before the first one — Pong — appeared on general release.

Likewise the personal computer was developed in the mid-1960s but it was 1975

TOMORROW'S TECHNOLOGY

THE SKY'S THE LIMIT
Micro power jumps by a factor of 10 every three years. This exponential rate of growth makes 1993's home computer 1,000 times more powerful than 1983's.

RESOURCE



before Steve Wozniak founded Apple. On that basis the laboratory research work carried out between 1973 and 1983 should give a clue to what will be commercially available before 1993.

In general, computer hardware produces 10 times as much for any given price as it did three years ago. This trend has been consistent for the last 30 years so we can expect the 1993 model to be 1,000 times as powerful as today's machines. Although software develops much more slowly, for the first few years micro software can jump a stage. As they grow more like minis and mainframes in their power they can adapt off-the-peg suites of programs written for their larger relatives.

The first major step forward this year is as old as the disc, but the widespread intro-

CARDS PUTTING ?

RESOURCE

Hollywood took 30 years to turn black and white silent movies into colour talkies. The home micro industry has managed that in just three. Meirion Jones dons his gypsy scarf and gold ear-rings to look ahead at the next 10 years of home computing.



duction of 3in. and 3.5in. microfloppy drives for between £150 and £200 will make mass-storage systems accessible to home computer owners. By 1984 the price of a drive should be less than £100. At the lower end of the market Sinclair's Microdrive when it finally appears should be a great improvement on present cassette-based systems.

Video discs are also becoming a fashionable storage medium because of their ability to illustrate interactive games, promotions or education programs with real film. Philips Laservision can store the equivalent of 54,000 still TV pictures on one disc. Sony has already released its SMC-70 video disc-based computer system in America, where Ford and General Motors both use similar video-disc computer systems to sell cars. In Britain one

firm is selling an interactive video disc-based system to teach medical staff how to diagnose illnesses.

At present the cost of such systems is prohibitive but there is hope.

In March Philips and Sony hope to wipe out the market for conventional LPs by launching a new 4.75in. laser disc and player. Already some record manufacturers plan to use the laser discs for a screen display to go with the record. It would be comparatively easy for software houses to put their programs on these new Compact Discs and incorporate real film sequences in interactive adventure games. Projected prices are in the region of £10 per disc, and although the players will originally cost £400 once they start selling in numbers prices will drop below £200.

1983's real innovation though will be communications between micros at a reasonable price. In February Oric will start delivering £60 Modems to fit on the Oric 1. This will make it possible to buy a colour computer and a Modem together for less than £160. Micronet 800 is another scheme to deluge computer owners with relatively cheap Modems, which starts this month. Before the summer Sinclair also hopes to join the Modem-makers' club.

In each case the motivation behind the scheme has been to sell software which can be downloaded from the phone much more cheaply and conveniently than by buying a cassette or cartridge and loading that in. If the technology is taken advantage of, it could be used to connect your home micro to vast databases containing most of the information you could ever need. You could send and receive electronic mail to and from anyone else with a micro and a Modem. You could play interactive computer games against an opponent who might live in another city.

As 1983's home micros become more competent a new type of software will emerge to take advantage of the possibilities. Sinclair hopes to introduce a home doctor on the ZX-83 which will ask the patient what his or her symptoms might be before sorting through a base of information to eliminate most possibilities and following up likely leads with more questions.

At the end of the "surgery" the computer would produce a list of possible causes of the symptoms in declining order of probability. Such an expert system could be described as exhibiting artificial intelligence — a term which will be ruthlessly exploited and twisted out of all recognition by computer product sellers.

There is already an adventure game for the Spectrum called The Hobbit which the publishers describe as having AI. To be fair the adventure is apparently every bit as imaginative and entertaining as the publisher's claims for it.

Atari's Chief Scientist Alan Kay believes that however good the hardware is, home computers will never reach their potential unless Basic is discarded. Despite the evidence he thinks that for every child who takes to programming with enthusiasm there are a dozen who are put off by the time it takes to produce anything interesting in Basic.

"The last thing we want to do is bring up a generation of kids who hate computers because they had to learn Basic." Equally he has little faith in the "grown-up" languages which he thinks will become available on home computers over the next two years. Kay developed Smalltalk — a tool-building language which encouraged the young to make maximum use of the computer's capabilities, and which has recently become available on the larger micros. Soon it will migrate to the home computer.

Making the most of manipulative languages will mean that the home computer will start to acquire a whole new paraphernalia to make the user interface more friendly than a keyboard.

It is already quite simple to persuade a modern micro to respond to a few simple spoken commands. The computer does not

(continued on page 37)

ZX99

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The ZX99 gives you software control of up to four tape drives (two for reading, two for writing) allowing merging of data files. This is achieved by using the remote sockets of the tape drives, controlled by USR statements or commands.

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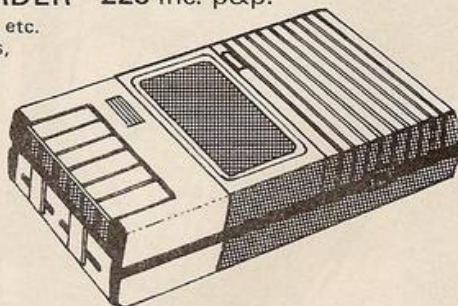
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(continued from page 35)

have to understand anything about meaning to respond to clearly-spoken, single-word commands — Speak to your Spectrum *Your Computer* November 1982. As home computing becomes more popular though, the temptation to do away with input through the keyboard will increase.

Even on mainframes the problems of recognising a word out of the stream of noises humans make when they are communicating with each other have not been totally solved. We distinguish similar-sounding words according to the context in which they are spoken. Until we start building computers which have somehow soaked up the same sort of picture of the world as the people talking to them, context will still prove a problem. Meanwhile much of the most successful work in speech recognition is classified because of its obvious defence and security applications.

Computer-generated speech is by contrast now a much easier problem. The Detroit dalek sound is already a thing of the past. Acorn's Kenneth Kendall speech chip is only the first of many voices that will humanise the sound of silicon.

Despite the low price and apparent appeal of the light-pen most computer-makers believe that a more modern approach is necessary. Sinclair for instance was considering making a light-pen available as an accessory but now research is concentrating on building complete systems of software and hardware designed to make the use of computers as easy as pen and paper.

One approach which the home computer-makers are thinking of borrowing from the minis is the mouse. The mouse itself is small and hand-held and can be moved around on the desk very much like a pen on paper. It produces a cursor on the screen which moves around as the mouse is moved across the desk. A few single controls on the mouse are enough to move sections of text or a design around on screen. In future the mouse could also be designed to read in text as required from a sheet of paper on the desk. At present even on minis the mice are connected by wire or fibre-optic link to the computer. The mouse will become far more effective once the physical connection can be discarded.

Since 1975 the home computer has changed out of all recognition but the television display which the user relies on has improved very little. Essentially the television or monitor is still the heavy box which it always was, displaying a small picture which you have to stare at. Now advances in flat-screen displays are changing all that and making light-weight, portable computers with built-in screens possible. Before the end of the decade it will be possible to produce a pocket-sized computer which could project a wall-sized display.

Sinclair's much delayed flat-screen project will be producing pocket televisions by next spring. We can expect flat screens to appear not only in Sinclair's computers over the next few years but in many others. The Japanese seem to favour large liquid-crystal displays for their flat screens but Sinclair relies on a flattened cathode ray tube with the electron gun displaced to one side. By 1984 he envisages making a 4ft. colour flat-screen

The shape of 1983

The machines released this year will offer more for less and are likely to come with useful applications already on board — there are hints that Sinclair's ZX-83 project may come with a built-in word processor. Price cutting will continue — the ZX-81 or its equivalent could cost £25 complete by the end of the year and Binatone insists that it is still going ahead with the £50 colour 16K micro despite delaying the launch from January to March.

Now Binatone plans to launch two other machines at the same time as the £50 Micro. Acorn hopes to finally launch the £150 Electron in February with a portable version to come in the summer. Portability will be an important theme this year. Sinclair is keeping his cards to his chest but the features he has previously mentioned — Sinclair Interview November *Your Computer* — still suggest that a small briefcase computer is a likely shape for the ZX-83. Nigel Searle, Sinclair's Research Director, will only say that while the Spectrum evolved from the ZX-81 the ZX-83 "will enter a new section of the market."

Apple is considering launching a new machine in the £200 price band, and Mattel makers of the Intellivision may hot up the competition with a £100 Spectrum contender. Commodore is again threatening to release the Max games machine at £100.

television. You could then hang your game of space invaders, or a flight simulator, on the wall.

By the end of the decade computer enthusiasts will be expecting their machines to be throwing up realistic three-dimensional displays. It is unlikely that people will still be prepared to sit and wear red and blue glasses night after night — although one American company is producing arcade computer generation games which do require this — so, much research is proceeding into three-dimensional display.

Holographic techniques offer some promises in the long term but in the meantime the problem of three-dimensional display has produced some ingenious ideas. In America a laser has been used to illuminate rapidly rotating panels to give an illusion of depth. Rudiger Hartwig of Heidelberg University is using a variation of this to create a real three-dimensional display. A helix in a column spins at high speed while a laser illuminates it from above. By deflecting the beam across the helix at high speed an apparent line can be created inside the column. An electro-mechanical deflector is sufficient at present to generate lines, spirals and helices in the column. Eventually Hartwig will use three lasers to produce colour with electronic deflection to speed up the process and hence produce higher definition.

In the late 1970s Massachusetts Institute of Technology used a mainframe to simulate the order of computing power which would be available in the home by 1990. A system called Dataland was developed which allowed the computer to go soft. You just had to sit in an armchair in front of a wall-sized TV display showing everything from a pocket calculator to a phone and a photograph album. Either using your voice or just pointing you could choose an item off the wall and then control it either on the wall display or on a small monitor by your chair.



Grid's Compass points the direction for 1983.

To make a phone call for instance you would ask for the phone — which need never appear as a hard object — and when it appeared on your monitor you could have the choice of dialling the number yourself by pushing the buttons as they appeared on screen or by asking the computer to find and dial the number of a particular person for you.

If you chose to look at your photo album you could direct the computer with the minimum of fuss to blow up any picture you might want across the wall. Such a system with built-in word processors and expert diagnostic systems would hold a database of all the information in your house, making it easily accessible. It would also have links with large external databases in case you wanted information it did not have.

This computer would also be the entertainment centre for the home. Not only could you ask it to put on a particular television program but you could ask it to find and show an old film — downloaded from a rental agency.

All this depends on microtechnology continuing its exponential growth. All other things being equal there are two ways to make chips which will produce more computing power for less money. Either you must increase the speed at which the individual components, or logic gates, on the chip switch, or you must fit more of them on to a chip.

At the moment 250,000 gates can be fitted on to a single 10mm. square slice of silicon but new photographic techniques are increasing this density all the time. Hewlett-Packard now believes that such a slice could support the million gates needed for a 64-bit processor.

Meanwhile the military in particular are examining the possibility of using gallium arsenide instead of silicon to produce chips which will work five times as fast. In Britain the acronym-happy Ministry of Defence is funding the VHPIC programme to produce very high performance integrated circuits — while the American Defense Department is spending \$200 million on VHSIC — developing circuits which will be 100 times as fast as present.

Although these developments take time to filter down from military to commercial use, — from the killing business to the business of making a killing — the time lag before new wonder chips appear in micros is decreasing all the time. As the U.S. Commissioner of Customs put it, with unnerving enthusiasm "The same technology which brings us the

(continued on page 39)

(continued from page 37)

likes of Pac-Man is scaring the hell out of our enemies."

Beyond 1993 the possibilities become more exotic — home computers which could in some way be described as alive. Plant matter will reappear in micros for the first time since Commodore gave up making Pets in wooden cases. The American bio-technology company EMV Associates hopes to produce biochips by the end of 1983. Using an electron beam EMV plans to deposit microscopic circuit designs on to protein. As the circuits will operate in three dimensions they have a potential capacity 10,000 times greater than their silicon equivalents.

It is not only the materials of which the insides of the computers are made which may become more biological. Technologies which begin to look more like the organisation of living creatures than machines are being developed.

Human beings have a nervous system made out of components which are inherently much slower than those of a computer but because of the way that the system is organised even the most powerful computers may never be able to compete with human beings in reacting intelligently to stimuli if they have to cope with inputs serially.

Parallel processing could speed up computers by many orders of magnitude and make them easier to interface to the real world. Parallel processing has always proved impossibly difficult to implement up to now but one British researcher expects to demonstrate a working system this year.

Is there life in biochips?

The concept of a living, self-replicating, computer existed in the realms of science-fiction long before companies like IBM and Genex began to intimate that a microchip with a biological, rather than a purely chemical basis, was a possibility under serious research.

A team at Warwick University, headed by theoretical physicist John Barber, is working on a biochip design that could be implanted in the human body. It would monitor minute changes in the calcium ions as a result of heart muscle action, thus providing early warning of a heart attack.

It may one day be possible to use chips to correct electrical signals in the human body, sorting out damaged nervous systems. After serious operations, such as open-heart surgery, or where the patient is under intensive chemotherapy, it is useful to monitor the body's potassium balance as this is linked to neural disorders. Since potassium produces ions in electrolysis a microchip could be implanted to perform the function of an electrode, thus measuring the level.

What does Dr Robertson of Edinburgh University, recipient of a £1.78 million SERC grant for microchip research think of the

"natural" biochip? "That technology will add something new to our capability. The interesting thing will be to see the integration of our new organic materials with straightforward silicon material."

While Dr Robertson is involved with the straightforward silicon materials, Professor Gareth Roberts and Dr Mike Petty at Durham are in the forefront of making Langmuir Blodgett films — a basic technique in biochip technology.

To make a Langmuir Blodgett film, first take a long-chain organic stearic acid with a carboxyl group of molecules at one end and a methyl group at the other. A soap film is a good example. Put it on the surface of water and the carboxyl group floats — the other end sinks. So the film's molecular chains point upwards. By applying lateral pressure you can form a raft. This can be pulled off on a substrate, making a chip which is thinner and more efficient than the all-silicon ones — the film is only one molecule thick.

The departure from silicon is significant. Silicon oxidises easily, hence its current popularity for microchip construction when compared with more tricky substances like gallium arsenide or indium phosphate. But if these Langmuir Blodgett techniques are successful they may sound the knell for the seath of silicon.

In Japan biological computers are taken seriously enough to form part of the plan for a fifth generation of computers. The Research Development Corporation is funding Hiroshi Shimizu who has coined the term biobionics,

or the study of self-organising life phenomena, to describe his research. Many experts predict that by the end of this century computers will need to combine biological organisation with biological materials.



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Super Expander commands

Auto — displays and increments line numbers automatically. The user can specify the starting line number and the interval between lines, if not then the starting line defaults to 100 and the interval to 10.

Renumber — automatically renumbers all the program lines including the Goto and Gosub references, starting at the line number specified and at the increment set by the user.

Delete — can delete a single line, or all the lines specified between a starting and finishing point, or all the lines from a starting point to the end of the program.

Find — searches the program for a specified Basic command, character, or character string, and displays all the lines in which it appears.

Change — searches for a Basic command or character string and replaces it with a new command or string.

Edit — changes from program mode to edit mode, which alters the function key commands.

Key — allows the user to alter the commands assigned to the function keys. The information assigned to any one key must be 10 characters long or less, and an automatic carriage return can be included in the function.

Help — displays the line in which an error has occurred during program execution and highlights the error in reverse characters.

Dump — displays all the variables and their values in the order in which they were defined, except those in arrays. The value of a variable can then be changed by over-writing it.

Trace — displays the program line number as it is being executed in a small window at the top right-hand corner of the screen. The Shift or Ctrl keys slow down the display if it is too fast. This is useful for finding infinite loops within a program.

Step — halts the program after each program instruction, displays the line numbers associated with that instruction and the first line number of the next instruction. The Shift or Ctrl keys cause the next instruction to be executed.

Off — cancels the Trace and Step modes.

Prog — changes the assignments of the function keys to normal Basic commands.

Merge — loads a previously stored program or subroutine from disc or cassette and incorporates it into the program already in the Vic's memory.

Kill — cancels the functions of the cartridge, but leaves the assignment of the function keys unaltered. It is necessary to inhibit the cartridge during normal program operation because memorising information for diagnostic messages such as Help increases execution time.

Ctrl A — scrolls up a listing.

Ctrl Q — scrolls down a listing.

Ctrl L — blocks out all the characters to the right of the cursor on a line.

Ctrl N — blocks out all the characters on the screen after the cursor.

Ctrl U — blanks out the line on which the character is positioned.

Ctrl E — inserts information between quotation marks on a program line.

VIC-20 ADD

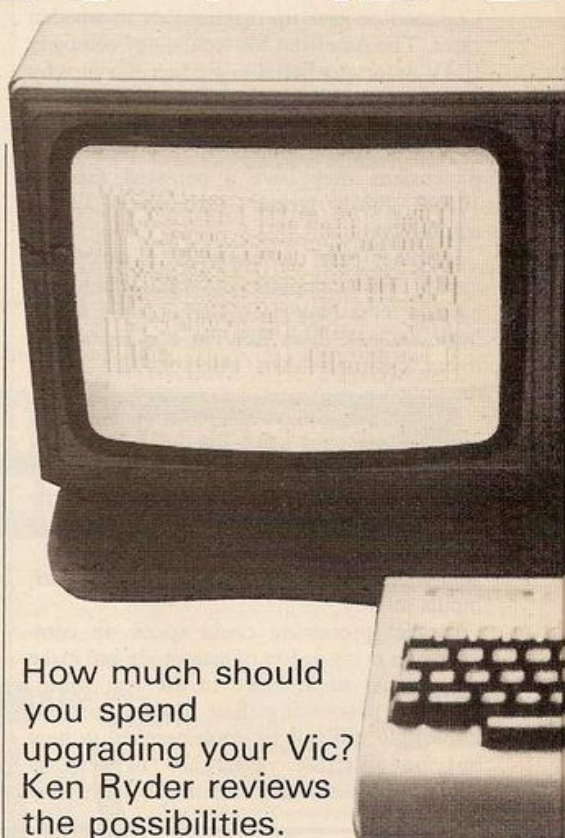
IF YOU WANT to upgrade your Vic-20, expanding the memory must be a priority. A screen expansion and some aids to programming in Basic and machine code are also often near the top of Vic-owners' shopping lists once they have tired of cartridge games.

With the Commodore expansion system a 3K, 8K or 16K memory pack can be plugged directly into the back of the Vic to give a maximum on-board memory of 21K, 19.5K of which is available for Basic programs. In order to expand to 32K a motherboard with six expansion slots can be plugged into the back of Vic allowing the 3K, 8K and 16K cartridges to be used together. This leaves three slots available for utility cartridges such as the programmer's aid, machine-code monitor, and games packs.

When the Vic has been fully expanded to 32K only 27.5 is available for Basic programs because the area of memory occupied by the 3K RAM pack is no longer used. However, it is still available for storage of machine-code programs, and for Peeking and Poking values to, so you could store an alternative character set or several screens of information there.

One of the main criticisms of the Vic is its 22x23 screen display, and a 40-column option has been long awaited. The Beebox was one of the first attempts, but was expensive and the manufacturer has now gone out of business. Stack Computer Services has stepped into the breach with a 40/80 column x 25 row monochrome card.

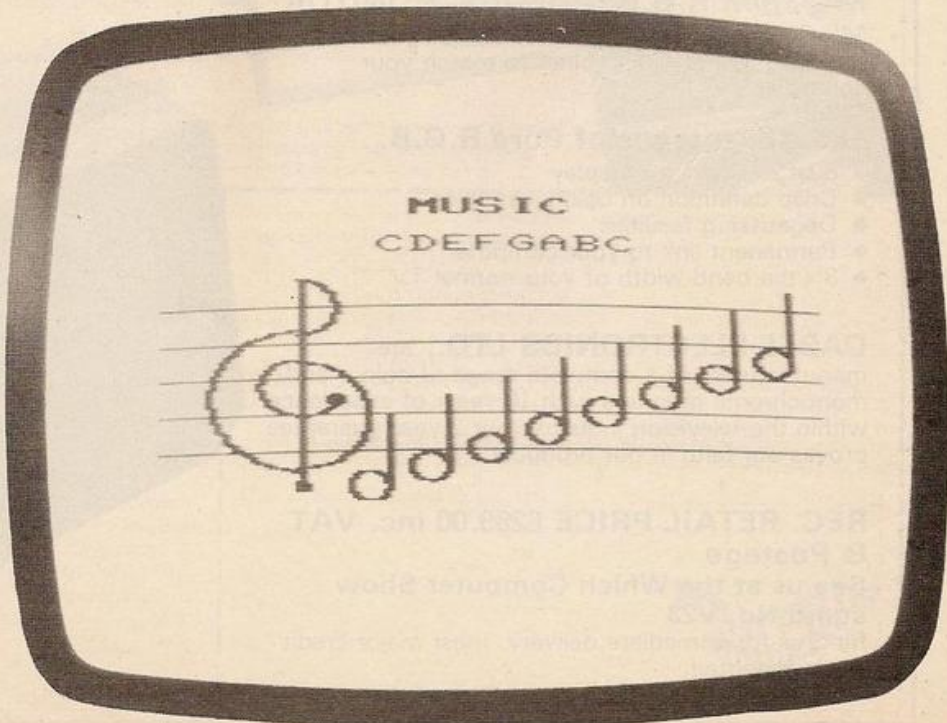
As soon as Commodore's Super Expander cartridge is plugged in you have 3K of extra RAM. The function keys assume eight single keystroke commands, which you can redefine if necessary. Nine new Basic commands are



How much should you spend upgrading your Vic? Ken Ryder reviews the possibilities.

available for plotting and colour control. Eighteen commands become available for the production of sound and music, and seven for reading values of sound and colour registers, including inputs from devices connected to the games port such as joysticks and light-pens.

The pre-assigned function-key commands





are Graphic, Color, Draw, Sound, Circle, Point, Paint and List. These may be changed using the Key command to any 128-character string, including a carriage return if required. If you do not want to use those graphics commands in a program, the function keys could be used to enter standard Basic commands instead such as Next, Goto, Print, and Gsub.

Unfortunately, the cartridge does not use the highest resolution available on the Vic, 176 × 184, but reduces the screen area slightly to 20 rows by 20 columns, giving a maximum resolution of 160 × 160. Presumably Commodore did this to reduce the screen memory overhead. Then for some reason they divided the screen into a 1024 × 1024 co-ordinate system with its origin in the top left-hand corner of the screen. As there are only 160 × 160 possible plotting positions this means that several co-ordinates occupy the same pixel.

Graphic selects one of the four graphics modes. These are: normal text, medium resolution, 80 × 160, multi-colour graphics allowing any of the 15 colours on the Vic to be used, high-resolution mode, 160 × 160, allowing only the eight keyboard colours to be used, and high-resolution multi-colour mode which allows the mixing of the high-resolution and medium-resolution multi-colour options. All of the modes except normal text require 3K RAM for the screen.

There are four colour registers available and a number from 0-15 can be stored in each,

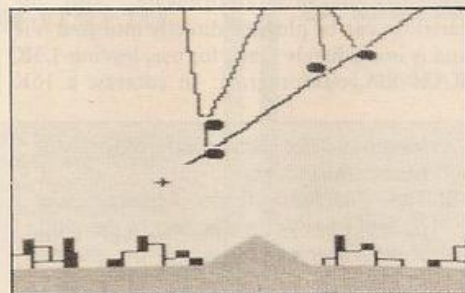


specifying a colour. Register 0 holds the screen colour, register 1 holds the border colour, register 2 holds the character colour used for plotting points and register 3 holds the auxiliary colour which also can be used for plotting, but only in multi-colour mode. The Color command sets the values for these registers.

Point plots a point on the screen at specified co-ordinates. Several points can be plotted using a single Point command, but all will be the same colour. The colours available and resolution depend upon the graphics mode selected. Region changes the character colour, register 2, to any of the eight keyboard colours in high-resolution mode, or any of the 16 colours in multi-colour mode.

Draw plots a straight line from one set of co-ordinates to another, for as many points as can be specified in an 88 character line. It can also be used to plot lines from the finishing points of previously drawn shapes and circles. Circle is an extremely powerful command allowing the user to draw circles, ellipses and arcs on the screen.

Paint fills an enclosed area with a colour starting at specified co-ordinates within the area. If the co-ordinates are outside the area, or the area is not fully closed then the whole



screen will be painted. Again the colours available depend upon the graphics modes.

Char permits strings of text to be displayed on the screen whilst in high-resolution or mixed mode. This facility is not available in medium-resolution multi-colour mode. ScnClr — clears the graphics screen.

The number and range of colours available in each graphics mode is a little complicated. The screen consists of 20 × 10 double-height blank characters, and there is a colour block associated with each character. In multi-colour mode medium-resolution plotting can be performed in any of the colours specified in registers 1, 2 and 3 against the background

REVIEW

colour of register 0 and any of the 16 colours can be entered in each register. Thus four colours can appear on the screen at one time.

In high-resolution mode plotting can only be performed in the character colour registers, and only the eight keyboard colours can be used. During a program the character colour can be changed using the Region command, but if two points of different colours try to occupy the same colour block such as two lines intersecting, some interference will occur. With careful programming it is possible to use all eight colours on the screen at one time.

In high-resolution mixed mode only registers 0 and 2 can be used for plotting, and all 16 colours can be specified. If the colour set in register 2 is one of the keyboard colours, all points will be in high resolution. If it is one of the other colours, plotting will be in medium resolution. Again if points of different colours or resolutions try to occupy the same colour block some interference may be produced, but with care it is possible to use all 16 colours on the screen at one time.

The music capabilities of the Vic are greatly enhanced by the Super Expander cartridge. The Sound command controls four voices and their volume, and can be used to produce two or three note chords. Each voice is allocated a three-octave range, which at first sight appears to give nine octaves. However some of the octaves overlap giving a five-octave range.

Entering Music Mode with the Ctrl and ☐ keys, converts keys A, B, C, D, E, F, G, #, \$, P, Q, V, S, O, R. into musical commands. Keys A-G play the natural notes A-G. If # is pressed before the note a sharp is played, if \$ is pressed before the note then the note is flat. V controls the volume of the note and R is a rest or silent period. The duration of the note or rest is determined by tempo, T. Any of the four "voices" can be chosen with S, and any of the three octaves in its range with 0. S302V5T9# A, plays A sharp of voice 3 in octave 2 at volume 5 for time 9; approximately 4 seconds.

All of the musical commands can be displayed on the screen by entering P, and this can be cancelled by Q. These commands can be entered directly at the keyboard, or they can be combined in a string and executed by a Print statement within a program.

There are also several commands which can be used to read the colour and sound registers, or test the condition of various peripherals

(continued on next page)

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that can be plugged into the games port. Rgr reads the mode set by the Graphic command and Rcolr reads the values of the registers set by the Colour command. Rdot reads the colour of any point on the screen and Rsnd reads the values of the four voice registers and their volume as set by the Sound command.

Rpot reads the values of any paddles or potentiometers connected to the user port and returns a number in the range 0-255. Rpen reads the X, Y, position of a light-pen on the screen and Rjoy reads the position of a switch-type joystick and its fire button.

Documentation consists of a 22-page booklet which describes each command complete with a small programming example. If you are thinking of buying a 3K expansion pack and want to use your Vic for graphics and sound, spend an extra £5 and buy the Super Expander cartridge — it is well worth it.

The Vic-20 Programmer's Aid Cartridge is a useful tool for writing, editing and debugging Basic programs. When first plugged into the Vic or expansion board it has no effect and must be initialised to gain access to the extra commands. This is achieved by typing SYS28681 followed by the Return key. Those of you familiar with the Vic memory map will realise that the area starting at location 28681 normally resides in an 8K block of RAM, if fitted. If you have a fully expanded Vic the last 8K block of RAM will be unavailable when using the Aid cartridge, allowing only Basic programs of 19.5K or less to benefit from it.

After initialisation the cartridge is in program mode and the function keys are assigned 12 useful Basic commands such as Goto and Gosub. Normally only eight function keys are available, the other four, F9-F12 are obtained by holding down the CTRL key and pressing the function keys. The Edit mode is entered by typing Edit, or by pressing the Ctrl and F1 keys together. In this mode the function keys are assigned special editing commands, which cannot be included in Basic programs such as Delete, Find and Step.

The function keys simply allow single-keystroke entry of commands and do not limit

the commands available. The user can even as sign his own commands to the function keys if desired using the Key command.

The cartridge comes complete with a 15 page instruction book describing each new command, together with a short programming example. The final section uses a dice-throwing program as an example of how to write and debug a Basic program using the features of the cartridge.

Anyone writing long complicated Basic programs of 19.5K or less will find this cartridge invaluable. The time and effort saved in program development could soon cover the cost.

Vicmon as the cartridge is affectionately referred to in the documentation, is similar to the Programmer's Aid, except that it simplifies the writing and debugging of assembly language programs rather than Basic. Typing SYS24576 followed by a Return initialises the cartridge, again the last 8K RAM block is occupied by Vicmon.

The function keys are not assigned any values. Upon initialisation the screen displays the contents of the 6502 registers, that is the program counter, status register, accumulator, index register X, index register Y and stack pointer. The commands offered are single characters followed by various parameters such as start or finish addresses, op-codes, operands and hex values. In fact all operands must be preceded by \$.

Vicmon should not be confused or compared with a full assembler/editor. It is a simple aid for the production of short machine-code programs or subroutines. For anyone who has tried hand assembly and a Basic loader for machine code this cartridge is heaven sent, reducing nervous breakdowns to a minimum. Although as all operands must be entered in hex, a decimal to hex conversion command would have been welcome, but I suppose you can't have everything.

At £35 this cartridge appears expensive when compared with some cassette-based assemblers, however, you are paying for the reliability of quality firmware. Also the cartridge can be plugged directly into your Vic and is immediately ready for use, leaving 3.5K RAM for your program. In contrast a 16K

RAM pack may be required to load a good software assembler.

The documentation assumes the same layout as the previous cartridges. It is aimed at the reader who is familiar with 6502 assembly language, but not an expert. The cartridge commands are presented in alphabetical order, leading to some page flicking, as some of the earlier commands refer to others further on in the text. Some important information, although obvious, is missing. For instance the M command can be used to create word tables or blocks of data as well as editing them; an example of the format required for each form of addressing would be beneficial; for conditional branching only the address to be branched to need be specified, this is only implied in an example; all two-bit addresses are entered MSB,LSB rather than LSB,MSB as in some assemblers.

Stack's 40-column card plugs directly into the back of the Vic or any expansion-board slot, and comes complete with its own video chip to control the display, 2K RAM for the screen memory, and the normal Vic/Pet character set in ROM. The card uses the Autostart facility of the Vic and if no action is taken at power-up the display is automatically in 40-column mode. Various key combinations during power-up will obtain the 80-column or normal Vic configurations. The display can be changed at any time, either directly from the keyboard or under program control.

The card comes complete with monitor and UHF output sockets, either of these together with the Vic's normal UHF output can be used to drive two separate televisions or monitors. For example a program listing or a table of results can be displayed on the 40/80-column screen whilst a graph is plotted on the other.

The card also offers a couple of other useful features. The screen can be set to give automatic line spacing, and if the normal Vic screen is not required the 1.5K memory normally allocated can be used for Basic program storage, also the lower 3K of RAM can be used for Basic giving the Vic a true 32K expansion potential. Obvious uses are word processing, communications, business applications and education.

CONCLUSIONS

- Commodore's cartridges are well presented and constructed, the firmware is professional and bug-free.
- The approach of the documentation is far superior to that of the Vic-20 user manual, including contents, introduction, examples, summary and indices, but the demonstration programs could be better.
- The Super Expander Cartridge offers good value for money and should be purchased in preference to a plain 3K RAM pack. It would be a great advantage if the Super Expander functions could be included with 16K RAM instead.
- The Programmer's Aid offers many useful editing and debugging features, but can only be used to develop programs up to 19.5K in

length. This limitation may well restrict its market.

- The Machine Code Monitor will appeal to anyone wanting to develop short assembly language programs. It falls nicely between the two extremes of hand assembly/Basic loader, and a full assembler/editor. The cartridge limits the maximum possible program RAM to 22.5K but this should be no real restriction to assembly language programs.
- Stack's 40/80-column board is a welcome addition to the Vic range of accessories. However, the cost, monochrome display and inability to give high-resolution graphics, 320 x 192, may fail to appeal to the home user market.
- Vic owners should consider their expansion plans carefully. If you are

only interested in Basic programming and do not require high-resolution graphics, it seems pointless to buy a 3K RAM pack as it will not be available for Basic when expanding above 6.5K.

- Expanding above 19.5K may be a waste of money and RAM if you want to use the Programmer's Aid, because the top 8K of expansion area is occupied by this cartridge when in use. If you are only interested in assembly language then Vicmon may be all you need, plugged directly into the back of your Vic the 3.5K on board will go a long way.
- The Programmer's Aid, Super Expander and Machine Code Monitor each cost £34.95, 3K of RAM costs £29.95 and the Stack 40/80-column card costs £115.

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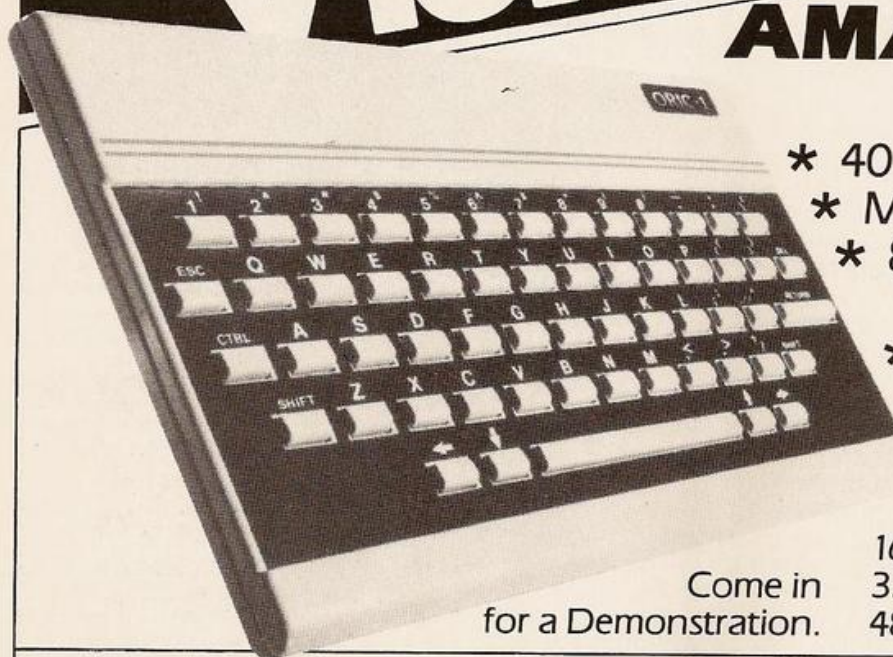
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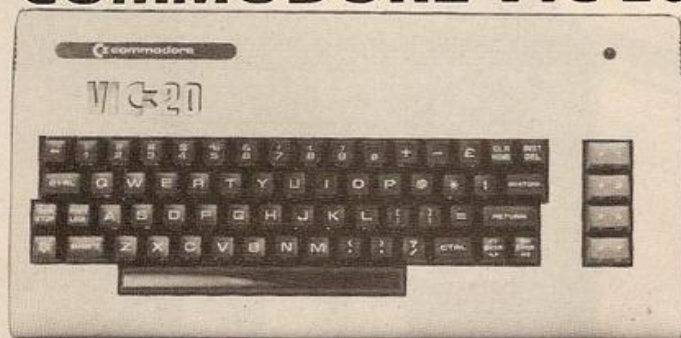
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GRAPHICS TABLETS

How often have you wanted to input a picture or a design straight into your home computer? Simon Beesley evaluates two products for the BBC and Sinclair machines which claim to allow you to do just that.

GRAPHICS TABLET

THE RD DIGITAL TRACER enables pictures to be drawn or copied to the Spectrum's screen. It consists of a mechanical arm which is hinged at the base and the middle and can be mounted on a drawing board. At each joint of the arm there is an angular transducer. Signals sent by the transducers are digitised by an interface board, plugged into the rear of the Spectrum. The board has a connection to take a ZX Printer or Microdrive.

The kit also includes a software cassette, an instruction booklet, a tracing sheet and a template for aligning the tracer with the tracing sheet.

Drawing program

Once you have loaded a drawing program you can transfer a picture to the screen by moving the head of the tracing arm.

Probably the most important question to answer is how easy is it to transfer an outline to the screen accurately. The tracer picks up movements within an area 30cm. by 20cm. Since the Spectrum's resolution is 255 pixels by 175 this gives just over a millimetre per pixel. The arm certainly responds to movements this small, but achieving an exact screen copy depends more on how much fine control the arm's action allows.

As with a joystick, the problem is to strike a balance between too much give and too much resistance: few people can manage to control a joystick steadily if it moves too freely, and, on the other hand, too stiff an action is equally likely to result in jerkiness.

The RD Tracer scores quite highly in this

department. Although the action is fairly free you can steady its movement by putting pressure on a pencil inserted in the tracing head.

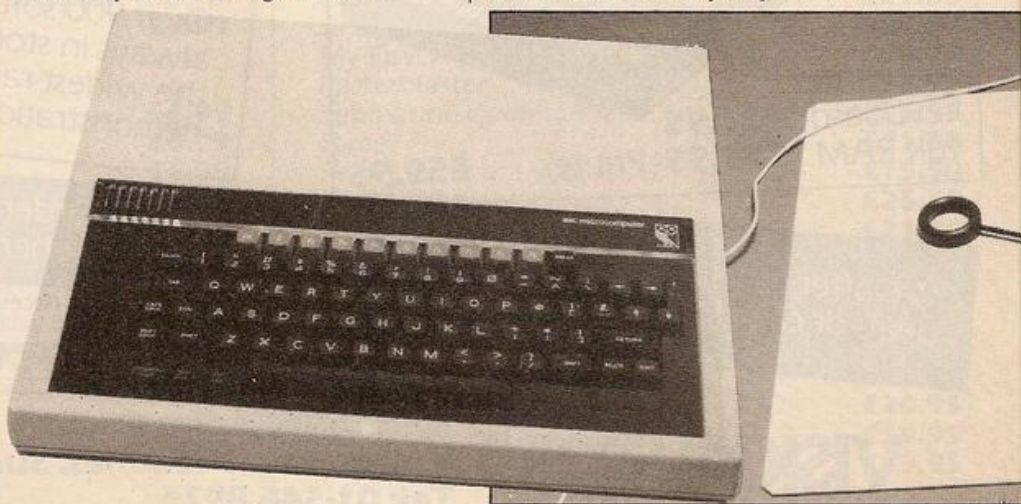
Four programs are included on the software cassette, which can be used alone or merged together. The main drawing program provides a number of plotting options and also allows you to use Spectrum Basic's plotting functions. Single-letter entries allow you to plot individual points or draw a continuous line, change the background or foreground colour, delete lines and print text. Among the other options is a facility for filling in or shading the area enclosing the tracer. The position of the tracer on the screen can be indicated by a small or large crosswire.

You can draw a circle using the Spectrum's Circle command and define the centre and radius through the tracer position. The Spectrum's facility for saving the screen to tape is also available.

The plotting modes

These and other plotting modes enable you to copy a picture to the screen as closely as the Spectrum's resolution and colour range permits. But putting a detailed colour picture on the screen could be a lengthy process. The programs are written in Basic and some of the routines are rather slow.

For example, keyboard entries are not detected instantly and filling an enclosed area can make demands on your patience. Bursts of



SURVEY



rapid sketching are too much for the tracer to copy faithfully.

This is a software, not a hardware, problem. To be fair, the routines RD Laboratories supplies are adequate but machine-code versions would make the tracer much more effective.

The software cassette also contains a program which prints the x and y co-ordinates of the tracer at the top of the screen as it moves and allows the origin and scale of the plotting co-ordinates to be changed. The third program provides a blind-drawing facility; points can be inputted at greater speed than normal and are then drawn at a slower speed.

Lastly, there is a program to design characters which does not make use of the

tracer and which is given free to the buyer.

While the tracer has an obvious use in schools and could perhaps even find a place in an office, RD Laboratories say that they have taken at least 50 percent of their orders from home users.

At a price of £49.95, inclusive of VAT and postage, this is the first such device to be produced which is suitable for low-cost micros.

It will also work with the ZX-81 and two short programs are included for this purpose but the ZX-81's limited screen resolution gives it only a limited application.

Software support

RD Laboratories intends to support the tracer with more general-purpose and specialised software packages. Details from 5 Kennedy Road, Dane End, Ware, Hertfordshire SG12 0LU. Telephone: 0920-84380.

Micro Management's Graphics Tablet for the BBC Model B comes ready-mounted on a Perspex board measuring 70 by 56 cm. Like the RD Digital Tracer the tablet has two cylindrical hinges at the base and the centre. Both the central hinge and the tracing head rest on the board which is covered with a Cellophane sheet to permit them to slide freely.

This is a rather more substantial piece of equipment than the Spectrum tracer but can be moved around the board with equal steadiness.

The manual warns that on early models of the BBC wavering might occur around the screen cursor point when drawing. The explanation is that the power pack and other components produce interference.

Wavering certainly occurred on one of the BBC Micros used but cleared up completely on a later model. The company suggests that if the problem persists after you have consulted a dealer you might like to buy their "splendid external converter" which should cure it.

While the hardware appears to be well designed the graphics tablet is poorly served by the software that accompanies it. A program is supplied on cassette and provides many of the same drawing options as the Spectrum tracer's software. These include facilities for drawing a straight line, filling a shape, changing the colour of the line, printing text and displaying the x and y co-ordinates of the cursor. In addition there are commands to position and draw the x and y axes, and to calculate the area of a shape in terms of a scale and units which have previously specified.

Setting the limits

Before drawing, the user needs to set the limits of the drawing area by moving the arm to four positions in sequence. Alternatively these initial settings can be loaded from tape. Screen pictures can also be saved to and loaded from tape.

These options, however, are not well presented. The program gives the user no indication of which plotting mode it is in; no prompts appear on the screen when an input is expected and the position of the cursor is marked by one barely visible pixel.

The existing set of commands allow the user to copy a picture to the screen fairly easily. But given the scope of BBC graphics and the speed of BBC Basic one might reasonably expect a more sophisticated package. It would not have been difficult to have included options for changing the background colour or drawing with a dotted line. A circle-drawing facility would also be useful.

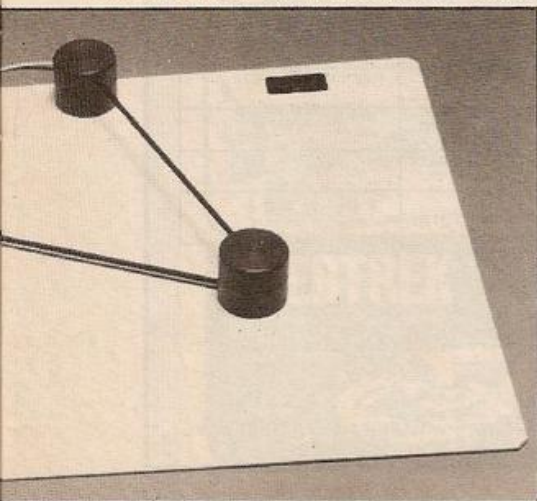
The program provided is a rather makeshift piece of software which makes little use of some of the best features of BBC Basic. Micro Management might reply that the program is not intended to be more than a sampler. But if that is the case the tablet begins to look rather expensive. It costs £86 which seems a lot for what is essentially quite a simple device.

Unlike the Spectrum the BBC Model B already has four analogue to digital converters on board and BBC Basic supplies the ADVAL function to read the converted digital input from the Analogue In port.

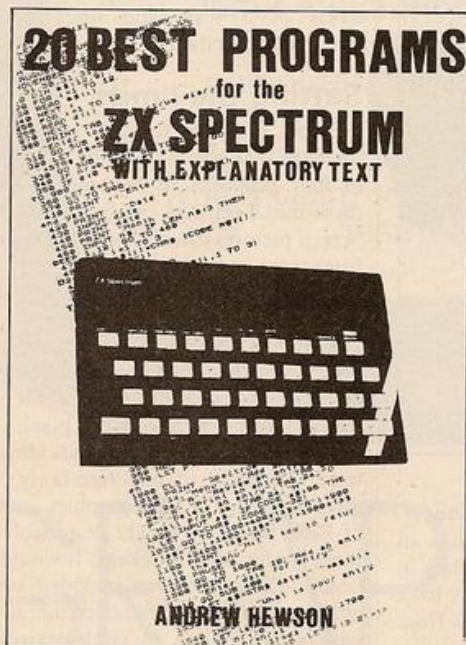
The BBC Graphics Tablet is available from Micro Management, 32 Princes Street, Ipswich, Suffolk. Telephone 0543-59181.

CONCLUSIONS

- Both devices allow a picture to be copied to the screen accurately, if rather slowly.
- The Spectrum Tracer's price and light-weight construction make it suitable for the hobbyist and for use in schools.
- Software for the Tracer is adequate but could be greatly improved upon.
- The BBC Graphics Tablet has a more solid design which affords a greater degree of fine control. With appropriate software it could find a wider application, outside the confines of the home and classroom.
- The program supplied with the BBC Tablet is barely satisfactory and scarcely justifies its relatively high cost.



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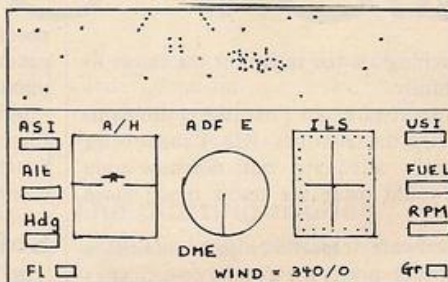
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"Programs for the people"

THE QUALITY of Spectrum software has improved since our last survey but originality remains in short supply. Most of the programs looked at are games programs and the bulk of these are modelled on the arcade classics, Space Invaders, Pac-Man, Defender and Asteroids. Perhaps this is because the games-buying public is only interested in games that fall into a recognisable category.

Some of the programs are written entirely in Basic. This need not count against them unless the program displays moving graphics.

The Spectrum's keyboard is not very suitable for fast-moving games although Quicksilver and Softek offer a joystick option on some games.

Sinclair has released a large range of programs written for them by ICL and Psion. By and large the ICL programs compare badly with those from Psion and have a rather amateurish look to them.

Each of the tapes in the ICL games series, Games 1 to 4, contains four short Basic programs with titles such as Galactic Invasion, Skittles and Train Race. These are the sort of programs a reader might like to key in from a listing in a magazine. They are fairly simple and afford a limited entertainment for a short period. In view of their variety each package represents reasonable value although they are perhaps more suitable for young people.

ICL has also produced five titles in a Fun to Learn series covering Music, History, English Literature, Geography and Inventions. They present a variety of quizzes on their respective subjects. Players can compete against each other in a race in which correct answers send them further along the track.

It is difficult to know who these programs



SPECTRUM SOFT

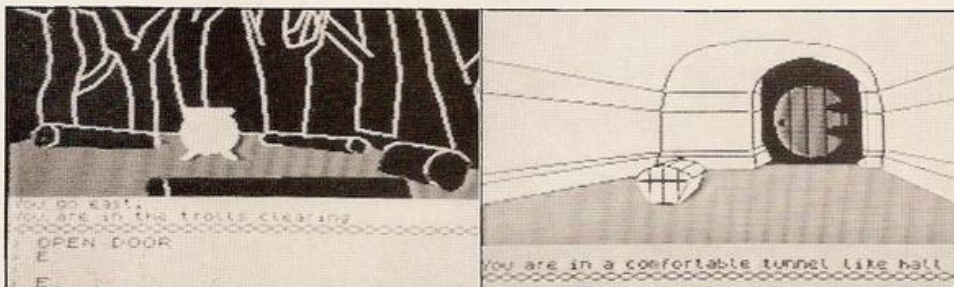
are aimed at. One soon runs through the stock of questions and the same names appear in different types of question. Some of the information presented is too obscure or eccentric to make the programs suitable for schools. In the English Literature quiz, for example, Ian Fleming rubs shoulders with Shakespeare and little-known seventeenth century playwrights.

Psion's collection of programs is far more satisfactory. Hungry Horace is loosely related to Pac-Man but has a number of original features. Horace has to eat the flowers in a park while avoiding the park guards. Sinclair gives a fair description of Horace as a subtle and amusing cartoon-style game.

Psion's 48K chess program was written in conjunction with Microgen. It plays a remarkably strong game even at the lower levels. As an averagely competent player I found it quite hard to beat at level two, although its play seemed to come adrift under pressure. The program's response time is quick and the pieces are quite easily distinguished.

Space Raiders and Planetoids are Psion's versions of the arcade games Invaders and Asteroids. Anyone who still has an appetite for these games will find the Psion products more

Simon Beesley braves attacks by trolls, bombardment by meteoroids, alien invasions and even English literature to bring you up to date with Spectrum software.



Top and above: *The Hobbit*. Right: *Meteoroids*, above right, *Fun to Learn*, and over page *Time Gate*.

than adequate. With Vu-Calc, Psion has scaled down a Visi Calc-type program to the dimensions of the home micro. These programs, which are commonly used on business micros, are usually described as providing a financial spreadsheet.

They enable the user to lay out financial data in rows and columns and enter formulae to run calculations on parts or all of the table.

Vu-Calc supplies a range of commands for entering data, text or formulae and performing calculations.

Basic programs which have been compiled by Softek's compiler, Super C, run — typically — 10 times faster. The compiler sits at the top of memory above RAMtop and is unaffected by a New command. It leaves room for a Basic program of up to 8K and a further 10K for

WARE

data. The present version cannot cope with decimals, arrays or string variables. These limitations need not be too constricting. Strings, at least, can be stored in the data areas as ASCII codes and accessed through Peeks.

At £14.95 this is good value; particularly since it enables people to write commercially respectable programs without having to master machine code. However Softek insists that anyone planning to sell programs created with the compiler should negotiate for the rights. Softek claims that trace elements have been included to detect code written with Super C.

The arcade game Asteroids crops up on almost every micro. Softek's version Meteoroids is one of the fastest for the Spectrum with good colour and sound. Softime supplies the Spectrum with a digital clock and alarm at the top of the screen which remains there while other programs are loaded and running. The last program in Softek's list is Zolan Adventure, a standard text adventure game which has the merit of fitting into 16K.

Quicksilver gave Time Gate considerable advance publicity claiming it would make as great an impact on the computer games' world as had Atari's Star Raiders. As it turns out the

game closely resembles Star Raiders. Given that the Atari is a rather more sophisticated computer it is not surprising that the Spectrum version of the game does not match the original.

Time Gate presents a view from the cockpit of a spaceship. An instrument panel below contains a long-range scanner and a variety of other indicators giving information on the ship's position and damage incurred. Your mission is to clear 18 galactic sectors of enemy craft.

The business of locating and firing on enemy ships is not as interesting as attending to all the other procedures. The controls are not as responsive as on the Atari. Nonetheless this is an elaborate game with excellent graphics — certainly one of the best so far for the Spectrum.

In an impressive piece of synthesised speech Quicksilver's chess program announces itself at the beginning with "this is the Chess Player". Rather startlingly the packaging relates how the Chess Player, an Evil Being, has called for a challenger from Earth. The planet's survival hangs on your game — and you thought you were just going to have a quiet game of chess.

In the event the program plays quite a strong game with the option of six levels of play. The board is clearly displayed and the pieces are well designed. Psion's chess program, however, is probably the better player.

Meteor Storm, another version of Asteroids, also announces itself but rather indistinctly. There is not much to choose between this and Planetoids or Meteoroids. The major problem for software companies writing an Asteroids-

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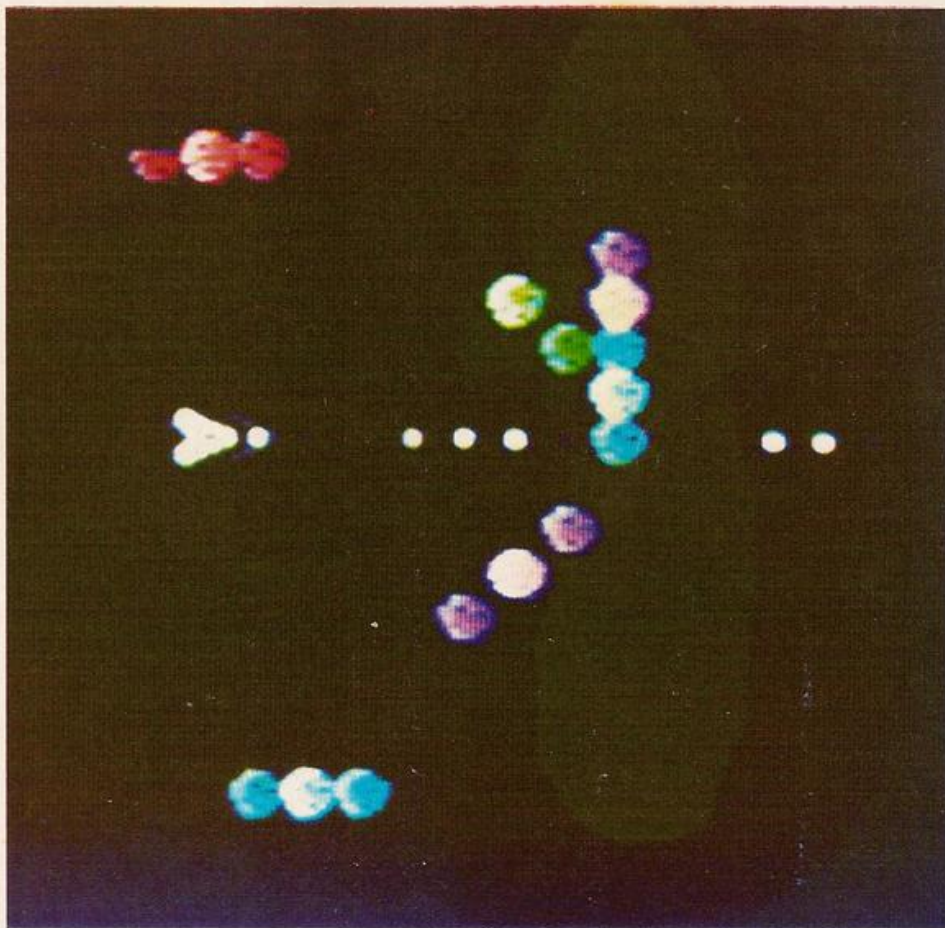
type game must be in finding an alternative title.

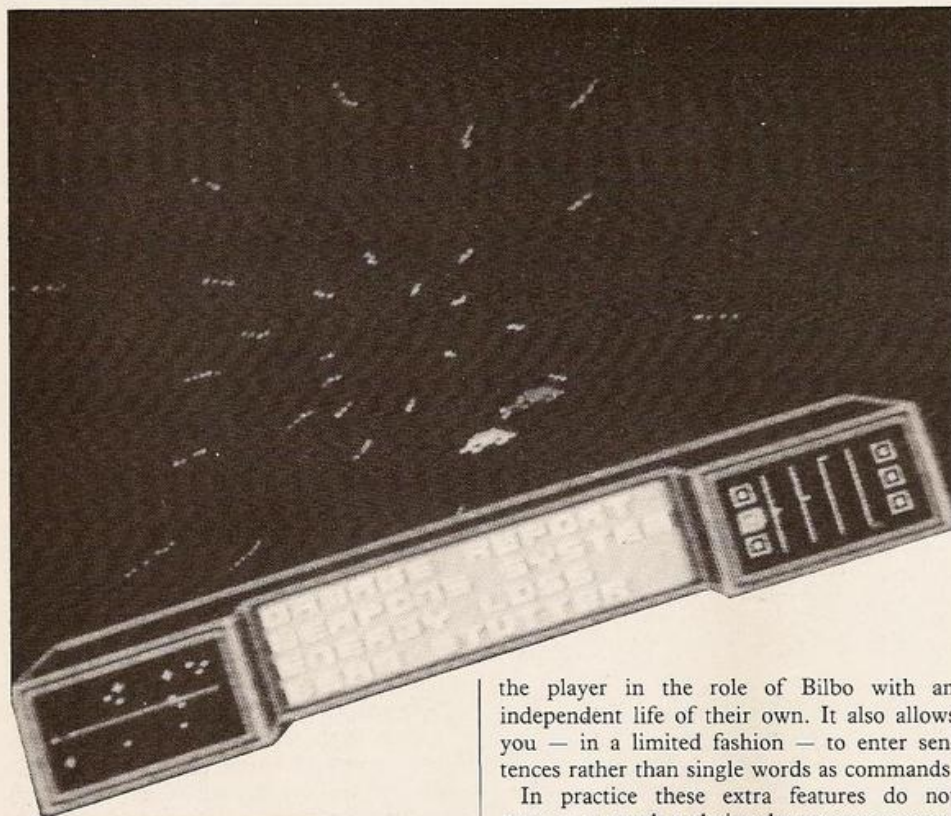
Spectres from Bug-Byte gives a novel twist to the Pac-Man concept. Eddie the electrician has to rewire a haunted house. Instead of eating or picking up objects in his path he lays down light bulbs. Reaching one of the four power generators enables him to illuminate the house and drive off ghosts.

The game has a highly individual flavour. The characters which glide around at a fairly leisurely pace, are engagingly different from the standard Pac-Man figures. This is one of the more original games yet to appear for the Spectrum.

Gulpmen from Campbell Systems is also based on Pac-Man but refreshingly breaks away from the standard format. It offers a choice of 15 different mazes and allows the speed of play to be set. At the highest levels your little man dashes around the maze at quite a pace.

(continued on next page)





(continued from previous page)

By contrast Jega's Specman, written in Basic, is dismally slow. Sometimes the ghosts seem to be stricken with paralysis and unwilling to take up the chase.

Escape from New Generation Software is a variation on the maze theme which involves escaping from dinosaurs. The dinosaurs — brontosauri, pterodactyls and such like — pursue the player's character with considerable animation through the maze which is shown in bird's-eye view.

Silversoft's games Orbiter and Ground Attack are probably the best Spectrum versions of the arcade games Defender and Scramble. Ground Attack requires the player to fly a plane through a series of caverns and avoid or destroy missile attacks from the ground. Scramble from Work Force is similar but marginally slower. Likewise Avenger — Abacus' version of Defender — is competent but not quite as accomplished as Silversoft's.

Mystery meeting

A gold sundial worth £6,000 is the prize for the first person to solve all the clues in the adventure game Pimania. As in Kit Williams' book *Masquerade*, deciphering all the clues will lead the winner to a meeting at a specific time and place with representatives from the authors of the game, Automata Ltd.

The other side of the program tape contains a disco single. Automata say that the clues are scattered in the music, the program and the graphics. Although we did not proceed very far with the quest the music and opening graphics seemed to bear out Automata's claim that the world of the Pi Man is totally bizarre.

Melbourne House has based *The Hobbit*, on the novel by Tolkien. It helps to have read the book in finding your way about.

The Hobbit is claimed to be an advance on other adventure games because it introduces other characters from the book who react to

the player in the role of Bilbo with an independent life of their own. It also allows you — in a limited fashion — to enter sentences rather than single words as commands.

In practice these extra features do not amount to much and give the program greater scope for the sort of inconsistencies adventure programs are prone to. Thorin, for example, repeatedly enters the scene and tells you to

hurry up. This is irritating because you were unaware that he had left and he seems to be totally devoid of constructive ideas. It is not a good idea, however, to kill him off since he sometimes proves too strong for your attack. Furthermore the manual suggests that you should stay on good terms with the other members of your party if you are to succeed in your quest.

Many of the locations in the adventure are illustrated by some excellent graphics. We only managed to complete 7.5 percent of the game during which the text was accompanied by six different pictures. The graphics coupled with a more varied plot than usual make *The Hobbit* superior to any other adventure games available for the Spectrum.

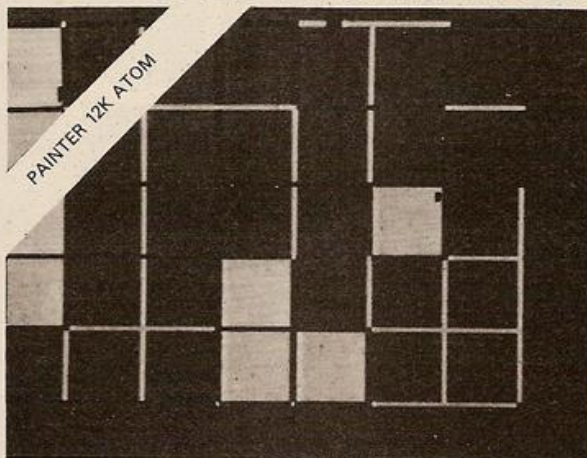
Both the assemblers tested, from ACS and PI software, require Z-80 mnemonics to be entered in Rem statements and both allow addresses to be replaced by labels. The ACS assembler, Ultraviolet, costs twice as much at £7.50 but offers several extra features. It allows multiple statement lines and provides five pseudo-instructions such as DEFS, which inserts a string of ASCII characters at the current assembly position.

ACS also supplies a disassembler, Infrared. Like the assembler this has two different versions for 16K or 48K machines. The program is easy to use and does all you might expect from it.

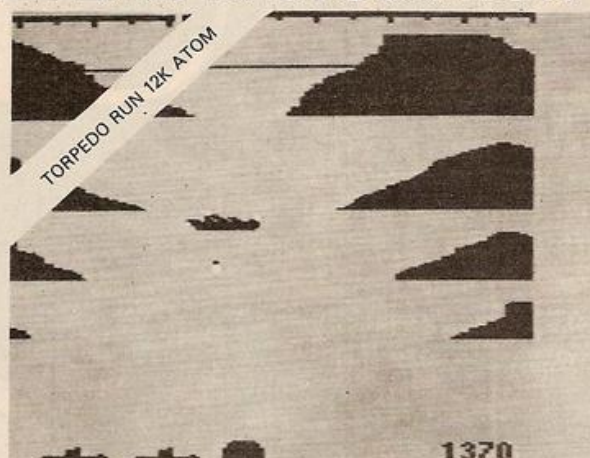
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	Softime	16K	£3.95				
	Zolan Adventure	16K	£4.95				
SS	Orbiter	16K	£5.95				
	Ground Attack	16K	£5.95				
SN	Sinclair Research, Stanhope Road, Camberley, Surrey.	AC	ACS Software, 7 Lidgett Crescent, Roundhay, Leeds LS8 1HN.	WF	Work Force, 140 Wilsden Avenue, Luton, Bedfordshire.		
SF	Softek, 329 Croxted Road, London SE24.	PI	PI Software, 18 Pilgrim's Lane, London NW3 1SN.	JS	Jega Software, 27 Hallcroft Avenue, Countesthorpe, Leicestershire LE8 3SL.		
SS	Silversoft, 20 Orange Street, London WC2H 7ED.	AB	Abacus Programs, 186 Saint Helens Avenue, Swansea, West Glamorgan SA1 4NE.	NG	New Generation Software, Freepost (BS 3434), Old Land Common, Bristol BS15 6BR.		
MH	Melbourne House 131 Trafalgar Road, Greenwich, London SE10.	QS	Quicksilver, 92 Northern Road, Southampton SO2.				
CS	Campbell Systems, 15 Rous Road, Buckhurst Hill, Essex IG9 6BL.	AU	Automata Ltd, 65a Osborne Road, Portsmouth PO5 3LR.	BB	Bug-Byte, Freepost, Liverpool L3 3AB.		

A + F SOFTWARE A + F

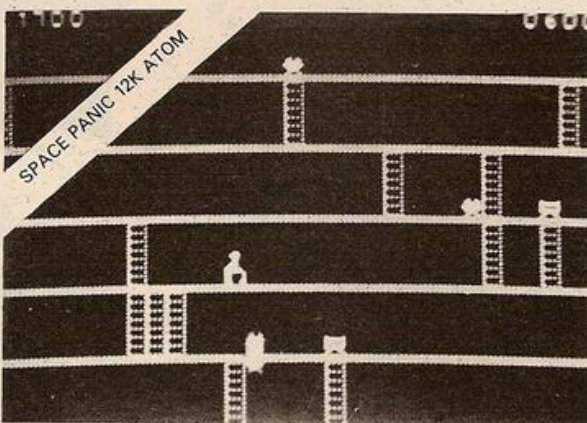
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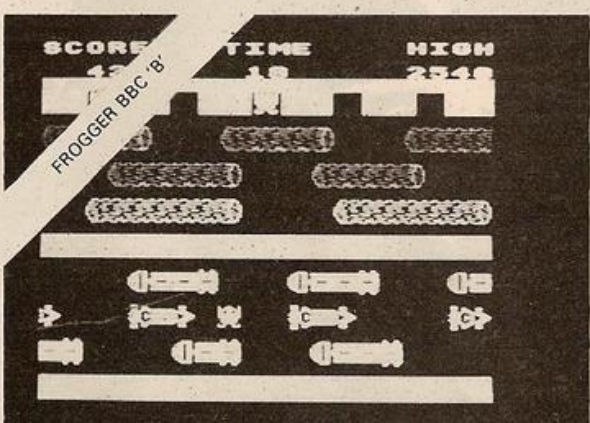
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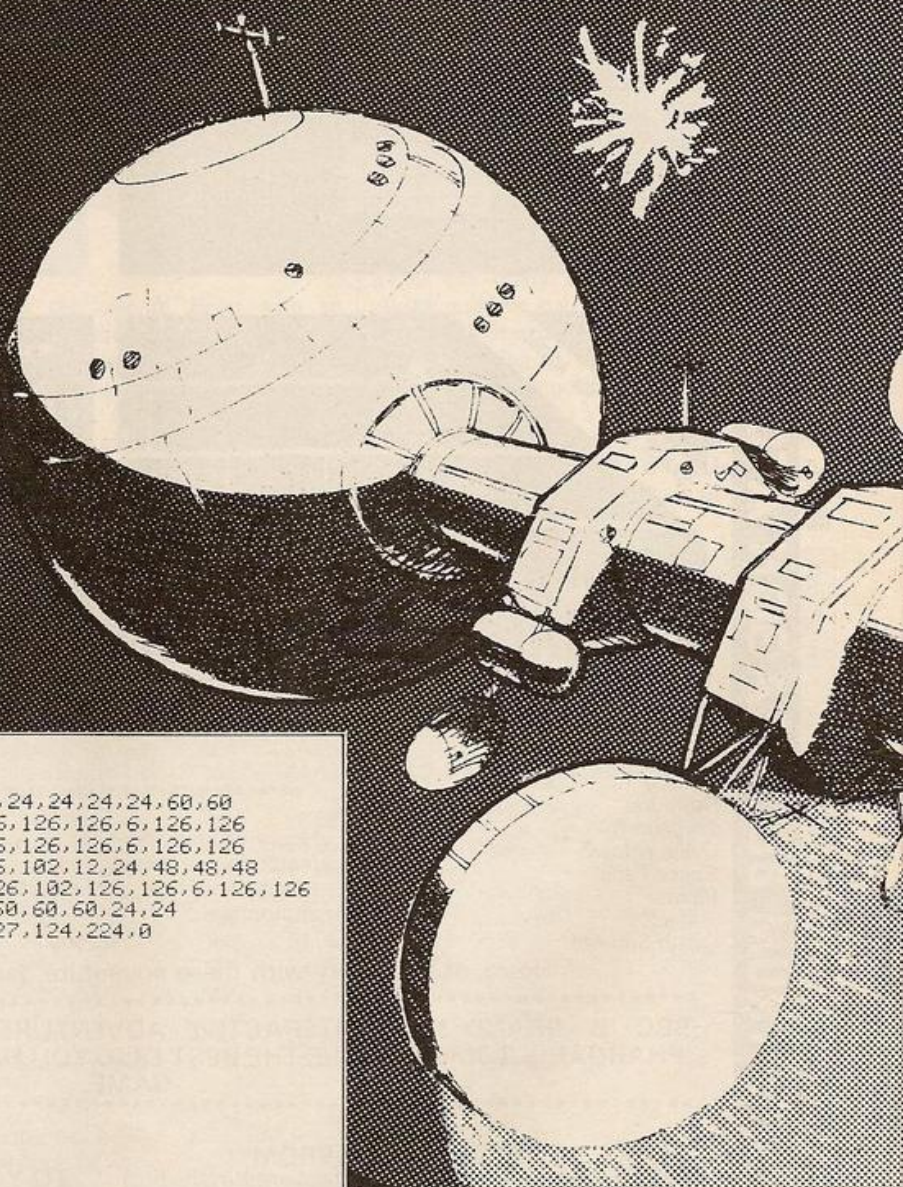
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SPACE RUN

Flee through the cosmos in this engrossing game of pursuit written by David Browne. Malignant alien beings seek tirelessly to destroy your vessel.



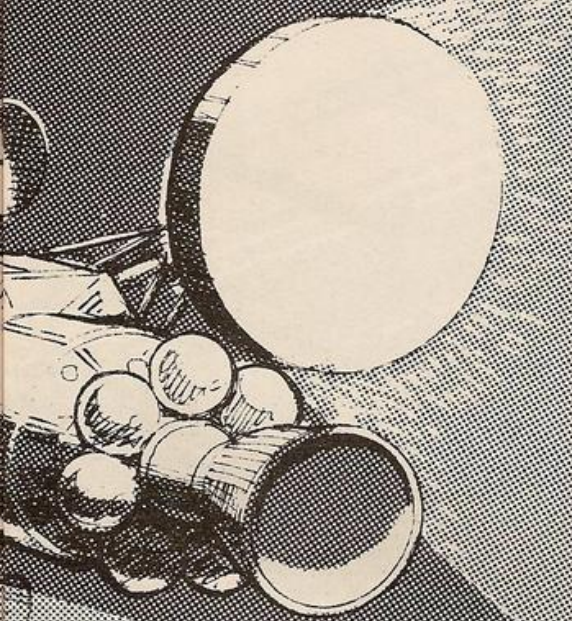
```
0 FORI=7552T07671:READA:POKEI,A:NEXT
1 DATA126,126,102,102,102,102,126,126,56,56,24,24,24,24,60,60
2 DATA126,126,6,126,126,96,126,126,126,126,6,126,126,6,126,126
3 DATA96,96,108,108,126,126,12,12,126,126,96,126,126,6,126,126
4 DATA126,126,96,126,126,102,126,126,126,126,102,12,24,48,48,48
5 DATA126,126,102,126,126,102,126,126,126,126,102,126,6,126,126
6 DATA24,24,60,60,60,126,126,66,66,126,126,60,60,60,24,24
7 DATA0,7,62,254,254,62,7,0,0,224,124,127,127,124,224,0
8 DATA0,60,126,171,213,126,60,0
10 PRINT"00000000"
11 PRINT"00000000"
12 FORT=1T020
13 PRINT"00000000"
14 NEXTT
15 PRINT"00000000"
16 POKE36879,8:TI$="000000"
17 POKE36869,255
18 POKE8185,160
19 PRINT"00000000"
20 GRAPHIC=209:A=7900
21 MINE=160:B=11
22 V=8142
23 Z=5
24 CL=0:POKE36878,15
25 X=8142:SOUND=36876
26 Y=15
27 LC=0
28 C=0
30 KEYS=PEEK(197)
41 IFKEYS=47THENC=1:GRAPHIC=59
42 IFKEYS=39THENC=2:GRAPHIC=58
43 IFKEYS=33THENC=3:GRAPHIC=60
44 IFKEYS=26THENC=4:GRAPHIC=61
45 IFC=1THENA=A+22:POKEA+22+B,160
46 IFC=2THENA=A-22:POKEA+22+B,160
47 IFC=3THENB=B-1:POKEA+B+1,160
48 IFC=4THENB=B+1:POKEA+B-1,160
50 IFA=7702THENC=1:GRAPHIC=59:A=A+22
51 IFA=8164THENC=2:GRAPHIC=58:A=A-22
```

THIS PROGRAM for the unexpanded Vic makes economical use of the user-defined character facility. Fifteen characters are defined in data statements and 10 of these redesign the numbers 0 to 9. It would be easier to read the definitions for numerals from the character set in ROM into RAM — but less pleasing to the eye.

In hot pursuit

The object of the game is to manoeuvre your ship around the screen avoiding two saucers in hot pursuit. Use the keys Z and X to turn left and right, the function keys F1 and F3 for up and down. Watch out for the deep-space mines laid by the pursuing alien hostiles.

NER



```

52 IFB=0THENC=4:GRAPHIC=61:B=B+1
53 IFB=21THENC=3:GRAPHIC=60:B=B-1
54 IFPEEK(A+B)=174THENPOKEA+B,215:GOTO800
55 POKEA+B,GRAPHIC
56 CL=CL+1
65 LC=LC+1
70 IFCL=2THENGOSUB200
71 IFCL=3THENGOSUB500
75 PRINT"  " "TI$";
76 IFPEEK(A+B)=174THEN800
90 GOTO30
200 KM=INT(2*RND(1))
205 IFKM=0THENMINE=174
210 IFB>YTHENY=Y+1:POKEY+Y-1,MINE:POKESOUND,220
220 IFAD>XTHENX=X+22:POKEX-22+Y,160:POKESOUND,225
230 IFAC>XTHENX=X-22:POKEX+22+Y,160:POKESOUND,230
240 IFB<YTHENY=Y-1:POKEY+Y+1,160:POKESOUND,235
250 POKEY+Y,62
255 CL=0:POKESOUND,0
260 MINE=160
265 IFX=AANDY=BTHEN800
280 RETURN
500 KM=INT(2*RND(1))
505 IFKM=0THENMINE=174
510 IFB>ZTHENZ=Z+1:POKEV+Z-1,160
520 IFAD>VTHENV=V+22:POKEV-22+Z,160
530 IFAC>VTHENV=V-22:POKEV+22+Z,160
540 IFB<ZTHENZ=Z-1:POKEV+Z+1,MINE
550 POKEV+Z,62
555 LC=0
560 MINE=160
565 IFV=AANDZ=BTHEN800
580 RETURN
800 POKEV+Z,209:POKEX+Y,209
801 POKEA+B,209
802 PRINT"*****GAME OVER"
803 PRINT"*****PUSH F7"
804 GETA$:IFA$="I"THENRUN
805 POKEA+B,215
806 FOR T=1 TO 10:NEXT T
807 GOTO801

```

One problem with redefining a limited character set is that if the program crashes you will not be able to read the error message to find out at which line an error has occurred.

The solution here is to key in

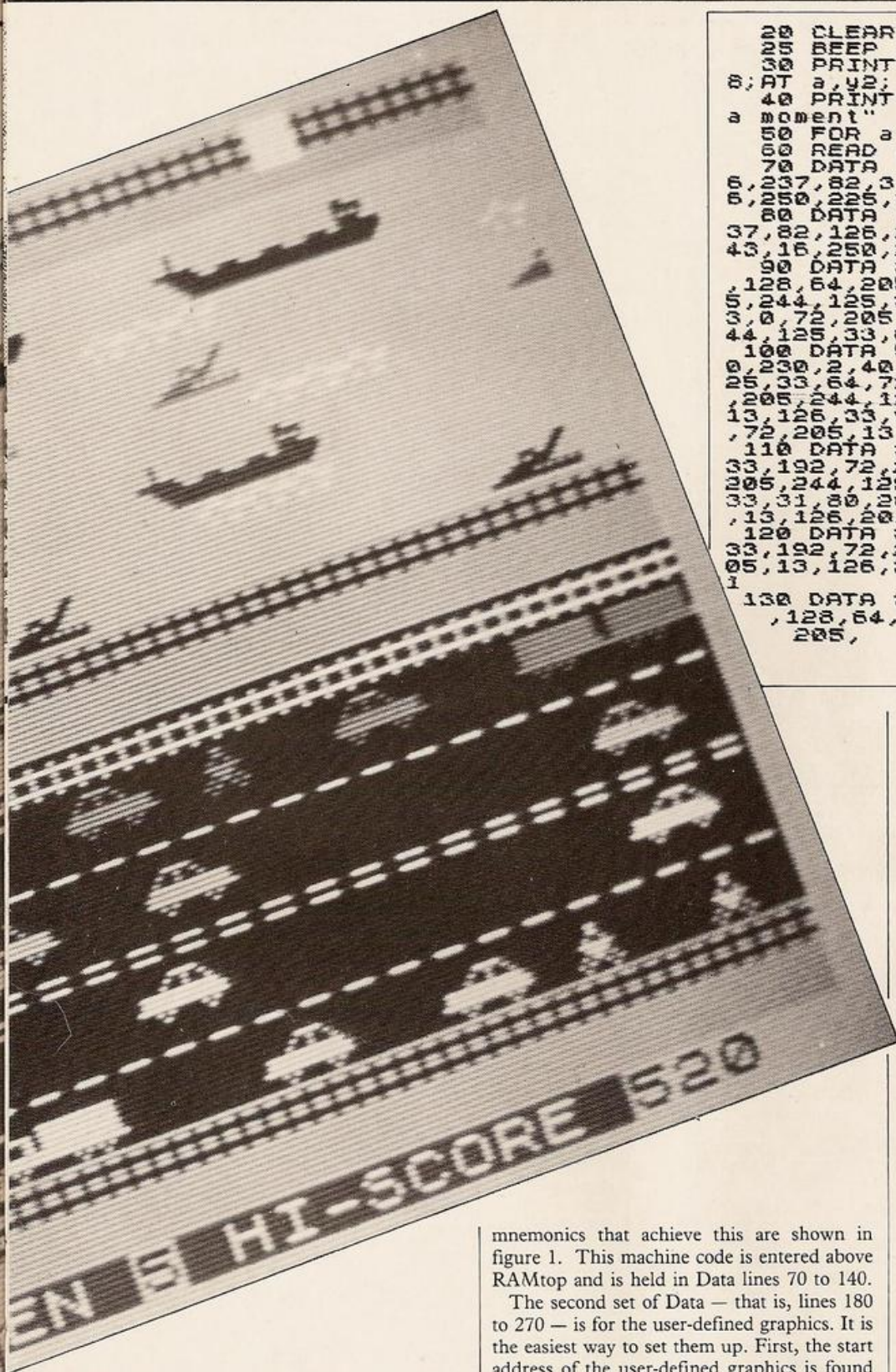
POKE 36869,240

and then press return. This will send the Vic back to the standard character set in ROM and turn the garbage on the screen into letters. Be careful to key it in correctly since the letters you type will not appear as such on the screen.

In line 16 the border and screen colours are set by Poking the value 8 into 36879. Changing this value will set up other colour combinations. ■

Figure 1.

	Code	Address	Mnemonic
	14	000044	LD C 6
RESTORE	20	000045	
?	21	000046	PUSH HL 31
	22	000047	LD DE 31
GO SUB	23	000048	
?	24	000049	ADD HL DE
	25	000050	LD A HL
	26	000051	RRR A
	27	000052	LD B 32
	28	000053	LD A hl
	29	000054	RRR A
	30	000055	LD hl A
	31	000056	INC HL
IF LIST	32	000057	DJNZ -5
	33	000058	
	34	000059	POP HL
	35	000060	INC H
	36	000061	DEC C
REM	37	000062	JR NZ -22
()	38	000063	
	39	000064	RET LD C 6
CODE	40	000065	
RESTORE	41	000066	
?	42	000067	XOR A HL 31
	43	000068	PUSH LD
GO SUB	44	000069	
A	45	000070	ed
	46	000071	LD A hl
	47	000072	ADD HL DE
	48	000073	RLA
	49	000074	LD B 32
	50	000075	LD A hl
	51	000076	RLA
	52	000077	LD hl A
	53	000078	DEC HL
IF LIST	54	000079	DJNZ -5
	55	000080	
	56	000081	POP HL
	57	000082	INC H
	58	000083	DEC C
	59	000084	JR NZ -23
DIM	60	000085	
()	61	000086	
	62	000087	RET LD HL 16479
STEP	63	000088	
	64	000089	CALL 32269
	65	000090	
	66	000091	LD HL 16512
	67	000092	
STEP POKE	68	000093	
	69	000094	CALL 32244
	70	000095	
	71	000096	LD HL 16512
	72	000097	
STEP POKE	73	000098	
	74	000099	CALL 32244
	75	000100	
	76	000101	LD HL 16507
OUT	77	000102	
STEP	78	000103	
	79	000104	CALL 32269
	80	000105	
	81	000106	LD HL 16432
	82	000107	
STEP POKE	83	000108	
	84	000109	CALL 32244
	85	000110	
	86	000111	LD HL 16432
	87	000112	
STEP POKE	88	000113	
	89	000114	CALL 32244
	90	000115	
	91	000116	LD HL 16432
	92	000117	
STEP POKE	93	000118	
	94	000119	CALL 32244
	95	000120	
	96	000121	LD A (25673)
	97	000122	
	98	000123	
	99	000124	
	100	000125	
	101	000126	
	102	000127	
	103	000128	
	104	000129	
	105	000130	
	106	000131	
	107	000132	
	108	000133	
	109	000134	
	110	000135	
	111	000136	
	112	000137	
	113	000138	
	114	000139	
	115	000140	
	116	000141	
	117	000142	
	118	000143	
	119	000144	
	120	000145	
	121	000146	
	122	000147	
	123	000148	
	124	000149	
	125	000150	
	126	000151	
	127	000152	
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	134	000159	
	135	000160	
	136	000161	
	137	000162	
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	141	000166	
	142	000167	
	143	000168	
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	197	000222	
	198	000223	
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	200	000225	
	201	000226	
	202	000227	
	203	000228	
	204	000229	
	205	000230	
	206	000231	
	207	000232	
	208	000233	
	209	000234	
	210	000235	
	211	000236	
	212	000237	
	213	000238	
	214	000239	
	215	000240	
	216	000241	
	217	000242	
	218	000243	
	219	000244	
	220	000245	
	221	000246	
	222	000247	
	223	000248	
	224	000249	
	225	000250	
	226	000251	
	227	000252	
	228	000253	
	229	000254	
	230	000255	
	231	000256	
	232	000257	
	233	000258	
	234	000259	
	235	000260	
	236	000261	
	237	000262	
	238	000263	
	239	000264	
	240	000265	
	241	000266	
	242	000267	
	243	000268	
	244	000269	
	245	000270	
	246	000271	
	247	000272	
	248	000273	
	249	000274	
	250	000275	
	251	000276	
	252	000277	
	253	000278	
	254	000279	
	255	000280	
	256	000281	
	257	000282	
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	371	000396	
	372	000397	
	373	000398	
	374	000399	
	375	000400	
	376	000401	
	377	000402	
	378	000403	
	379	000404	
	380	000405	
	381	000406	
	382	000407	
	383	000408	



```

220 CLEAR 32243: GO TO 40
230 BEEP .01,5-2
300 PRINT OVER 1; PAPER 8; INK
5; AT a,y2; "X": RETURN
40 PRINT AT 11,5; "Please wait
a moment"
50 FOR a=32244 TO 32494
60 READ b: POKE a,b: NEXT a
70 DATA 14,8,229,17,31,0,25,12
6,237,82,31,0,32,126,31,119,35,1
6,250,225,36,13,32,234,201
80 DATA 14,8,175,229,17,31,0,2
37,82,126,25,23,0,32,126,23,119,
43,16,250,225,36,13,32,233,201
90 DATA 33,95,64,205,13,126,33
,128,64,205,244,125,33,126,64,20
5,244,125,33,223,64,205,13,126,3
3,0,72,205,244,125,33,0,72,205,2
44,125,33,0,72,205,244,125
100 DATA 55,121,92,0,0,0,0,0,
0,230,2,40,20,33,64,72,205,244,1
25,33,64,72,205,244,125,33,64,72
,205,244,125,24,18,33,95,72,205
,13,126,33,95,72,205,13,126,33,95
,72,205,13,126
110 DATA 33,128,72,205,244,125,
33,192,72,205,244,125,33,192,72,
205,244,125,33,31,80,205,13,126,
33,31,80,205,13,126,33,95,80,205
,13,126,201
120 DATA 33,128,72,205,244,125,
33,192,72,205,244,125,33,31,80,2
05,13,126,33,95,80,205,13,126,20
1
130 DATA 33,95,64,205,13,126,33
,128,64,205,244,125,33,0,72,
205,

```

(continued on next page)

Your man moves at a speed of eight pixels per second and so can outrun all the traffic, but be careful not to hit traffic from behind. Use 0 to move right, 9 to move left, and 1 to move up.

A fanfare is played each time a home is filled and 50 bonus points are given. Every time four homes are filled an extra fanfare is played, the homes empty, the speed increases — there are three changes of speed — an extra random position spider is added, and the game continues. The spiders incidentally move in both directions. A maximum of 10 spiders can be placed on the central island, but I have not managed that level myself yet.

Each time your man is hit he will flash for a few seconds to the sound of a rising beep and then fall back down the screen to the base line to the sound of a falling beep. The men-counter will be reduced by one. The sub-routine for this flash and beep — lines 25 and 30 — has been placed at the start of the listing so that access time is reduced to a minimum. The Spectrum searches through the listing from the beginning each time a subroutine is called and so, if placed at the end of the program, it would take longer to locate and slow down the rate of flash and beep.

At the end of the game, when all men are lost, you are given the option to replay or end. If the N key is pressed then RAMtop will be reset to its normal value on both 16K and 48K Spectrums and the program including user-defined graphics will be erased from memory. This is achieved in just one instruction

RANDOMISE USR 0

One last useful feature of the Spectrum is used to detect a hit. This is shown in line 690 when Screen\$ will return a string containing a space if there is no traffic in the next "Print man" position or an empty string if the next Print position is a user-defined graphic or part of a user-defined graphic.

THIS GAMES program — written in machine code and Basic — just fills a 16K Spectrum. It makes full use of all the colours available and all 21 user-definable graphics.

The object of the game is to cross a busy road and river to arrive safely home. The graphics are flicker-free and move smoothly. The graphics character for the man, however, flashes to indicate position.









The machine-code section of the program is used to roll a screen line left or right — one pixel at a time — to give the illusion of a smooth flow of traffic. The machine code and





















mnemonics that achieve this are shown in figure 1. This machine code is entered above RAMtop and is held in Data lines 70 to 140.

The second set of Data — that is, lines 180 to 270 — is for the user-defined graphics. It is the easiest way to set them up. First, the start address of the user-defined graphics is found by Peeking the system variable 23675/6, so it is equally suitable for the 16K and 48K Spectrum, and then all 168 bytes are entered, starting from this address, in one For-Next loop. It does seem rather long-winded to have 21 For-Next loops as suggested in the Spectrum manual, when the addresses of the user-defined graphics run consecutively.

Once the program has been entered it is advisable to Save it before Running just in case a wrong machine-code Data entry has been made which may cause the program to crash.

(continued from previous page)

```
244,125,201
140 DATA 33,95,64,205,13,125,33
,223,64,205,13,125,33,128,72,205
,244,125,33,192,72,205,244,125,2
01
150 LET a=PEEK 23875+255*PEEK 2
3675
160 FOR b=a TO a+167
170 READ c: POKE b,c: NEXT b
180 DATA 15,18,34,127,255,255,4
0,16,128,64,32,254,254,255,40,16
190 DATA 127,127,127,127,127,25
5,21,8,254,254,254,254,255,255,8
4,128
200 DATA 0,248,196,196,254,254,
40,16,24,24,36,126,60,90,165,65
210 DATA 55,40,145,124,55,56,40
,108,1,2,4,127,127,255,20,8
220 DATA 240,72,68,254,255,255,
20,8,0,31,35,35,127,127,20,8
230 DATA 127,127,127,127,255,25
5,2,1,254,254,254,254,255,16
8,16
240 DATA 16,41,199,0,38,0,0,0,0
,68,255,68,68,255,68,0
250 DATA 0,34,85,143,151,163,16
0,0,68,170,241,233,197,5,0
260 DATA 16,16,16,254,63,31,15,
7,0,0,0,30,255,255,255
270 DATA 96,124,84,120,127,255,
254,252,0,0,3,2,15,63,255,0,8,12
,152,240,224,85,255,0
280 PRINT AT 11,3;"Do you want
instructions?";AT 13,11;"(y)es";
AT 15,11;"(n)o"
290 PAUSE 0: IF INKEY$="y" THEN
GO TO 300
295 GO TO 400
300 CLS: PRINT AT 0,11;"OBJECT
...To guide a car across a road a
nd driver, avoiding   
A dog patrols the central
island."
310 PRINT "There are 4 HOMES
to be filled, i.e. gaps in top f
ence    
320 PRINT "Once all 4 HOMES ar
e filled the speed will increase
,an extra  will be added and t
he HOMES will empty."
330 PRINT "AT 18,9;"Press any
key."; PAUSE 0
370 CLS: PRINT AT 7,11;"CONTRO
LS"
375 PRINT "
"
380 PRINT FLASH 1;AT 11,6;"1";
FLASH 0;"2 3 4 5 6 7 8";FLASH
1;"9";FLASH 0;"";FLASH 1;"0"
390 PRINT AT 18,5;"Press any ke
y to PLAY"; PAUSE 0
400 BRIGHT 1: PAPER 5: BORDER 5
: CLS
410 LET hi=0
420 PRINT PAPER 4;AT 10,0;"
"
430 LET lives=9: LET score=0: L
ET home=0
440 POKE 32425,201: POKE 32450,
201: POKE 32469,201
450 PRINT AT 0,0: PAPER 4;"####
"; PAPER 7;" "; PAPER 4;"####
"; PAPER 7;" "; PAPER 4;"####
"; PAPER 7;" "; PAPER 4;"####
"; PAPER 7;" "; PAPER 4;"####
"; PAPER 7;" "
455 IF home<>0 THEN GO TO 660
460 PRINT PAPER 4; INK 5;"
"
470 PRINT "
"
480 PRINT INK 7;"
"
490 PRINT INK 2;"
"
500 PRINT INK 7;"
"
510 PRINT INK 1;"
"
520 PRINT INK 7;"
"
530 PRINT "
"
540 PRINT PAPER 4;"#####
"
550 PRINT PAPER 0; INK 7;AT 11,
```

```
0;"#####
"
560 PRINT PAPER 0; INK 3;"   
570 PRINT PAPER 0; INK 7;"-----
"
580 PRINT PAPER 0; INK 5;" 
590 PRINT PAPER 0; INK 7;"=====
"
600 PRINT PAPER 0; INK 4;"  
610 PRINT PAPER 0; INK 7;"-----
"
620 PRINT PAPER 0; INK 6;"  
630 PRINT PAPER 4;"#####
"
640 PRINT PAPER 4;"
"
650 PRINT PAPER 1; INK 7;" SCOR
E ";AT 21,11;" MEN "; PAPER 5; I
NK 0;lives; PAPER 1; INK 7;" HI-
SCORE "
660 LET x1=20: LET y1=16: LET x
2=x1: LET y2=y1
670 PRINT PAPER 8; INK 8;AT x1,
y1;" "
680 RANDOMIZE USA 32295
690 IF SCREEN$ (x2,y2)=" " THEN
GO TO 880
700 LET a=x2: FOR b=25 TO 35: G
O SUB 25: GO SUB 25: NEXT b
730 FOR a=x2 TO 20 STEP 2: GO S
UB 25: GO SUB 25: NEXT a
740 LET lives=lives-1: PRINT AT
21,16;lives
750 LET x2=20
760 IF lives<>0 THEN GO TO 660
770 IF hi>score THEN GO TO 790
780 LET hi=score: PRINT AT 21,2
7,hi
790 PRINT FLASH 1; PAPER 7;AT 1
2,0;"
"
800 PRINT AT 14,0;" Another ga
me? (y)es (n)o "
840 IF INKEY$="n" THEN RANDOMIZ
E USA 0
850 IF INKEY$<>"y" THEN GO TO 8
40
860 PRINT PAPER 5;AT 21,7;"
"
870 GO TO 415
880 IF x2<>0 THEN GO TO 1050
890 PRINT PAPER 8; INK 8;AT x1,
y1;" "; PRINT AT x2,y2;"X"
900 RESTORE 920
910 FOR a=1 TO 8: READ b,c: BEE
P b,c: NEXT a
920 DATA .1,11,.1,11,.8,16,.05,
11,.05,16,.05,11,.05,15,1,20
930 LET home=home+1: LET score=
score+50: PRINT AT 21,7;score
950 IF home/4<>INT (home/4) THE
N GO TO 660
960 IF home=4 THEN POKE 32425,0
970 IF home=8 THEN POKE 32450,0
980 IF home=12 THEN POKE 32469,
0
985 IF home>36 THEN GO TO 450
990 LET a=AND*31
1000 LET a=a+1
1005 IF a>31 THEN LET a=0
1010 IF SCREEN$ (10,a)=" " THEN G
O TO 1000
1020 IF SCREEN$ (10,a+1)=" " THEN
GO TO 1000
1030 PRINT PAPER 4;AT 10,a;"
"
1035 RESTORE 920: FOR a=1 TO 8:
READ b,c: BEEP b,c: NEXT a
1040 GO TO 450
1050 PRINT PAPER 8; INK 8;AT x2,
y2;"X"
1060 LET x1=x2: LET y1=y2
1070 IF INKEY$<>"1" THEN GO TO 1
100
1080 BEEP .001,33
1090 LET x2=x2-2: LET score=scor
e+5: PRINT AT 21,7;score
1100 LET y2=y2+(INKEY$="0" AND y
2<>31)-(INKEY$="8" AND y2<>0)
1110 GO TO 670
AB =  HI =  OP = 
CDE =  JKL =  QRS = 
F =  M = 
G =  N =  TU = 
```

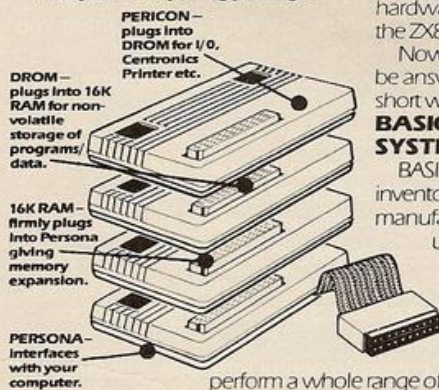

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Here is the rest of the program required to put a spring in the step of Stuart Nicholls' Happy Hopper. Good luck with your ZX games.

HOPPER

FROGGER (moving graphics)

16775	0E 00	LD C, 00	Roll left/right subroutine.
	7E	LD A, (HL)	A check is made at start of each
	FE 97	CP 97	line to see if the frog will roll off the
	28 1F	JRZ +31	screen. If it does, then a jump is made
	F5	PUSH AF	to miss out the roll sequence.
	06 13	LD B, 13	
	23	INC HL	The background character occupied by the
	7E	LD A, (HL)	frog is then found and used to erase
	2B	DEC HL	the frog. Also C is increased to 1 so
	77	LD(HL), A	that a check can be made that the
	23	INC HL	subroutine has been skipped.
	10 F9	DJNZ -7	
	F1	POP AF	
	77	LD(HL), A	
	19	ADD HL, DE	
	7E	LD A, (HL)	
	FE 97	CP 97	
	28 0D	JRZ +13	
	F5	PUSH AF	
	06 13	LD B, 13	
	2B	DEC HL	
	7E	LD A, (HL)	
	23	INC HL	
	77	LD(HL), A	
	2B	DEC HL	
	10 F9	DJNZ -7	
	F1	POP AF	
	18 04	JR +4	
	0C	INC C	Increase value of C to 1
	3A 3C 40	LD A, (16444)	Get occupied square character and
	77	LD(HL), A	print over frog.
	C9	RET	Return from subroutine.
			<i>Start of moving graphics routine</i>
16819	2A 0C 40	LD HL(D-FILE)	Get start of D-File.
	23	INC HL	
	11 15 00	LD DE 00 15	LD DE with 21 — DE is
			not altered from this
	19	ADD HL, DE	value during program, and move to row 2
	CD 87 41	CALL SUB 16775	Roll this row left and next row right.
	0D	DEC C	Check to see if C = 1
	28 B0	JRZ (To 16753)	if yes, goto 16753
	19	ADD HL, DE	Move down one line.
	CD 87 41	CALL SUB 16775	Roll row left and next row right.
	0D	DEC C	Check to see if C = 1,
	28 A9	JRZ (To 16753)	if yes, goto 16753.
16840	2A 0C 40	LD HL (D-File)	Move along display until frog is
	7E	LD A, (HL)	found. When found erase it with
	FE 97	CP 97	character stored at 16444. Then
	28 03	JRZ +3	store D-file position of frog at
	23	INC HL	16445/6. Remove the frog from
	18 F8	JR -8	the display before rolling the road
	3A 3C 40	LD A (16444)	otherwise the frog will move with the
	77	LD(HL), A	traffic.
16858	2A 0C 40	LD HL (D-File)	Get start of road 6 lines down.
	23	INC HL	
	06 06	LD B, 06	
	19	ADD HL, DE	
	10 FD	DJNZ -3	
	CD 87 41	CALL 16701	Call roll left/right
	19	ADD HL, DE	Move to next line
	CD 87 41	CALL 16701	Call roll left/right.
			There is no need for a check that C = 1
			as frog has been removed from display.
16874	2A 3D 40	LD HL, (16445/6)	Load HL with frog position.
	3A 26 40	LD A, (16422)	Load A with "last key high"
	FE DF	CP DF	Value if key is "5"
	20 03	JRNZ +3	
	2B	DEC HL	If 5 then decrease HL
	18 22	JR (16921)	
	FE F7	CP F7	Value if key is 8
	20 03	JRNZ +3	
	23	INC HL	If 8 then increase HL
	18 1B	JR (16921)	
	FE FD	CP FD	Value if key is 0
	20 17	JRNZ (16921)	
	ED 52	SBC HL, DE	If 0 then move 1 line.
	E5	PUSH HL	Store new position of frog.
16901	2A 0C 40	LD HL(D-File)	Increase score routine. Used only
	01 ED 00	LD BC 00 ED	when frog moves up.
	09	ADD HL, BC	
	7E	LD A, (HL)	
	3C	INC A	
	FE A6	CP A6	
	20 05	JRNZ +5	
	36 9C	LD(HL), 9C	
	2B	DEC HL	
	18 F5	JR -11	
	77	LD(HL), A	
16920	E1	POP HL	Get store new frog position
	7E	LD A(HL)	Check that it is not off screen.
	FE 76	CP 76	
	20 04	JRNZ +4	If not, then check new position
	2A 3D 40	LD HL(156446/6)	If it is off screen then get original
	7E	LD A, (HL)	position and check it.
	FE 17	CP 17	Check if home
	20 10	JRNZ +16	
	36 AD	LD(HL), AD	If home then print H.
16936	2A 0C 40	LD HL(D-File)	Check top row to see if all home
	23	INC HL	bases are filled, if yes then return
	7E	LD A(HL)	to Basic. If * is found, then
	FE 76	CP 76	jump to dual-purpose delay at 16966.
	C8	RETZ	
	FE 17	CP 17	
	20 F7	JRNZ -7	
	18 10	JR +16	
16950	FE 80	CP 80	Check new frog position for safe
	28 IC	JRZ (16982)	squares that is road logs lily or
	FE 83	CP 83	kerbs, and if any of these then
	28 18	JRZ (16982)	proceed to 16982.
	FE 1C	CP 1C	
	28 14	JRZ (16982)	
	FE 08	CP 08	
	28 10	JRZ (16982)	
			<i>Dead frog/home delay</i>
16966	F5	PUSH AF	Print an * in place frog/ found unfilled
	36 17	LD(HL), 17	home position
			Delay loop
	11 00 10	LD DE, 10 00	
	1B	DEC DE	
	7A	LD A, D	
	BC	OR E	
	Z + * FB	JRNZ -5	
	F1	POP AF	Get original square character.
	77	LD(HL), A	Print it.
	C3 71 41	JP (16753)	Start again with frog at baseline
16982	32 3C 40	LD(16444), A	Store new square value before
	36 97	LD(HL), 97	overprinting frog.
16987	2A 0C 49	LD HL (D-File)	Decrease time routine as in
	01 F7 00	LD BC, 00 F7	demonstration program except that
	09	ADD HL, BC	numbers are in inverse video.
	7E	LD A(HL)	
	A7	ADD A	
	20 08	JRNZ +8	
	06 03	LD B, 03	
	23	INC HL	
	36 9C	LD(HL), 9C	
	10 FB	DJNZ -5	
	C9	RET	
	3D	DEC A	
	FE 9B	CP 9B	
	20 05	JRNZ +5	
	36 A5	LD(HL), A5	
	2B	DEC HL	
	18 EA	JR -22	
	77	LD(HL), A	
17017	11 00 30	LD DE, 30 00	Delay loop — governs speed of game,
	1B	DEC DE	to increase speed, reduce value of DE
	7A	LD A, D	
	B3	OR E	
	20 FB	JRNZ -5	
17025	C3 B3 41	JP 16819	GOTO 16819 — start of routine.


```

10 REM A-MAZ-ING COPYRIGHT K & S
BRAIN NOV 1982
20 GOTO10000
100 CLS:PRINT@224,"TIME",,"MOVES
",,"FOOD",,"MONEY"
110 X=U-99:Y=U+99:Z=Y-X:FORA=0TO
Z STEP32:FORC=0TO6:PRINT@ (A+C)
,CHR$(B(X+A+C)):NEXTC,A:PRINT@26
2,M
120 T=(INT(TIMER/50)):IFT>UP THE
N12000ELSEPRINT@230,T:PRINT@294,
F:PRINT@326,M0
130 A=JOYSTK(0):AA=JOYSTK(1):IFA
>10ANDA<50ANDAA>10ANDAA<50THEN12
0
140 M=M+1:F=F-1:IFF<1THEN13000
150 IFA<10THENV=U-32
160 IFA>50THENV=U+32
170 IFAA>50THENV=U-1
180 IFAA<10THENV=U+1
190 IFB(V)<>143THEN210
200 B(U)=143:U=V:B(U)=YU:PRINT@3
84,"":GOTO110
210 IFU=0 THEN11000
220 IFB(V)=128THENPRINT@84,"NO W
AY":SOUND1,5:GOTO110
230 IFB(V)=144THEN14000
240 IFB(V)=100THENPRINT@384,"CON
GRATULATIONS",,"YOU HAVE FOUND T
HE DRAGON":YU=117:GOTO200
250 IFB(V)<145THEN110
260 ON(B(V)-143)/16GOTO1000,2000
,3000,4000,5000,6000,7000
1000 F=F+50:PRINT@84,"FOOD":SOUN
D150,5:GOTO200
2000 MO=MO+50:PRINT@84,"MONEY":S
OUND200,5:GOTO200
3000 DATA3,0,4,0,5,0,6,0,7,0,3,1
,5,1,7,1,3,2,4,2,5,2,6,2,7,2,0,3
,1,3,2,3,3,7,3,8,3,9,3,3,3,3,
4,4,4,5,4,6,4,7,4
3010 DATA3,5,4,5,5,5,6,5,7,5,3,6
,4,6,5,6,6,6,7,6,3,7,4,7,5,7,6,7
,7,7,3,8,4,8,6,8,7,8,3,9,4,9,6,9
,7,9,1,10,2,10,3,10,4,10,6,10,7,
10,8,10,9,10,1,11,2,11,3,11,4,11
,6,11,7,11,8,11,9,11
3020 C=RND(8):CLS0:FORN=1TO65:RE
ADX,Y:SET(X,Y,C):NEXT:RESTORE
3030 FORN=1TO20:SET(0,2,C):SET(1
0,2,C):FORZ=1TO50:NEXTZ:RESET(0,
2):RESET(10,2):FORZ=1TO50:NEXTZ:
SET(0,4,C):SET(10,4,C):FORZ=1TO5
0:RESET(0,4):RESET(10,4):FORZ=1T
O50:NEXTZ
3040 PRINT@224,"YOU HAVE MET A T
ROLL",,"WITH A PASSION FOR MONEY!"
3050 PRINT@320,"UNLESS YOU GIVE
HIM $100",,"HE WILL EAT YOU!":NE
XT
3060 PRINT@224,,,,,,,,,PRINT@
224,"YOU HAVE $";MO
3070 IFMO>99THEN3100
3080 SET(0,2,C):SET(10,2,C)
3090 FORN=1TO50:FORM=4TO6:SET(M,
3,C):FORZ=1TO50:NEXTZ:RESET(M,3)
:NEXTM:PRINT@384,"THE TROLL JUST
ATE YOU":SOUND1,1:NEXTN:RUN
3100 SET(0,4,C):SET(10,4,C)
3110 MO=MO-100:PRINT@352,"YOU HA
D ENOUGH TO PAY THE TROLL":PRINT
@384,"YOU NOW HAVE $";MO;"LEFT"
3120 FORN=1TO20:RESET(6,8):RESET
(6,9):RESET(6,10):RESET(6,11):RE
SET(7,11):RESET(8,11):RESET(8,12
):SET(8,8,C):SET(8,9,C):SET(9,8,
C):SET(9,9,C)
3130 FORZ=1TO50:NEXTZ:SET(6,8,C)
:SET(6,9,C):SET(6,10,C):SET(6,11
,C):SET(7,11,C):SET(8,11,C):SET(
8,12,C):RESET(8,8):RESET(8,9):RE
SET(9,8):RESET(9,9):NEXTN:GOTO10
0
4000 PCLS:PMODE3,1:SCREEN1,0
4010 FORN=1TO16:DRAW"C4":DRAW"S"
+STR$(N):DRAW"AOL18H4U4E4336F4D4
G4L18C2BM-4,-5LHVERFDGLBM+8,+0LH
UERFDGLBM-3,+5"

```

MAZE GAMES — a well-established part of home computer tradition — offer endless scope for imagination in programming, as well as hours of frustration in the playing. You are always sure that if you try just once more you will succeed. The scenarios of maze-type adventure games are many and varied but the principles are usually very similar. They may be text-only or they may give you a graphic indication of your whereabouts and the consequences of your actions. Your view is generally limited to your immediate surroundings, and the perils you may have to face are many and varied.

The principles of maze construction and the main running routine given here are of general application, whilst the consequence routines give examples of the sort of effects you can produce with a little effort.

The total program given requires that you escape from the maze with as much money as possible, and preferably rescue the dragon from St Clair at the same time, before you run out of time or food, and before you are eaten by a troll or a giant spider.

If you only enter lines 20-260 and from 10000-10110 you can dream up your own consequence subroutines and amaze yourself with your own ingenuity.

A simple method of setting up a maze on the Dragon is to use a variable array. The text screen contains 512 print positions, so this is a convenient number to deal with. Life is actually simpler if the array is rather bigger than this, and adding an extra three lines at the top and bottom gives a total of 672 for the array. Of course, various items also need to be included in appropriate numbers. The array and its contents are dealt with in the routine at 10000.

Line 10020 sets up the variables: A1 is the array size; A2 is the screen start; A3 is the screen end; A4 is the screen size; A5 is the number of blocked paths; A6 is the number of items; A7 is the number of space warps; MO is the money; UP is the time allowed; F is food; YU is you.

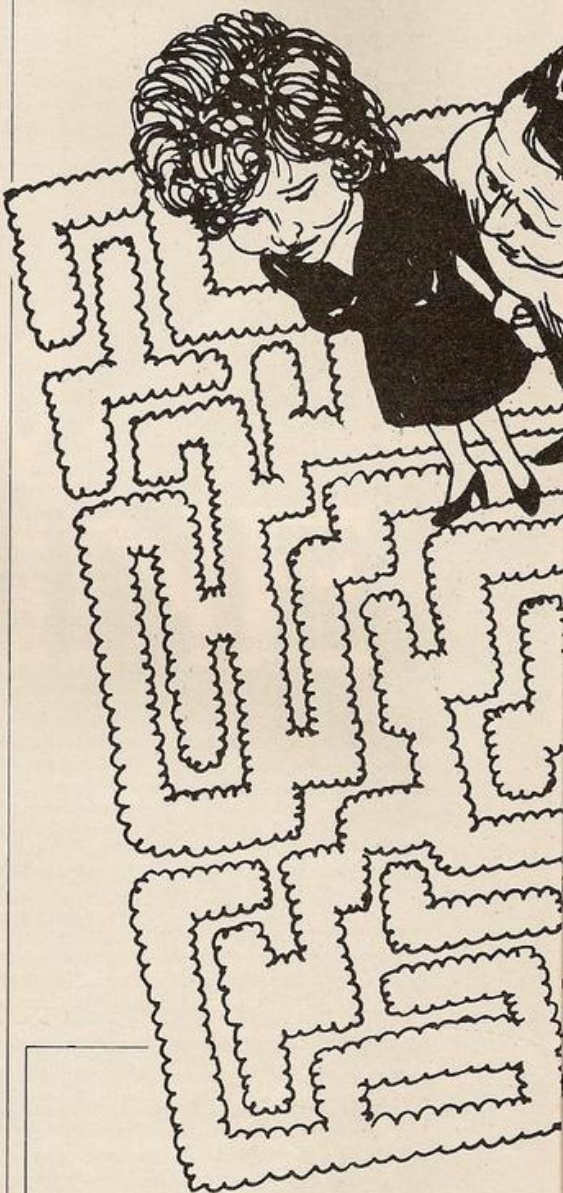
Line 10030 sets up the array and fills it with CHR\$(128) — black. Line 10040 inserts A5 (450) green — CHR\$(143) — pathways at random. Line 10050 inserts A6 (50) randomly-coloured blocks at random. Line 10060 inserts A7 (50) space warps — CHR\$(144) — but still black, at random.

Line 10070 resets the bottom but one line to green, to give you a chance to escape. Line 10080 sets the way out — O — on the bottom line, and sets you — U — and the dragon — D — in random start positions. Line 10090 checks that you can move in your first turn and if not, redraws the maze. Line 10100 prints the maze on the screen. Line 10110 clears the low- and high-resolution screens and sets the internal timer to zero then leads back to the main running routine at 100.

This routine is at the beginning of the program so that it is executed as rapidly as possible. The speed of Dragon Basic is such that this update routine works almost as fast as you can think what to do next.

Line 110 looks at the three lines above and below your present position, prints out the contents of the array for a small distance — C — either side and above and below your

MAZE

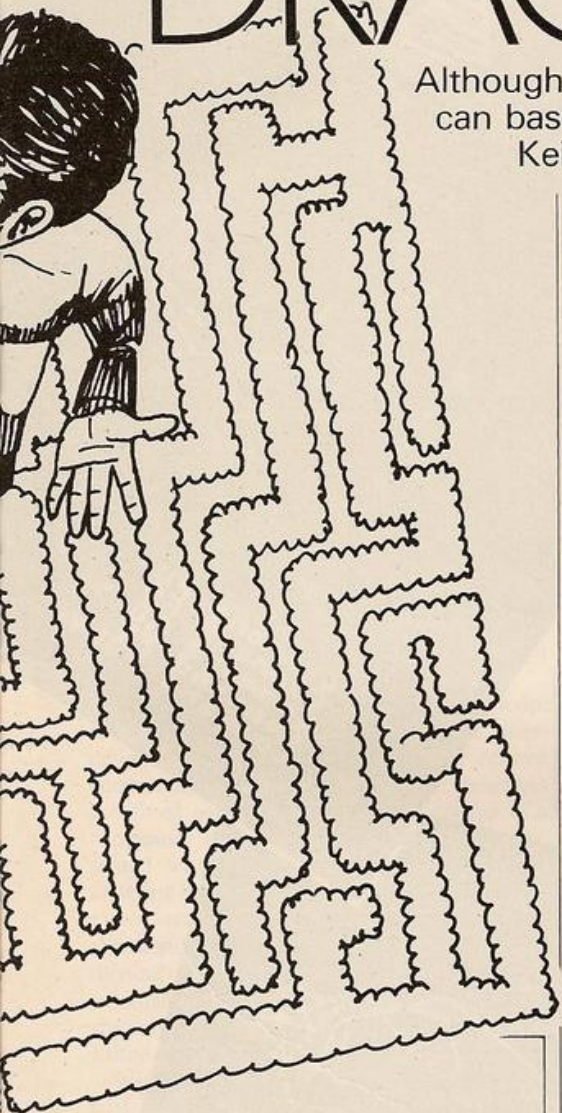


```

4020 FORC=0TO1:DRAW"C"+STR$(C):D
RAW"R4ND12R6ND12R6F4D8U8H4R6F4D8
U8H4L26ND12L6ND12L6G4D8U8E4L6G4D
8U8E4R22":IFC=0THENSOUND(N*15),N
4030 NEXTC,N:IFYU=85THEN4050
4040 CLS4:PRINT@160,"YOU WERE LU
CKY!":PRINT@224,"THE DRAGON FRIE
D THE SPIDER!":FORN=1TO3000:NEXT
:GOTO200
4050 LU=RND(10):IFLU<5THEN4070
4060 CLS2:PRINT@128,"YOU WERE LU
CKY!":PRINT@192,"THE SPIDER COUL
DN'T STAND THE TASTE OF YOU!":
FORN=1TO250STEP2:SOUNDN,1:NEXT:
GOTO100
4070 CLS0:PRINT@128,"WHAT DOES I

```


MACHINE: DRAGON



Although it's a full game in itself, you can base new subterranean epics on Keith and Steven Brain's maze.

position and prints the move number — M. Line 120 checks if time is up and, if not, prints the time, T; food, F; and money, MO.

Line 130 checks that the joystick is not centred. Line 140 updates the move and food counters and checks for starvation. Lines 150-180 calculate your next position. Line 190 checks if the pathway chosen is clear and, if so, line 200 updates your position. Line 210 checks for the exit, 220 for a blocked pathway, and 230 for a space warp.

Space warps are difficult to avoid, as CHR\$(144) looks exactly the same as CHR\$(128). They can be avoided by not bumping against the walls, but sometimes you need to be able to find one to get out of a dead end. Line 240 reports the dragon and converts you into an inverse U. Line 260 directs the program to the various routines dealing with coloured blocks.

The alternative lines 130, 150-180 use the cursor keys in place of a joystick, but we think this makes it too easy as you do not have to remember to centre the joystick to avoid re-entering a disastrous routine.

The routines at 1000 and 2000 simply increase your food and money, and delete these items from the array.

The Troll routine at 3000 uses a mixture of text and low-resolution graphics, and checks for money. Note that data must be restored after use, and that you only need to erase and reconstruct parts which move.

The Spider routine at 4000 uses high-resolution graphics and a scaled draw command. Dragons fry spiders, otherwise you have a 50:50 chance of escaping. Note that only the legs are erased — drawn in background colour — and redrawn for each move, and that the dragon is detected by YU being inverse.

The whirlpool routine at 5000 uses the circle command and both screens — XX=INT(RAND(0)) — and loses you a random proportion of your food and money.

The St Clair routine at 6000 checks for the dragon, which he does not like.

The seeing stone at 7000 quickly prints out the whole maze, and the final successful status report is at 11000.

Failure due to time is reported by 12000, and due to starvation at 13000. Finally the space warp routine at 14000 displays a space warp of random length, of random colours, and at a random angle. It can move you anywhere in the maze.

```
NTCHR$(185);:NEXT:IFYU=117THEN60
20
6010 PRINT@320,"YOU MUST TELL ME
IF YOU SEE HIM":FORN=1TO5000:NE
XT:GOTO100
6020 PRINT@288,"DEATH TO ALL YOU
DRAGON LOVERS!","ST CLAIR?":FO
RM=1TO3:FORN=100TO1STEP-5:SOUNDN
,M:NEXTN,M:RUN
7000 CLS2:PRINT@224,"THE SEEING
STONE WILL GIVE YOU","A BRIEF GL
IMPSE OF THE MAZE":FORN=1TO1000:
NEXT
7010 CLS0:FORN=97TO576:PRINTCHR$
(B(N));:NEXT:FORN=1TO250:NEXT:CL
S:GOTO100
10000 CLS:PRINT" MAZE UNDER C
ONSTRUCTION",,"";CHR$(85);"= Y
OU",CHR$(100);"= DRAGON",,"";C
HR$(117);"= YOU + DRAGON",,"";
"CHR$(159);"= FOOD",CHR$(175);"
= MONEY",,
10010 PRINT" ";CHR$(191);"= TROL
L",CHR$(207);"= SPIDER",,"";CH
R$(223);"= WHIRLPOOL",CHR$(239);
"= ST CLAIR",,"";CHR$(255);"= S
EEING STONE"
10020 A1=672:A2=97:A3=576:A4=447
:A5=450:A6=50:A7=50:MO=100:UP=10
00:F=800:YU=85
10030 DIMB(A1):FORA=1TOA1:B(A)=1
28:NEXT:SOUND1,1
10040 FORA=1TOA5:B(RND(0)*A4+A2)
=143:NEXT:SOUND10,1
10050 FORA=1TOA6:B(RND(0)*A4+A2)
=(RND(7)*16)+143:NEXT:SOUND20,1
10060 FORA=1TOA7:B(RND(0)*A4+A2)
=144:NEXT:SOUND30,1
10070 FORA=513TO544:B(A)=143:NEX
T:SOUND40,1
10080 O=545+RND(29):B(O)=143:U=R
ND(A4)+A2:B(U)=YU:D=RND(A4)+A2:B
(D)=100:SOUND50,1
10090 IFB(U+1)=143ORB(U-1)=143OR
B(U+32)=143ORB(U-32)=143THEN1010
OELSE SOUND1,10:RUN
10100 CLS0:FORA=A2 TO A3:PRINTCH
R$(B(A));:NEXT
10110 FORA=1TO1000:NEXT:CLS:PCLS
:TIMER=0:GOTO100
11000 CLS(RND(8)):PRINT@96,"CONG
RATULATIONS - YOU ESCAPED!","Y
OU TOOK"MMOVES",,"YOU HAD:",MO
;"DOLLARS",,F;"FOOD",,(UP-T);"TI
ME LEFT"
11010 IFYU=117THENPRINT@384,"AND
YOU HAD THE DRAGON WITH YOU!"
11020 FORN=1TO8000:NEXT:RUN
12000 CLS0:PRINT@224,"YOU RAN OU
T OF TIME!","THIS IS THE END O
F YOUR UNIVERSE":FORN=1TO1000:NE
XT:CLS0:FORN=250TO1STEP-1:SOUNDN
,1:NEXT:RUN
13000 CLS0:PRINT@224,"YOU STARVE
D TO DEATH!","BETTER LUCK IN Y
OUR","NEXT REINCARNATION!!":SOUN
D1,50:RUN
14000 PCLS(RND(4)):PMODE3,1:SCRE
EN1,0:FORNM=1TO(RND(4)):FORN=1TO
62STEPNM:DRAW"S"+STR$(N):DRAW"C"
+STR$(RND(3)):DRAW"BM-6,+8U16R12
D16L12BM128,96":SOUND(NM*N),1:NE
XTN:DRAW"A"+STR$(RND(2)):NEXTNM
14010 B(U)=143:U=RND(431)+128:B(
U)=YU:V=U
14020 CLS0:FORN=97TO576:PRINTCHR
$(B(N));:NEXT:FORN=1TO500:NEXTN
:CLS:GOTO100
```

alternative lines for use
of cursor keys instead of
a joystick for movement

```
130 I$=INKEY$:IFI$=""THEN130ELSE
I=ASC(I$)
150 IFI=94THENV=U-32
160 IFI=10THENV=U+32
170 IFI=8THENV=U-1
180 IFI=9THENV=U+1
```

```
T FEEL LIKE INSIDE A GIANT SPIDE
R?":PRINT@256,"HARD LUCK!":FORN=
10TO200STEP10:SOUNDN,2:NEXT:RUN
5000 XX=INT(RND(0)):PCLS(RND(4)*
(XX+1)):PMODE3,1:SCREEN1,XX
5010 FORN=1TO150STEP4:CIRCLE(128
,96),N,(RND(4)*(XX+1)),N/300:SOU
NDN,1:NEXT
5020 CLS(RND(8)):PRINT@192,"YOU
HAVE ESCAPED FROM THE","WHIRLPOO
L BUT YOU LOST:",
5030 LM=RND(0):LF=RND(0):PRINT,I
NT(MO*LM);"MONEY",,INT(F*LF);"FO
OD":FORN=1TO5000:NEXT
5040 MO=MO-INT(MO*LM):F=F-INT(F*
LF):GOTO100
6000 CLS4:FORN=1TO32:PRINTCHR$(1
85);:NEXT:PRINT@32,"I'M ST CLAIR
AND I'LL KILL","ANYONE WHO HELP
S THAT DRAGON!!":FORN=1TO32:PRI
```


LOGO is a computer language and a powerful educational tool. It has many of the characteristics of the almost synonymous Lego, insofar as Logo provides a small number of basic building blocks. The blocks can be put together very easily to produce complicated results.

Logo has no formal syllabus or correct methods. The emphasis is not on learning the facts about Logo, but learning about thought processes that can be extended to other situations. Seymour Papert in *Mindstorms* gives an example of extending Logo ideas to juggling; a skill that I was able to learn in 30 minutes after reading his analysis.

Allowing a child to explore a Logo system by exploring his or her own ideas and being rewarded by feelings of creative and aesthetic achievement uses the most powerful motivating forces. Most educational software is much more conservative, relying on practice rather than creativity and producing external rewards.

As a computer language a full version of Logo should provide the minimal features of a high-level language: loop structures, decision-branching and editing facilities; in addition, a full Logo includes powerful features such as list-processing and recursive functions.

Logo, like Lisp and Forth, is a threaded interpretative language. It provides a small number of system commands which, when referenced, call short machine-code subroutines. The systems commands can be linked together to give a user-defined command which can then be included within a further defined command.

One of the advantages of using Logo as an introductory computer language is that the structuring of programs in Basic follows naturally from this experience. The problems of spaghetti programming are avoided.

Full implementations of the Logo language are rare and expensive. The TI-99/4 version costs £60 and the BBC version is reported to cost £55. It is much more usual to find a subset of Logo commands and facilities related only to controlling a screen object called a turtle. This limited system is known as graphics Logo or turtle talk.

In this program the routines to control the screen are controlled by Basic subroutines. The program also does not allow procedures to be defined with a parameter but does support very powerful use of the Logo variables which can produce the same effect. Designed for use by children, the system is very user-friendly and almost crash-proof. It has been well-tested with groups of children and does provide an effective Logo environment. If your seven-year-old cannot handle Basic, try this instead. You may not need a secondary school if you do.

Commands are given to the system either by using one of the system command mnemonics in table 1 or by giving one of the defined commands. If a system command is given, it may or may not require a parameter. Numeric parameters can be given either as a number or as a term that includes the system variables NM, TR, SZ.

Numeric parameters can be evaluated by the Basic Eval function. If the Eval function is used with a parameter string that cannot be

TURNING

Turtle graphics are the family of drawing routines at the heart of Logo. Fintan Culwin presents a full turtle program for the BBC Micro.

evaluated, an error condition is produced that crashes the system down to its lowest level.

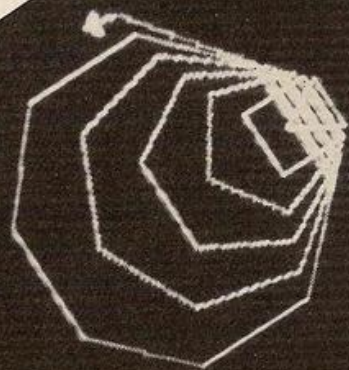
A string parameter is the name of a command; for memory efficiency it should not be longer than eight characters. System commands have to be given to the system as mnemonic space parameters.

Clear Screen clears the screen, resets the angle to 0 and homes the cursor to the centre of the screen. Pen Up and Pen Down set trace

output from the cursor off and on. Fill and End Fill fills the areas in the same way as Plot in BBC Basic, starting with the second point after Fill is called. Cursor On and Off switch the cursor on and off. Long procedures can be speeded up significantly by turning the cursor off.

Quit allows you to leave the system to store definitions on tape. The definitions are stored as strings — this is exactly the situation where the most cassette-filing system errors occur so make sure you have your CFS patch in when you use it.

Cursor Right and Down move the cursor around the screen. Use negative parameters to move left or up. Right and Left turn rotate the cursor clockwise and anti-clockwise respectively. Angle sets the cursor to a definite value. Forward and Backwards move the cursor with appropriate



Command PD
Command LUCAS
Command POLY
Command POLY



Command PD
Command POLY



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(listing continued from page 65)

```

990 IF FLF=0 THEN FLF=FLF+1
1000 PL=1: PROCUR(PL,X1,Y1)
1010 RETURN
1020 RP=1:RTS=STR$(13)+ " *STR$(PN-1)+ " :REPEAT
1021 PROCINP
1030 RTS=RTS+STR$(V1)+ " "+V$+ " "
1040 IF V1<100 THEN PROCAC(T,V1,V2,V$) ELSE :SC=0: S$(0)=DT$(V1-100,1):REPEAT
:PROCEX:UNTIL SC<0
1060 UNTIL V1=14:RTS=RTS+STR$(16)+ " *STR$(0):RP=0: IF ED=0: S$(0)=TRT$:SC=
0:REPEAT:PROCEX:UNTIL SC<0
1070 RETURN
1080 PROCSTRIP(P$):IF P$="0" THEN PRINT"## you need to give it a name ! ##
:RETURN
1090 PROCIND(P$):IF FDF=0 THEN 1110 ELSEDF=0:IF FDF<100 THEN PRINT"## :P
$ is a system command ##":ELSE IF FDF=100-DT AND ED1=0 THEN PRINT"## you
are still defining ":P$ " ##"
1100 IF FDF=100-DT AND ED1=0 THEN PRINT"## you have already defined ":P$ "
##":RETURN
1110 IF DT=50 THEN PRINT"## my chips are full ##":R.
1111 DF=1:P$=US:DT$(DT,0)=P$:DT$(DT,1)="":REPEAT
1120 PROCINP: IF V1=100-DT THEN PRINT"## you are still defining ":DT$(DT,0
): " ##":GOTO 1120
1130 DT$(DT,1)=DT$(DT,1)+STR$(V1)+ " "+V$+ " "
1140 IF V1<100 THEN PROCAC(T,V1,V2,V$):IF V1=14 THEN FORN=0 TO1:PROCSTRIP(R
T$):RTS=MID$(RT$,U+1):NEXT:DT$(DT,1)=DT$(DT,1)+RT$
1160 IFV1>100 THENG$(0)=DT$(V1-100,1):SC=0:REPEAT:PROCEX:UNTIL SC<0
1170 UNTIL V1=16:DT=DT+1:DF=0:RETURN
1180 PROCINDO:RETURN
1190 CLS:VDU 14:FORN=1 TO 30:PRINT$(N):SPC(8):NEXT:VDU 15:R=GET:CLS:RETU
RN
1200 CLS:VDU 14:N=0:REPEAT:N=N+1:PRINT$(N-1 MOD 3)*10):DT$(N,0):UNTIL
(N=50 OR DT$(N,0)=""):VDU 15:R=GET:CLS:RETURN
1210 IF P$="0" THEN PRINT"##edit what ? ##":RETURN:ELSE PROCIND(P$):IF FDF=
0 THEN PRINT"## I don't recognise ":P$ " ##":RETURN:ELSE IFDF<100 THEN PRI
NT"## that's a system command ##":RETURN:ELSE EDF =FDF-100
1220 ED1=1: CLS:PRINT"D elete""E nter""R eplace""I nsert""A bandon":VDU
28,10,31,39,26
1230 ED$=DT$(EDF,1):TED$=""
1240 REPEAT
1250 PROCSTRIP(ED$):ED1=VAL(US):ED$=MID$(ED$,U+1):PROCSTRIP(ED$):ED$=MID$(
ED$,U+1):ED2$=US
1260 IF ED1<100 THEN PRINT$(ED1): " ":ED2$:ELSE PRINT$(ED1-100,0)
1270 R=GET:IF(R<60 AND R<65 AND R<73 AND R<82) THEN 1270
1280 IF R=65 THEN 1310:ELSE IF R=68 THEN 1290 ELSE IF R=69 THEN GOSUB 1320
:GOTO 1290 ELSE GOSUB 1350:IF R=73 THEN GOTO 1260 ELSE GOTO 1250
1290 IF RP=1 AND (ED1=16 OR V1=16) THEN PRINT"## still repeating can't end
##":GOTO 1260
1291 UNTIL (ED1=16 OR V1=16))
1300 DT$(EDF,1)=TED$
1310 ED=0:VDU 28,0,31,39,26:CLS:RETURN
1320 TED$=TED$+STR$(ED1)+ " "+ED2$+ " "
1330 IF ED1=13 THEN RP=1 ELSE IF ED1=14 THEN RP=0
1340 RETURN
1350 PROCINP:IF V1=13 THEN RP=1 ELSE IF V1=14 THEN RP=0
1360 IF LEN(V$)<2 THEN 1370 ELSE IF (INSTR(V$, "NM")>0) OR (INSTR(V$, "TR")>0)
OR (INSTR(V$, "SZ")>0) THEN TED$=TED$+STR$(V1)+ " "+V$+ " ":RETURN
1370 TED$=TED$+STR$(V1)+ " "+V$+ " ":RETURN
1380 ED1=0:IF P$="0" THEN ED1=1:PRINT"## what command ? ##":RETURN
1390 PROCIND(P$):IF FDF=0 THEN PRINT"## don't recognise ":P$ " ##":RETURN
1400 IF FDF<100 THEN PRINT"## that's a system command ##":RETURN
1410 FDF =FDF-100
1420 DC$=DT$(FDF,1):REPEAT PROCSTRIP(DC$):DS1=VAL(US):DC$=MID$(DC$,U):PROC
STRIP(DC$):DS2=VAL(US):DC$=MID$(DC$,U)
1430 IF DS1<100 THEN PRINT$(DS1): " ":US: " ": " :ELSE PRINT$(DS1-100,0): "
" :
1460 UNTIL DS1=16:PRINT:RETURN
1470 IF P$="0" THEN PRINT"## what command ? ##":RETURN:ELSE PROCIND(P$):I
F FDF=0 THEN PRINT"## I don't know ":P$ " ##":RETURN:ELSE IF FDF <100 THEN
PRINT"## that's a system command ##":RETURN
1480 C=0:FDF$=STR$(FDF)+ " 0 ":REPEAT:C=C+1
1490 UNTIL (INSTR(DT$(C,1),FDF$)>0) OR (C=DT-1))
1500 IF (C=DT-1) OR INSTR(DT$(DT-1,1),FDF$)>0 THEN PRINT"## can't needed by
":DT$(C,0) " ##":RETURN
1510 NZ=FDF-100:REPEAT:DT$(NZ,0)=DT$(NZ+1,0):DT$(NZ,1)=DT$(NZ+1,1):NZ=NZ+1
:UNTIL NZ=DT:DT=DT-1
1511 C$=0:REPEAT C$=C$+1
1512 T$="" :REPEAT:PROCSTRIP( DT$(C$,1)):DT$(C$,1)=MID$(DT$(C$,1),U):TX=VAL
(US)
1513 IF TX<FDF THEN T$=T$+ " "+STR$(TX) ELSE T$=T$+ " "+STR$(TX-1)
1514 PROCSTRIP(L$*(C$,1)):DT$(C$,1)=MID$(DT$(C$,1),U):T$=T$+ " "+US+ " "
1515 UNTIL TX=16
1516 DT$(C$,1)=T$:UNTIL C$=DT-1:RETURN
1520 QU=1:RETURN
1530 GOSUB 2190:AG=PN:GOSUB 2190:RETURN
1540 PRINTTAB(5): " ## NM= " :NM:TAB(15): " ##" :TAB(5): " ## TR= " :TR:TAB(15): " ##
":TAB(5): " ## SZ= " :SZ:TAB(15): " ##":RETURN
1550 IF HD=0 THEN RETURN ELSEHD=0:GOSUB2190:RETURN
1560 GOSUB2190:HD=1:RETURN
1570 NM=EVAL(P$)
1571 RETURN
1590 TR=EVAL(P$)
1600 RETURN
1610 SZ=EVAL(P$)
1620 RETURN
1690 DEFFROCEX
1695 IF SC=100 THENPRINT"## my chips are full ##":ENDPROC
1700 TX$=S$(SC):PROCSTRIP(TX$):E1=VAL(US):TX$=MID$(TX$,U):PROCSTRIP(TX$):E
2=VAL(US):TX$=MID$(TX$,U)
1710 IF (E1<6 AND E1<14) OR E1=24 OR E1>27 THEN E2=EVAL(US)
1720 IF E1=16 THEN S$(SC)="":SC=SC-1:GOTO 1760
1730 IF E1=13 AND E2>1 THEN 1770 ELSE IF E1=13 THEN S$(SC)=TX$:GOTO1700
1740 IF E1>100 THEN 1800
1750 PROCAC(E1,E2,US):S$(SC)=TX$:GOTO 1700
1760 ENDPROC
1770 RX$="" :RY$=TX$:REPEAT:PROCSTRIP(RY$):E3=VAL(US):RY$=MID$(RY$,U):RX$=R
X$+US+ " ":PROCSTRIP(RY$):E4=VAL(US):RY$=MID$(RY$,U):RX$=RX$+US+ " ":UNTIL E3
=14
1780 EP=INSTR(RX$, " 14 0"):RX$=LEFT$(RX$,EP-1):RX$=RX$+ " 16 00 ":S$(SC+1)=
RX$
1790 E2=E2-1:TX$="13 "+STR$(E2)+TX$:S$(SC)=TX$:SC=SC+1:GOTO 1760
1800 S$(SC+1)=DT$(E1-100,1):S$(SC)=TX$:SC=SC+1:GOTO 1760
1810 DEFFROCEX(US):UU=0
1820 IF ASC(US)=32 THEN ST$=MID$(US,2):UU=UU+1:GOTO 1820
1830 US="" :U=0:REPEAT:U=U+1:IF ASC(MID$(ST$,U,1))>32 THEN US=US+MID$(ST$,
U,1)
1840 UNTIL (MID$(ST$,U,1)=" " OR U)=LEN(ST$)
1850 U=U+U
1860 ENDPROC
1880 DEFFROCEX(FD$):FDF=0:PROCSTRIP(FD$):FD$=US
1890 N=0:REPEAT:N=N+1:UNTIL (FDF=D$ (N) OR N=30):IF FDF=D$ (N) THEN FDF=N
1900 N=0:REPEAT:N=N+1:UNTIL (FDF=D$ (N) OR N=30):IF FDF=D$ (N) THEN FDF=
N+100
1910 ENDPROC
1920 DEFFROCEX(DO):THD=HD:UD=1:GOSUB 2190:HD=1:NH=NM:TR=TR:SZ=SZ
1930 PROCSTRIP(DO):UD1=VAL(US)
1940 IF UD1=100 THEN S$(0)=DT$(UD1-100,1):PLOT4,AX,AY:SC=0:REPEAT:PROCEX:U
NTIL SC=0:GOTO 2000
1950 IF (UD1=1 OR UD1=15 OR UD1=17 OR UD1>18 AND UD1<24) THEN PRINT"## can
't undo ":D$(UD1): " ##":GOTO 2000
1960 T$=MID$(D$(0),U):PROCSTRIP(T$):UD2=VAL(US):T$=MID$(T$,U)
1965 GOSUB 2190:PLOT4,AX,AY:GOSUB 2190
1968 IF UD1=2 THEN GOSUB2190:PLOT4,AX1,AY1:AG=GA1:GOSUB2190
1970 IF UD1=3 THEN PU=1
1980 IF UD1=4 THEN PU=0
1990 IF UD1=5 THEN FL=0
2000 IF UD1=6 THEN IF FL=1:FL=0:ELSE FL=2
2010 IF UD1=7 THEN PROCAC(7,-UD2,"")
2020 IF UD1=8 THEN PROCAC(8,-UD2,"")
2030 IF UD1=9 THEN PROCAC(9,-UD2,"")
2040 IF UD1=10 THEN PROCAC(10,-UD2,"")
2050 IF UD1=11 OR UD1=12 THEN GOSUB 2090
2060 IF UD1=13 AND DF=1 THEN PRINT"## EN definition and redefine ##"
2070 IF UD1=16 THEN PRINT"## EN Delete definition ##"
2075 IF UD1=24 THEN GOSUB2190:AG=GA1:GOSUB2190
2080 HD=THD:GOSUB 2190:UD=0:NH=NM:TR=TR:SZ=SZ:ENDPROC
2090 T$=DT$(0,1):PROCSTRIP(T$):X1=VAL(US):T$=MID$(T$,U+1):PROCSTRIP(T$):Y1
=VAL(US)
2100 T$=DT$(0,0):PROCSTRIP(T$):X2=VAL(US):T$=MID$(T$,U+1):PROCSTRIP(T$):Y2
=VAL(US)
2110 FLF=FLF-1
2120 DT$(0,1)=DT$(0,0)
2130 IFFLF<=1 THEN PLOT3,-X1,-Y1:GOTO 2160
2140 PLOT0,-X1,-Y1:PLOT0,-X2,-Y2
2150 PLOT1,X2,Y2
2160 RETURN
2170 DEFFNAN(Z)=Z*ACOS(RAD(AN))
2180 DEFFNSIN(Z)=Z*ASIN(RAD(AN))
2190 IF HD=1 THEN RETURN
2200 GCOL$=1
2210 AN=AG:Z=Z5:VWZ=FNSAN(Z):WVZ=FNCAN(Z):PLOT1,VWZ,WVZ:PLOT0,VWZ,WVZ
2220 AN=AG+220:Z=Z5:VX=FNSAN(Z):WVZ=FNCAN(Z):PLOT0,VX,WVZ:PLOT0,-VX,-WVZ
2230 AN=AG+140:Z=Z5:VX=FNSAN(Z):WVZ=FNCAN(Z):PLOT0,VX,WVZ:PLOT0,-VX,-WVZ
2240 PLOT0,2$-VWZ,2$-WVZ
2250 GCOL$=1
2260 RETURN
2270 DEFFROCTUR(PL,X,Y)
2280 IF (PT=9 OR PT=10) THENAG=AG:AG=AG-PN:GOSUB2190:AG=AG+PN:GOSUB2190:ENDP
ROC
2290 GOSUB2190
2300 IF UD=1 AND PL=1 THEN PL=3
2310 PLOTPL,X,Y
2320 GOSUB 2190
2330 DT$(0,0)=DT$(0,1):DT$(0,1)=STR$(X)+ " "+STR$(Y)
2340 IF FLF=3 THEN GOSUB 2370
2350 ENDPROC
2370 T$=DT$(0,1):PROCSTRIP(T$):X2=VAL(US):T$=MID$(T$,U+1):PROCSTRIP(T$):Y2
=VAL(US)
2380 T$=DT$(0,0):PROCSTRIP(T$):X3=VAL(US):T$=MID$(T$,U+1):PROCSTRIP(T$):Y3
=VAL(US)
2390 IF UD=1 THEN PL=03 ELSE PL=01
2400 PLOT0,-X2,-Y2:PLOT0,-X3,-Y3
2410 PLOT0,X3,Y3:PLOT PL,X2,Y2
2420 RETURN
2500 REM
2505 IFERR=26 AND LERR=670 THENPRINT"### SERIOUS ERROR ###":IFDF=1 THEN 2560 EL
SE IF DF=1 THEN 2520 ELSE IF RP=1 THEN 2540 ELSE 2600
2510 PRINT"ERROR NUMBER ":ERR: " AT LINE ":LERR:END
2520 PRINT"## DEFINITION ABANDONED ##":GOTO 2600
2540 PRINT"## REPEAT ABANDONED ##":GOTO 2600
2560 PRINT"## EDIT ABANDONED ##":GOTO 2600
2600 PRINT"## DON'T DO IT AGAIN ##":R=GET:VDU 28,0,31,39,26:CLS:DF=0:RP=0:
ED=0:DT$(DT,0)="":GOTO 170

```

(continued from page 65)

ProcTur controls plotting lines on the screen and the subroutine called at line 2190 controls the cursor on the screen.

Following this, two of the major routines can be introduced. The ProcInp accepts the commands and passes its results to the major procedure ProcAct. This consists of a Gosub stack which calls routines corresponding to the 30 allowed terms. The simple screen-handling commands can now be keyed in. This will give a minimal system capable of executing commands immediately on the screen.

The system can now be extended by adding the structures that allow it to be described as a language, the Repeat loop, and the definition

routine depend upon the ProcEx procedure.

There only remain the parts that make life easier: the Editing, Description Delete and Quit routines to complete the system.

The main variables of the program, besides the flags, are the arrays. D\$(30) holds the mnemonics for the system commands. The arrays DT\$(50,2) holds the defined command names in DT\$(DT,0) and their representation in DT\$(DT,1). DT is the defined command counter.

The definition of a command is held in the array as a sequence of pairs of strings. The first string of the pair holds the command number as described in ProcFind, the second string holds a dummy value 0 or a simple

numerical value or a term that will give a numerical result when passed to the Basic's Eval function. This is made clearer by an example.

Suppose you defined your first term QSQ as FD NM*.8 // RT 90 this would be stored in DT\$(1,1) as " 12 NM*.8 10 90". The command SQ defined as RP 4//QSQ//NX would be stored as "13 4 101 14 0".

The execution of a defined term or a repeat loop is handled by ProcEx; this controls the stack SS(100). The string to be executed is placed on the bottom of the stack and is stripped of pairs of values to be passed to ProcEx. If a repeat loop or a defined term is

(continued on page 69)

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encountered then the relevant string is placed on top of the stack and execution of the stack moves up one level.

In operation, the program, operating system

RAM and screen memory occupy 22K of your 32K. This leaves 10K for the program variables and the stack.

It is possible to use up all of this memory before the reserved limit of 50 defined terms

and 100 stack levels is fully used. Despite this you may wish to add further system commands. Commands to change foreground and background colours could easily be added by adding subroutines to the subroutine stack.

HOW TO TALK TURTLE

THE ESSENCE of turtle graphics is the "turtle" concept. Imagine a mechanical turtle, crawling over a sheet of paper, drawing a line as it goes. It can do two main things: it can go forward for any distance you may wish, and it can turn right through any angle — a negative angle is the same as a left turn. With these two functions, it is easy to make the turtle draw complex patterns; for instance, the imaginary command sequence:

```
FWD(10) TURN(90) FWD(10) TURN(90)
FWD(10) TURN(90) FWD(10) TURN(90)
```

would draw a square of side length 10, leaving the turtle back where it started, facing in the original direction. Try it on a piece of paper.

This simple example should hint at how more complex patterns can be generated. There are, however, several important points about the way in which turtle graphics acts which may not be immediately obvious.

The pattern is drawn from wherever the turtle may be at the start — it takes absolutely no notice of the screen's co-ordinate system. This makes it very easy to draw any pattern anywhere; once you have written a routine to draw the shape you want — the difficult part — you can put the turtle in the correct starting position and set it off. This goes even further, since the pattern may be drawn at any angle, because the turtle simply starts moving in the direction in which it is pointing. Put it in the middle of the screen, turn it right 45° and set it running to draw a diamond.

Turtle graphics make it easy to scale the size of a pattern as well. Suppose in the previous example we had used

```
FWD(n) TURN(90)
```

that would draw a square of side length *n* at any angle, anywhere on the screen.

The final major benefit of turtle graphics is the ease with which routines may be debugged. At its simplest, you can "play turtle". Walk and turn as the program specifies and see if your footsteps trace out the

David Peckett's programs allow you to test the water before taking the turtle plunge.

pattern you wanted them to. If they do not, the bug should be obvious immediately. This technique appeals particularly to children of all ages, who can have great fun debugging turtle graphics routines.

What facilities do we need from a turtle graphics system? Obviously, there must be commands to instruct the turtle to go forwards and to turn. There must also be a way to put the beast anywhere on the screen, facing in any direction. Sometimes, we may wish to move the turtle without drawing a line, and so we need ways to switch its pen on and off. Also, since we are using a BBC Micro, there must be a way of changing the Ink colour.

Additionally, it would be useful if we could control more than one turtle simultaneously. The Apple turtle graphics system does not allow this, but it might be very helpful in games to be able to move turtles simultaneously.

As a final refinement, the turtle graphics system should allow us to write any message on the screen at the turtle's present position, without affecting that position.

Take a look now at listing 1, which is a set of procedures to implement all these requirements. Their names are in line with the general run of turtle graphics commands.

Note that the listing does not show the arrays which are used in conjunction with the procedures. You need five to support the system:

TRTLX(n) and TRTLY(n)

which contain the turtles' positions in absolute screen co-ordinate terms while

TRTLA(n)

holds the angle at which each turtle is facing, using the convention of "up is 0°" and recording the angles in degrees clockwise.

TRTLCOL(n)

holds the logical colour number selected for each turtle — you can alter the logical colours by the usual VDU 19 command. Finally,

TRTLDOWN(n)

is an array whose elements are set to 1 to show that the associated turtle is writing, or 0 if its pen is up. The dimension of all of these arrays, given by "n" represents, of course, how many turtles are available.

Remember, though, that having dimensioned the arrays at the start of your program, there is no need to refer to them again. The procedures in listing 1 keep them completely up to date.

All the procedures have a common syntax, which is of the form

PRONAME(n,d1. .)

The first item in the brackets is the number of the turtle which is to be addressed. It is followed by the appropriate number of items of data; in most cases, there are no data items, or only one, but the positioning commands

PROCTRTLMOVE and PROCTRTLSET take more items of data.

The procedures are thoroughly explained by Rem statements and should be easy to follow, but let us take a closer look at what each one does.

ProcTrtlInt. This procedure simply sets the selected turtle up to a standard starting position. It goes to the centre of the screen, facing up, with its pen down and ready to draw a white line. You would normally use this procedure at the start of a graphics run, but it can be called at any time; the turtle goes straight to the start position, from wherever it may be, without drawing a line.

ProcTrtlMove. This is one of the two fundamental turtle graphics instructions. It

(continued on next page)

Listing 1.

```
L.
10000 REM** BBC Turtlegraphics routines
10010 REM** 26 Sep 1982, by D S Peckett
10020
10030 REM** Put turtle "tno" in centre of screen, pointing up, pen down.
10040 REM** and ready to draw in white
10050 DEF PROCRTTLINIT(tno)
10060 PROCRTTLSET(tno,640,512,0):REM** Position and angle
10070 PROCRTTLPENDOWN(tno):REM** Put the pen down
10080 PROCRTTLPENCOL(tno,0):REM** 7 will select white in any mode
10090 ENDPROC
10100
10110 REM** Move turtle "tno" for "td" units in the direction it is facing.
10120 REM** Keep a record of the position if it goes over the screen edges.
10130 DEF PROCRTTLMOVE(tno,td)
10140 tx=TRTLX(tno)+td*SIN(RAD(TRTLA(tno))):REM** Get the new x-axis position
10150 ty=TRTLY(tno)+td*COS(RAD(TRTLA(tno))):REM** and the y-axis position
10160 PROCRTTLMOVETO(tno,tx,ty):REM** Actually move it
10170 ENDPROC
10180
10190 REM** Move turtle "tno" to (tx,ty), drawing a line in the selected
10200 REM** colour if the "pen" is "down".
10210 DEF PROCRTTLMOVETO(tno,tx,ty)
10220 GCOL 0:TRTLCOL(tno):REM** Select the foreground colour for this turtle
10230 MOVE TRTLX(tno),TRTLY(tno):REM** Put cursor at turtle's current position
10240 PLOT 4:TRTLDOWN(tno),tx,ty:REM** Draw the line, if pen is down
10250 TRTLX(tno)=tx:REM** ..the pointers
10260 TRTLY(tno)=ty:REM** ..the pointers
10270 ENDPROC
10280
10290 REM** Turn turtle "tno" through "ta" degrees in a clockwise direction.
10300 DEF PROCRTTLTURN(tno,ta)
10310 ta=ta+TRTLA(tno):REM** Get new angle
10320 PROCRTTLTURNTO(tno,ta):REM** Actually set it to the new angle
10330 ENDPROC
10340
10350 REM** Set turtle "tno" to point at angle "ta".
10360 DEF PROCRTTLTURNTO(tno,ta)
10370 ta=ta MOD 360:REM** One revolution only
10380 IF ta>180 THEN ta=ta-360:REM** Adjust the range of angles...
10390 IF ta<-180 THEN ta=ta+360:REM** ...to -180 to +180
10400 TRTLA(tno)=ta:REM** Set it
10410 ENDPROC
10420
10430 REM** Position a turtle
10440 DEF PROCRTTLSET(tno,tx,ty,ta)
10450 TRTLX(tno)=tx
10460 TRTLY(tno)=ty
10470 TRTLA(tno)=ta
10480 ENDPROC
10490
10500 REM** Set turtle "tno" to be ready to draw
10510 DEF PROCRTTLPENDOWN(tno)
10520 TRTLDOWN(tno)=1
10530 ENDPROC
10540
10550 REM** Stop "tno" drawing a line as it moves
10560 DEF PROCRTTLPENUP(tno)
10570 TRTLDOWN(tno)=0
10580 ENDPROC
10590
10600 REM** Select a logical colour for turtle "tno" — usual BBC colour codes
10610 DEF PROCRTTLPENCOL(tno,tcol)
10620 TRTLCOL(tno)=tcol
10630 ENDPROC
10640
10650 REM** Write the string held in "tmesg" at position of turtle "tno"
10660 REM** without disturbing the turtle
10670 DEF PROCRTTLMESS(tno,tmesg)
10680 VDU 5:REM** Merge cursors
10690 MOVE TRTLX(tno),TRTLY(tno):REM** Position cursor
10700 PRINT tmesg:REM** Print the message
10710 VDU 4:REM** Separate cursors
10720 ENDPROC
```


(continued from previous page)

moves the chosen turtle the defined distance in whatever direction it happens to be facing. The distance is given in terms of the standard BBC graphics layout of 1,280 by 1,024 — thus

```
PROCRTLMOVE(2,640)
```

would move turtle 2 a distance equivalent to half the horizontal width of the screen. If the pen is down, the turtle will draw a line behind it in the selected colour.

ProcTtlMoveTo. This procedure would normally only be used by **ProcTtlMove** but is available at any time, if you insist on using it. It moves the turtle to a position defined by the BBC's normal X, Y system, drawing a line behind it as it goes.

ProcTtlTurn. The second of the two fundamental turtle-graphics commands, this procedure turns the selected turtle through the given angle, which is defined in degrees. Any angle may be given, including those greater than 360°. Nothing is visible on the screen when you Turn, but the effect appears when the turtle is Moved.

ProcTtlTurnTo. Like **ProcTtlMove To**, this routine is intended for use with other procedures, but is available at any time for setting a turtle up to an absolute angle.

ProcTtlSet. This routine sets a turtle to any absolute (X, Y) screen position and angle. The turtle moves without drawing a line, but it retains whatever Pen and Colour selections have been made.

ProcTtlPenDown/Up. These two procedures instruct the selected turtle to start and stop writing respectively.

ProcTtlPenCol. To choose the colour lines which a turtle is to draw, use this procedure. The colour is defined by a number representing a logical colour — which you may redefine to any true colour by the normal VDU 19 command — and the computer reacts as usual to colour numbers greater than those which are available in the current mode. For instance:

```
PROCRTLPENCOL(1,2)
```

in Mode 0 will actually select logical colour 0, drawing the background colour and erasing whatever it may cross.

ProcTtlMess. Finally, to write a message at the current position of any turtle, use this. It writes whatever is in the given string without moving the turtle.

You have probably realised that some of these procedures are, actually, redundant in the sense that it is quicker and easier to address the appropriate array directly. In particular, **ProcTtlPenDown/Up/Col** can all be performed as simply, and slightly faster, by directly accessing the arrays. They are included, however, to make the set of procedures complete and compatible with any other turtle graphics systems you may come across.

It might be a good idea now to have a look at some examples of turtle graphics in action. Listing 2 gives a very basic, even crude, demonstration.

This is a simple program to draw a line around the screen under control of the left and right arrow keys. As written it will only run on a 32K machine, but it is easy to alter line 120 to, say, Mode 4 in order to get around that problem. The program uses just one turtle, which starts off in the middle of the screen, and then crawls forward.

The heart of the program is the Repeat Unit loop at lines 200-300. These lines repeatedly move the turtle forward and then check to see whether specific keys have been pressed. As you will see from the program the right arrow will turn the turtle right 5° on each pass through the loop, the left arrow will turn it left the same amount, and the U and D keys raise and lower the pen to switch the line off and on.

To change the colour, press C; the program will then wait for one of keys 0 to 7 inclusive to be pressed. Once one is pressed, the turtle will move off again, leaving a trail of the newly selected colour. The whole thing carries on until the Q key is hit.

Two points about the routine may be of interest. **CHR\$224** is defined — in line 90 — as a little arrow, which moves around with the turtle to show where it is. Without it, you could get lost when the pen is up. Secondly, the keys are interrogated via **?215**; this is quicker than the **Inkey()** function, and makes it easy to react repeatedly to keys which are held down continually, as when the turtle is being turned.

The second example — listing 3 — applies turtle graphics to drawing many copies of the same shape, each one being of a different size and angle. It is a good demonstration of the way in which this type of graphics lends itself to rotating and scaling a display without the need for complex mathematical routines, which would probably otherwise have to be developed especially for each application. The program can be adapted to draw a wide range of shapes but, as it is presented here, it draws a complex spiral pattern which creates an attractive shell-like display.

Its heart is **ProcPoly(n,l,a)**, which draws an n-sided regular polygon, with a corner at the screen centre, of side length l and at angle a. It uses Turtle 1 to do the job, initially positioning it at screen centre, and then steadily Moving and Turning it to complete the drawing of the polygon.

The advantages of a general routine like this is that it can draw a polygon with any number of sides from three up. The more sides it has, the more the shape looks like a circle; in this case, the program draws 20-sided polygons, which are as near as makes no difference for most purposes to a circle.

The main part of the program is the simple For-Next loop at lines 120-150 which steadily adjust the angle at which the polygon is drawn, while at the same time increasing its size by means of the **Length=Length+2** instruction in line 140. The effect as the pattern develops on the screen is of a series of circles which grow as they roll around a central point.

Listing 2.

```
10 REM** Simple Program to demonstrate Turtlegraphics
20 REM** The turtle moves across the screen, and is steered with
30 REM** the right and left arrows
40 REM** The pen can be put up and down, and the colour changed
50 REM** 29 Sep 1982, by D S Peckett
60
70 REM** Set up the arrays needed by Turtlegraphics
80 DIM TRTLX(1),TRTLV(1),TRTLA(1),TRTLCL(1),TRTLDM(1)
90 VDU23,224,255,64,32,16,8,0,0,0:REM** Pointer character
100 P=CHR$224:REM** This will show where the turtle is
110
120 MODE1
130 *FX 11.0
140 CLS
150 *FX 4.2
160
170 PROCRTLINIT(1):REM** Set up turtle 1
180 GCOL 3,7:PROCRTLNESS(1,P):REM** Point to turtle
190
200 REPEAT
210 GCOL 3,7:PROCRTLNESS(1,P):REM** EOR function flashes the Pointer
220 PROCRTLMOVE(1,7):REM** Move forward 7 units
230 GCOL 3,7:PROCRTLNESS(1,P):REM** Flash turtle pointer
240 REM** Use "?215" for high-speed read of keyboard
250 IF ?215=249 THEN PROCRTLTRN(1,5):REM** Go right?
260 IF ?215=153 THEN PROCRTLTRN(1,-5):REM** Go left?
270 IF ?215=181 THEN PROCRTLPENUP(1):REM** "U" to lift pen up
280 IF ?215=175 THEN PROCRTLPENDOWN(1):REM** "D" to put pen down
290 IF ?215=210 THEN PROCNEMCO(1):REM** "C" to change colour
300 UNTIL INKEY#="Q":REM** Quit?
310
320 *FX 4.0
330 *FX 11.50
340 END
350
360
370 REM** Choose a new colour
380 DEF PROCNEMCO(tno)
390 LOCAL tcol#,tcol
400 REPEAT
```

```
410 tcol=GET$:REM** Get a key
420 UNTIL tcol#="0" AND tcol#="9":REM** Make sure it's a colour
430 tcol=VAL(tcol):REM** Convert to a logical colour number
440 PROCRTLPENCOL(tno,tcol):REM** New colour
450 ENDPROC
```

Listing 3.

```
10 REM** Draw a spiral pattern with BBC Turtlegraphics
20 REM** 26 Sep 1982, by D S Peckett
30
40 REM** Set up the arrays for turtlegraphics
50 DIM TRTLX(1),TRTLV(1),TRTLA(1),TRTLCL(1),TRTLDM(1)
60 MODE4
70 VDU 19,1,2,0,0,0,0:REM** Green lines on a black background
80
90 REPEAT
100 CLG
110 Length=15:REM** Initial length of each side of the polygon
120 FOR Angle=0 TO 360 STEP 10
130 PROCPCOLVG(20,Length,Angle):REM** Draw 20-sided polygons
140 Length=Length+2:REM** Each one will be a little larger
150 NEXT Angle
160 UNTIL GET#="Q":REM** Pause - finish if "Q" is pressed
170
180 END
190
200
210 REM** Procedure to draw an "n"-sided regular polygon, side length "l",
220 REM** with a vertex at screen centre and the first side at angle "a"
230 REM** to the vertical.
240 DEF PROCPCOLVG(n,l,a)
250 LOCAL count#,ang
260 PROCRTLINIT(1):REM** Initialize turtle 1
270 PROCRTLTRN(1,a):REM** Turn for the first side
280 ang=360/n:REM** Turtle must turn this much at each vertex
290 FOR count=1 TO n
300 PROCRTLMOVE(1,l):REM** Draw a side
310 PROCRTLTRN(1,ang):REM** Turn for the next side
320 NEXT count
330 ENDPROC
```




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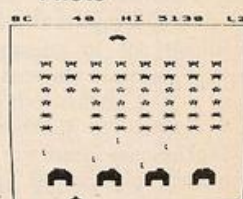
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Atomic-powered word processing could make all those Christmas thank-you letters less of a chore.

Geoff Byrns shows you how.

A WORD PROCESSOR is ideal for writing reports, newsletters, circulars and personal letters, or for preparing any text where you may wish to make copies or alter slightly before printing. Written mostly in Basic, Scribe allows just such flexibility. Text can be stored to and loaded from tape and a brief rundown of its features will illustrate what Scribe has to offer.

The word processor program has the facility to insert from one to 64 characters of text; to erase single characters or any size block of text; to allow text to be dumped onto tape; and to load text from tape. It can also carry out character or block movement of text, and replace text.

Control codes for the printer are embedded within the text and new lines, tab, and double width characters can all be generated under software control. You can also view text — even though text is echoed to the screen whilst typing it may be desirable to review the text periodically.

Choose your width

The printed line width may be chosen by the user. It is set at 64 and all printing is controlled to disallow broken words at the end of a line.

The program occupies most of the lower text space, including an 800-byte buffer for memory transfers and a scratchpad, but this can be reduced considerably by fully abbreviating the Basic keywords and using multiple-line statements where possible.

Like any piece of software the more you

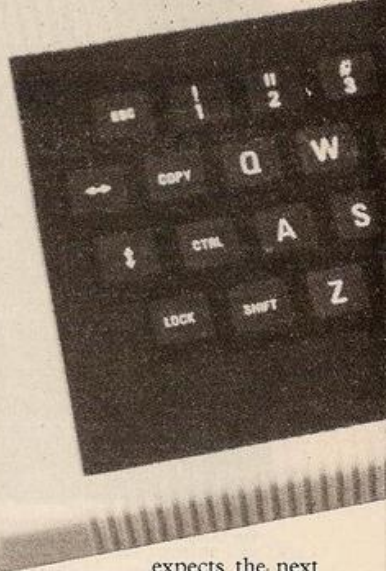
know about it, the more you can get out of it and it becomes possible to alter the program to suit your own purpose. The best way to get to know Scribe is to use it — but first a complete review of its commands is in order.

On running, the program sits and waits with a blank screen for you to type. This could be described as the typing mode, as opposed to the command mode which is described later. In the typing mode all keyboard characters except the Return and Copy keys are accepted as text, which is then copied to the upper text space and echoed to the screen. The upper text space is an ideal repository for text and it allows the equivalent of something like four sides of A4 paper packed with words — enough for most purposes.

Inverse characters are taken to represent upper case, and normal characters represent lower case opposite to the usual practice. In this way, the keyboard is used as one would use a typewriter. Since most mistakes are noticed during typing the normal use of the Delete key is catered for. Incidentally, the Repeat key may also be used with any other key as standard and when any key is pressed, a short blip from the internal speaker is produced which has proved a great aid to typing.

To leave this mode and enter the command mode one merely needs to press the Ctrl key and simultaneously press the Copy key. The Atom responds with a blip and moves the cursor one space forward. At this point, Scribe

ATOM



expects the next key-press to be a command from the following list — an error trap is included for those with shaky fingers should an incorrect key be pressed.

Save text
allows text to be dumped to tape. Once this has been successfully saved the routine returns to the typing mode through the View routine.

```

0 REM SCRIBE 2.5 ** (C) G.W.BYRNS 1982
1 DIM H(64),K(64),I(3)
10 A=#202:B=A:F=#0:X=#380:O=#0
15 W=64:REM W=WIDTH CHANGE TO SUIT
20 DIM LL(7):F,I=0:TO10:LL(I)=1:N
25 F,U=0:TO1
30 P=#200
35 P,#21
35 L
40 LL0 JSR#FFE3:STA#00:JSR LL2:LD#00:CHP#14:BCS LL7
42 JMP LL0:LL7 RTS
45 LL1 LDA#31:CHP#00:BCS LL3:LD#00:JSR#FF4:LL3 RTS
47 LL2 LD#00F:LL4 LDA#FF:STA#01:LL5 DEC#01:BNE LL5
55 LDA#002:EOR#04:STA#002:DEX:BNE LL4:RTS
60 LL6 LDA#0:JSR#FF4:LD#02:JSR#FF4:LD#00:JSR#FF4:RTS
100
105 P,#6:P,#12
110 N
200 DO:REM ACCEPT TEXT FROM KEYBOARD
203 LI,LL0
205 IF ?#00=127 LI,LL6:A=A-1: ?#A=D:G,202
210 ?#A=?#00:A?I=#0:A=A+1
215 IF A=?#97FC:G,6
220 LI,LL1
220 UNTIL ?#000=191
225 A=A-1:I=#00000000
230 LI,LL0
240 IF ?#00=00 G,P:REM PRINT ROUTINE
245 IF ?#00=75 G,K:REM CONTROL CODE ROUTINE
250 IF ?#00=73 G,I:REM INSERT ROUTINE
255 IF ?#00=66 G,V:REM VIEW ROUTINE
260 IF ?#00=83 G,t:REM SAVE ROUTINE
265 IF ?#00=76 G,u:REM LOAD ROUTINE
270 IF ?#00=69 G,e:REM ERASE ROUTINE
275 IF ?#00=92 G,r:REM REPLACE ROUTINE
280 IF ?#00=77 G,m:REM MOVE ROUTINE
295 IF ?#00=27 P,"unon9 key ","TRY AGAIN":G,200
299 END
300 A=B:M=0:P,#12:P,#21:P,#2
305 P,#32
310 DO
315 IF ?#A16 OR ?#A159 G,c
320 GOS,1:REM FIND LENGTH OF WORD
325 IF M>W P,#13:M=0:Q=0+1:IF Q>59 GOS,2
330 M=M+L
335 IF M>W P,#13:M=0:M=M+L:Q=0+1:IF Q>59 GOS,2
350 F,T=0 TO L-1
355 IF A?T=32:P," "G,370
357 IF A?T<65 A,A?T>32:P,#A?T>32:G,370
360 P,#A?T>32:REM U/LOWER CASE CONVERSION VICE VERSA
370 N
375 GOS,3:REM ECHO TO SCREEN
380 A=A+L
390 U,?#A=0
395 P,#13
400 P,#6:P,#3:G,200
500 L=0
510 DO
512 IF ?#A128 G,517
515 L=L+1
517 A=A+1
520 U,?#A=32 OR ?#A=0 OR ?#A128
530 A=A-L:I,R
600 P,#3:P,#6:F,T=0 TO L-1
610 P,#A?T>
620 N,I,P,#21:P,#2:R
600 C IF F=1 AND ?#A161:P,#15:F=0:G,850
905 IF ?#A161:P,#14:F=1
610 IF ?#A162:P,#13:P,#32:M=0:Q=0+1
620 IF ?#A163 M=M+0:F,I=0 TO 7:P,#32:N
630 A=A+1:G,315
900 LI,LL0
905 IF ?#00=60: ?#A=161
910 IF ?#00=78: ?#A=162:P,#A/P,#0
915 IF ?#00=84: ?#A=163:P," "
950 A=A+1: ?#A=0:G,200
1000 P,"'IN:INSERT TEXT FROM'"#J
1010 IN,"TEXT TO BE INSERTED"#"H
1015 II(0)=A:II(2)=A:A=B
1020 GOS,4:REM FIND MATCH BETWEEN #J AND TEXT
1025 IF F=0 GOS,b:G,1
1030 A=A+LEN(J):D=LEN(H)
1035 GOS,0
1036 G,1090
1040 DO:REM OPEN TEXT WINDOW TO ALLOW INSERTION
1050 II(3)=II(0)+0
1060 ?II(3)=?II(0)
1070 II(0)=II(0)-1
1080 U, II(0)<A:R
1090 F,I=0 TO LEN(H)-1
1100 A?I=H?I
1110 N
1120 A=LEN(H)+II(2):G,v
1500 F=0
1510 DO
1520 IF ?#A=?J GOS,w
1530 A=A+1
1540 UNTIL ?#A=0 OR II(1)=LEN(J)
1550 A=A-1
1560 IF II(1)=LEN(J):F=1
1570 II(1)=0:R
1600 II(1)=0
1610 F,I=0 TO LEN J-1
1620 IF A?I<J?I:I=LEN J:G,1640
1630 II(1)=II(1)+1
1640 N:R
1700 V,P,#12:P,#14
1705 F,I=0 TO A-B-1

```


SCRIBE



L.....Load text
allows text loading from tape. A beep signals successful loading and loaded text is automatically displayed. The text may then be added to or manipulated.

I.....Insert text
Respond to the prompts as they appear and single characters, words or sentences — up to 64 characters long — may be inserted anywhere within the text. Remember that the ASCII code 32 is a space and just as much a valid character as any other — so if you want to insert a word or sentence after another

word, treat the space as a normal character.
E.....Erase text

Allows for single characters, words or entire blocks of text to be erased. Again respond to prompts as they appear treating a space as previously outlined.

M.....Move text
allows any amount of text up to 800 characters to be moved from anywhere to anywhere within the text.

R.....Replace text
offers a full global search and replacement facility. The replacement can be longer, shorter or the same length as the target text since the routine contains the necessary logic to cater for all circumstances.

The global search and replace is the default condition but you also have the option to operate only on the first target found. This is achieved by appending the replacement word with a] as the final character before Return is pressed. This is an extremely useful and powerful command but under extreme circumstances it may be moving the equivalent of several hundred K of RAM around, so be patient. This command has a great many uses, one of which would be to personalise standard letters, for instance, every occurrence of Mr Smith could easily be replaced by Mr Winterbotham throughout the entire text with one simple command.

Viewing text

Another obvious example is when spelling or typing errors have crept into the text unnoticed; again these can simply and easily be replaced by the R command.

V.....View text

This routine prints the entire contents of text to the screen in paged mode. Printer controls are displayed as graphics characters so it is easy to see where, and how many, codes are embedded in the text. The function can be aborted at any time by pressing the Shift key, whereupon a return to the typing mode is executed. It is unfortunate that the Atom screen is fixed at 32 columns wide, since the ideal would be to have the same width screen as the printer, but in practice I have not found this to be detrimental to the layout of any printed matter.

K.....Printer control codes.

This is really a command with sub-commands. On entering the command mode by pressing the Ctrl and Copy keys, then pressing K steers the user to a routine which expects one of three other keys to be pressed. These are D, N, T.

D toggles on the double-width printing and all characters encountered after this control code are double printed until the next D code turns off the effect.

All these control codes are transparent to the user — that is, they do not appear on the screen or get printed out. But you can see them when you use the V view command. The N code forces a new line in the Printed output and is useful in producing the desired layout.

The T code produces a tab of eight spaces. I have implemented a software Tab in this application since different printers have different methods of implementing the same by hardware — so this method should be universal but could easily be substituted to suit your own printer. Any number of the N and T codes may be used to obtain the desired format.

P.....Print text

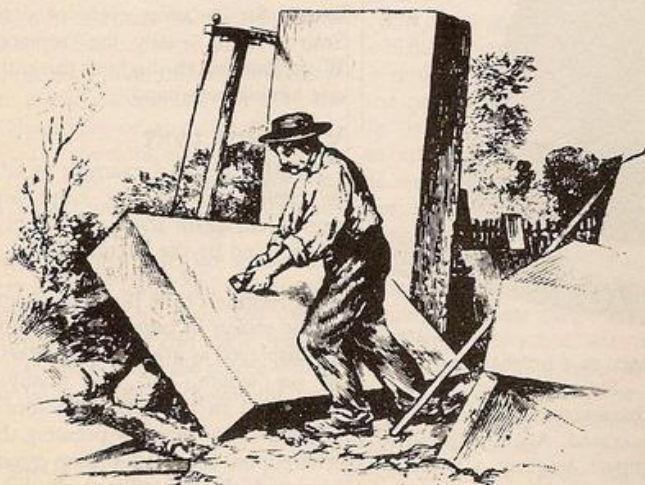
Once this command has been invoked the text is sent to the printer formatted according to the control codes. The routine also ensures that no broken words are printed at the end of lines and auto-paging of the document is under software control. During printing the text is echoed to the screen.

The program itself is modular in its approach. I trust this can be seen from the Rem statements in the listing, which incidentally should be omitted from the working copy of the Program since some of the coding will then occupy the buffer space.

```
1707 IF ?#0001<>255 I=A/P.//G.1720
1710 P.#(B?I)
1720 N.
1725 P.#15/G.200
1800 P.#12/?#0200=A%256/?#0201=A/256
1810 Z=FOUR""
1812 BPUT Z,##A/WAIT
1815 E=B-2/PUT Z,(A-E)
1820 F.I=E TO A
1825 BPUT Z,?I/WAIT
1830 N.
1840 G.v
1850 P.#12/Z=FIN""
1855 E=B-2/DO U. BGZ Z=##A
1860 I=GET Z
1865 F.N=0 TO I
1866 E?N=BGZ Z
1870 N.I.P.#7
1880 A=?#0201*256+?#0200
1885 G.v
1900 P.//IN."ERASE FROM"#J
1910 II(0)=A/A=B
1920 GOS.f
1925 IF F=0 GOS.b/G.e
1930 A=A+LEN(J)
1940 II(3)=A
1950 P.//IN."ERASE TO"#J
1960 GOS.f
1970 D=A-II(3)
1980 I=0
1990 DO
1995 ?(II3+I)=A?I
2000 I=I+1
2010 UNTIL II(3)?I=#D
2020 A=II(0)-D
2030 G.v
2100 P.#J HAS NOT BEEN LOCATED"/R.
2200 F.I=0 TO LENH-1/REM WRITE IN NEW TEXT
2210 A?I=H?I
2220 N.I=A+A+LENH)/R.
2500 P.#13/F.I=0 TO 4/P.#13/N./0=0/R.
3000 G=0
3010 P.//IN."REPLACE THE FOLLOWING"/J
3020 IN."WITH "/#H/Z=0
3025 IF H?LEN H-1)=93 Z=1/H?LEN H-1)=13
3030 II(0)=A;II(2)=A/A=B
3040 IF LENH>LENJ) G.4010
3050 IF LENH>LENJ) G.5010
3060 DO
3070 GOS.f
3080 IF F=0 AND G=0 GOS.b/GOS.d/G.4000
3090 G=1
3095 IF F GOS.h
3097 IF Z F=0/A=II0
```

```
4000 UNTIL F=0/A=II(0)
4005 G.v
4010 D=LENH>LENJ)
4015 DO
4020 GOS.f
4030 IF F=0 A. G=0 GOS.b/GOS.d/G.5000
4035 G=1
4040 IF F GOS.o/GOS.h/II(2)=II(2)+D/II(0)=II(2)
4050 IF Z F=0
5000 UNTIL F=0
5002 A=II2
5005 G.v
5010 DO
5020 GOS.f
5030 IF F=0 A. G=0 GOS.b/G.6020
5035 G=1
5040 D=LENJ>LENH)
5050 IF F=0 G.6020
5055 GOS.h/II(2)=II(2)-D
5060 I=0
5070 DO
5080 A?I=A?I+D)
5090 I=I+1
6000 UNTIL A?I=#D
6010 IF Z F=0
6020 UNTIL F=0
6025 A=II(2)
6030 G.v
6100 P.//IN."MOVE TEXT BEGINNING"/J
6110 P.//IN."ENDING"/H
6115 II(0)=A/A=B
6120 GOS.f
6125 II(2)=A/J=H
6130 GOS.f
6135 E=A+LEN(J)
6140 D=E-II(2)
6145 IF D>000 P."BLOCK TOO LARGE"/G.m
6150 F.I=0 TO D
6155 X?I=II(2)?I
6160 N.
6165 I=0
6170 DO
6175 ?(II2+I)=E?I
6180 I=I+1
6185 UNTIL II(2)?I=#D
6190 II(0)=II(0)-D/E=II(0)
6195 P.//IN."PLACE BUFFER AFTER"/J
7000 A=B/GOS.f/A=A+LEN(J)
7005 GOS.o
7010 F.I=0 TO D-1
7015 A?I=X?I
7020 N.I=A+E+D/G.v
7100 P.F.I=0 TO 100/WAIT/N./R.
```


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"Without sounding pushy I would like to conclude this review by saying — if you have a ZX81 and like games, then you should buy Michael Orwin's Cassette 4."

2 extracts from ZX Computing, Oct/Nov '82

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CUBE Rubik Cube simulator, with lots of functions including 'Backstep'.

SECRET MESSAGES This message coding program is very txlp qexi jf.

MARTIAN CRICKET A simple but addictive game (totally unlike Earth cricket) in machine code. The speed is variable, and its top speed is very fast.

Cassette 3 costs £5.

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8 games for 16k

ZX-SCRAMBLE (machine code)



Bomb and shoot your way through the fortified caves.

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GALAXY INVADERS (machine code)
Fleets of swooping and diving alien craft.

SNAKEBITE (machine code)

Eat the snake before it eats you. Variable speed (very fast at top speed)

LIFE (machine code)

A ZX81 version of the well known game.

3D TIC-TAC-TOE (Basic)

Played on a 4x4x4 board, this is a game for the brain. It is very hard to beat the computer at it. 7 of the 8 games are in machine code, because this is much faster than Basic. (Some of these games were previously available from J. Steadman).

Cassette 4 costs £5.

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Life is what you make it, and Peter Whittle certainly puts some zest into the generation game.

COMPLICATED PATTERN manipulation games such as John Conway's Life are ideally suited for programming on to a computer with visual display. Generally speaking, a lot of simple computation has to be performed to generate each new pattern from the previous one. This computation normally takes the form of checking the adjacent positions of each part of the pattern and then applying simple rules in order to generate the new pattern or, in the case of Life, the new generation.

This non-arithmetic computation is very inefficiently performed when written in Basic, involving many slow For-Next loops. With the game of Life on the ZX-81 it typically takes 20 seconds or more per generation. However, this type of computation is ideally suited for a fairly simple machine-code routine.

The display of the ZX-81 can be looked on as an array of 768 squares arranged in a grid 32 across by 24 down. The normal Basic print statements can only use the top 22 lines, the bottom two being used for report codes, although the whole 24 lines are accessible to a machine-code routine. When the total amount of memory exceeds 3.25K a clear screen is padded out with 24 by 32 spaces.

The computer blocks off 793 bytes of the memory to store this display, the extra bytes being Newline characters to mark the end of each line. The character at each position is coded with a number as listed at the back of the ZX-81 handbook. The starting address of this display file is stored at locations 16396 and 16397 and, in general, may move around in the memory — so its position must be checked each time the routine is called.

The game of Life

Briefly, the game of Life is as follows. Imagine a rectangular array of squares — in the case of the ZX-81 display, 24 by 32 in size. A pattern is first of all set up on the array either by a series of suitable print statements or by a more flexible program as suggested below. Certain rules are then repetitively applied to the pattern which will, in general, change the pattern at each step. If a suitable starting pattern is used a very interesting development of shapes can be observed.

The rules to be observed are as follows: first, any square surrounded by less than two, or more than three, occupied neighbouring squares will die of loneliness or overcrowding respectively. Secondly, any square surrounded by three occupied squares will become occupied, that is, live. Third, any square surrounded by two occupied squares remains unchanged. As can be seen, for each position on the array on which the game is to be played, the eight immediately adjacent positions need to be examined to determine whether it lives or dies.

With all the For-Next loops needed to program this in Basic, it could take a very long time to run. However, with the machine-code routine to be described, even in Slow mode where the microprocessor has to share its time between executing the program and

LOCATION	DECIMAL	LABEL	INSTRUCTION	COMMENT
16514	203,86	CHECK	BIT 2,(hl)	Bit 2 set?
16516	40,1		JRZ 1	
16518	60		INC a	Yes
16519	35		INC hl	
16520	201		RET	
16521	42,12,64		LD hl,(16396)	Display file start
16524	35		INC hl	
16525	14,22		LDc,22	Line count
16527	6,30	CH2	LDh,30	Column number
16529	17,30,0	CH1	LDde,30	
16532	175		X OR a	Reset count
16533	205,130,64		CALL CHECK	
16536	229		PUSH hl	For next position
16537	205,130,64		CALL CHECK	
16540	205,130,64		CALL CHECK	
16543	25		ADD hl,de	For next line
16544	205,130,64		CALL CHECK	
16547	229		PUSH hl	For square being tested
16548	35		INC hl	
16549	205,130,64		CALL CHECK	
16552	25		ADD hl	
16553	205,130,64		CALL CHECK	
16556	205,130,64		CALL CHECK	
16559	205,130,64		CALL CHECK	
16562	225		POP hl	Square being tested
16563	87		LDd,a	d has count
16564	62,3		LDa,3	
16566	186		CP d	d = 3?
16567	40,8		JRZ,LIVE	Jump if yes
16569	61		DEC a	Else
16570	186		CPd	d = 2?
16571	32,8		JRNZ,DEAD	Jump if no
16573	203,86		BIT 2,(hl)	Is bit 2 set also
16575	40,4		JRZ,DEAD	Jump if no
16577	203,198	LIVE	SET 0,(hl)	
16579	24,2		JR,OUT	
16581	203,134	DEAD	RES 0 (hl)	
16583	225		POP hl	Next position in hl
16584	16,199	OUT	DJNZ,CH1	End of row?
16586	35		INC hl	Yes
16587	35		INC hl	
16588	35		INC hl	
16589	13		DEC c	Reset line count
16590	32,191		JRNZ,CH2	Last line?
16592	30,52		LD e,52	Yes
16594	42,12,64		LD hl,(16396)	Display file
16597	1,33,0		LD h,33	
16600	0		ADD hl,bc	Start position
16601	14,22		LD c,22	Line count
16603	6,33	ST2	LDh,32	Row count
16605	35	ST1	INC hl	
16606	203,70		BIT 0,(hl)	Bit 0 set?
16608	32,4		JRNZ,LIFE	Jump if yes
16610	175		X OR a	zero a
16611	119		LD(hl),a	Kill
16612	24,1		JR,OUT	
16614	115	LIFE	LD(hl),e	New life
16615	15,244	OUT	DJNZ,ST1	End of line?
16617	35		INC hl	Yes
16618	13		DEC c	Line count
16619	32,238		JRNZ,ST2	Last line?
16621	201		RET	Yes

Figure 1.

ZX-81 LIFE

generating the display, each generation still takes less than one second.

Loops are performed most efficiently in machine code by setting a count in one of the registers — normally b, c, d or e so that a, or accumulator may be used for arithmetic and the hl pair for register indirect addressing. Each time the program section is to be executed, the count is decremented by one and then checked for zero with the JRZ or JRNZ instructions; do a relative Jump if JRZ is zero or JRNZ is not zero respectively and the loop either repeated or not.

The most efficient register to use is the b register because there is a special instruction DJNZ which decrements b and tests for zero in one. Another instruction type that is used in the program is the bit set and test group.

In the game of Life the whole pattern is

scanned and a new pattern is formed according to the rules previously defined. In order to avoid saving this new pattern in its own part of the memory and then transferring it into the display file, the life/death decision is made and then the square marked in a way that will be invisible to the status-checking routine when it is called for the neighbouring squares. The newly-formed pattern must be kept separate so as not to interfere with the testing of adjacent squares. The square marking is done by setting and testing particular bits of the word, coding each position in the display.

On the ZX-81, O, the character we will use to define the pattern, is coded 34H or 00110100. Counting the bits from the right, starting at 0 we see that bit 2 is a 1. The instruction BIT2 will test this particular bit

(continued on next page)

(continued from previous page)

and set the zero flag — if the bit is a zero — and reset it if the bit is a 1. The zero flag can then be tested by a JRZ or JRNZ instruction. SET and RES will similarly set or reset the particular bit specified.

The only other instructions that may be new to beginners in machine-code programming — although, of course, familiar to regular readers of *Your Computer* — are Push and Pop. These use an area of memory set aside by the computer-operating system for temporary storage. This is called the stack and works on a last-in, first-out principle. Data in the form of 16-bit words is entered or Pushed into the stack or retrieved or Popped from the stack.

The stack pointer, a register we need not worry about here, automatically keeps track of the current top-of-stack position. These instructions are used to temporarily store data out of the way, while the computer gets on with something else. For the readers who missed out, *Your Computer* ran a series on machine code from August to November 1982.

The complete machine-code routine is shown in figure 1. Briefly, its operation is as follows: the whole display is scanned and for each square the bit-checking subroutine, Check, is called for each of the eight surrounding squares, with a count of the number of live ones found and kept in the A register, program location 16525 to 16561.

The count is then checked and bit 0 set or

reset accordingly 16563 to 16582. Incidentally, this bit setting and resetting will produce an intermediate pattern of Ps and ■s, that is, the codes 00110101 and 00000001 in the display file. Once the whole array has been processed, it is scanned once more and for each square, bit 0 is tested to determine its new status and a 0, or 52 substituted for death — a 0 — or life — the letter O — respectively — 16594 to 16621. And that is all there is to it.

The program is loaded into the first Rem statement as suggested by Sinclair, so type out the following; remember to follow the first Rem with 110 spaces, approximately 4 lines.

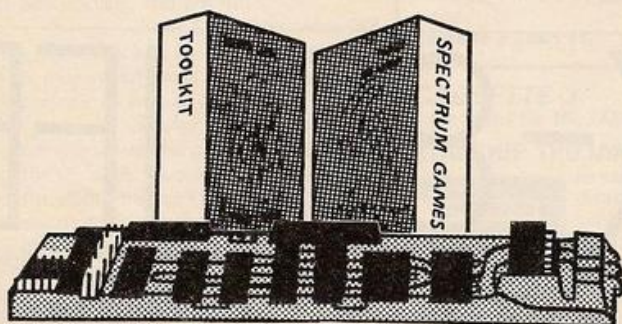
```
1 REM
10 LET L = 16514
20 PRINT L,
30 INPUT I
40 POKE L, I
50 PRINT PEEK L
60 LET L = L + 1
70 GO TO 20
```

On running this program it will print out the location. You then type in the decimal numbers as listed in figure 1. Note that some instructions consist of two or more numbers. The screen printout will show that they have been entered properly. When the screen is full type Cont to continue. When you get to 16622 type Stop. The machine-code routine will now be loaded in the Rem statement. All it needs now is a Basic set-up and operating program with some user-friendly embellishments.

```
1 REM....etc
10 LET L = PEEK 16396 + 256 * PEEK 16397
```

```
20 PRINT "      ""LIFE""
21 PRINT
25 PRINT " MOVE CURSOR WITH
ARROWS "
26 PRINT " PRESS O TO WRITE"
27 PRINT " PRESS P TO START "
28 PRINT " PRESS ANY KEY TO RUN AND
BREAK TO STOP "
29 PRINT " WHEN READY PRESS CONT "
30 STOP
31 CLS
32 LET A = 345
40 LET B = A
50 IF INKEY$ = "5" THEN LET A = A - 1
60 IF INKEY$ = "6" THEN LET A = A + 33
70 IF INKEY$ = "7" THEN LET A = A - 33
80 IF INKEY$ = "8" THEN LET A = A + 1
81 IF A < 1 THEN GOTO 32
82 IF A > 724 THEN GOTO 32
85 IF PEEK (L + A) = 118 THEN GOTO 32
87 IF A < > B THEN POKE (L + B), 0
90 POKE (L + A), 146
100 IF INKEY$ <> "O" THEN GOTO 130
110 POKE (L + A), 52
120 LET A = A + 1
130 IF INKEY$ = "P" THEN GOTO 140
135 GOTO 35
140 POKE (L + A), 0
141 LET A = 1
147 PRINT AT 0, 18; "GENERATION"; A
150 IF INKEY$ = " " THEN GOTO 150
160 LET L = USR 16521
165 LET A = A + 1
170 GOTO 147
```

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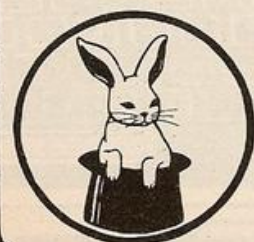
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Machine K Memory


```

10 DIM A$(20)
20 POKE 106,PEEK(106)-8
30 GRAPHICS 17:POKE 708,180:POKE 709,124:POKE 710,160:POKE 711,50:POKE 712,4
40 P=PEEK(106):N=P*256
50 FOR M=0 TO 1023:POKE N+M,PEEK(57344+M):NEXT M
60 FOR M=0 TO 103:READ D:POKE N+M+8,D:NEXT M
70 POKE 756,P:A$="$$$$$$$$$$$$$$$$$$$$"
80 FOR M=1 TO 4:POSITION 0,13+M:PRINT #6;A$(1,M+2);CHR$(37);CHR$(38);:NEXT M
90 PRINT #6;CHR$(163);" ";CHR$(39);CHR$(163)
100 POSITION 18,16:PRINT #6;CHR$(163);CHR$(41)
110 POSITION 16,17:PRINT #6;CHR$(39);CHR$(40);A$(1,2);A$;A$;A$;A$
120 PRINT #6;" CHARACTER SET DEMO":POSITION 0,13:PRINT #6;CHR$(163)
130 POSITION 0,0:PRINT #6;CHR$(129);CHR$(130);"      ";CHR$(135);CHR$(137);CHR$(130)
140 POSITION 8,8:PRINT #6;CHR$(135):POSITION 17,10:PRINT #6;CHR$(129);CHR$(130)
150 SOUND 0,50,6,6:SOUND 1,51,4,4
160 POSITION 11,12:PRINT #6;CHR$(10);CHR$(11):POSITION 5,8:PRINT #6;CHR$(10);CHR$(11)
170 FOR D=0 TO 25:NEXT D
180 POSITION 11,12:PRINT #6;CHR$(12);CHR$(13):POSITION 5,8:PRINT #6;CHR$(12);CHR$(13)
190 FOR D=0 TO 25:NEXT D:GOTO 160
200 DATA 0,3,15,31,63,255,255,0,0,192,224,248,252,255,255,0
210 DATA 60,126,255,255,126,24,24,24
220 DATA 255,255,255,255,255,255,255,255
230 DATA 192,224,240,254,255,255,255,255
240 DATA 0,0,0,0,0,0,240,252,0,0,0,0,0,12,126,255
250 DATA 0,0,0,1,63,127,255,255,15,63,127,127,255,255,255,255
260 DATA 1,3,63,202,74,63,31,7,128,192,252,171,170,252,248,224
270 DATA 1,3,63,213,85,63,31,7,128,192,252,83,82,252,248,224

```

ONE OF THE best features of the Atari 400 and 800 computers is the facility to redefine character sets. One can create as many character sets as the imagination can conceive and the computer's memory will hold.

This makes it possible to hold and display instantly any one of a number of character sets, or change the characters at the push of a button. Furthermore, by using Display List Interrupts different character sets can be mixed on the same screen in virtually any way. But perhaps the most interesting thing about a character set is that it takes up just 1K of RAM; imagine, the Latin, Cyrillic and Norse alphabets in 3K, and each one selectable at will.

To create your own character set the first thing to do is decide where in memory to store it. This is because the character set must not be overwritten by a Basic program and must not interfere with an area of memory already used for something else, for example, DOS.

The ideal place is at the top of the available memory. To ensure that it is protected from Basic, first determine the amount of RAM and then subtract from this the amount of memory to be used. Next, the operating system must be fooled into thinking that it only has this reduced RAM capacity available.

Memory location 106 contains the number of pages that are available for use by Basic; a page is 256 bytes long. This location is set by the operating system immediately after switching on the computer and, during a system Reset, this means one is free to alter the value stored there at will. Therefore, placing a smaller number in it can seal off the amount of memory required for use. This is achieved by using the following program.

```

10 GRAPHICS 0
20 POKE 106,PEEK(106)-8
30 P=PEEK(106)
40 N=P*256

```

Line 20 subtracts eight from the number of pages Basic can use. Four of these pages are for use by the new character set; $4 \times 256 = 1024$ or 1K. The other pages are used by the display; if a higher resolution mode than Graphics 0, 1 or 2 is used then more pages will have to be set aside for the display's use.

Line 30 sets P equal to the number of pages Basic can use; N in line 40 is given the number for the start of the new character set.

If we are not going to redefine a complete character set and wish to retain the use of part of the original set then the internal characters in ROM must be transferred to the space reserved in RAM. To do this, enter this program line:

```

50 FOR M=0 TO 1023:POKE N+M,
  PEEK(57344+M):NEXT M

```

The original character set resides in ROM at location 57344 onwards. N, as we know, contains the starting address of the new character set.

Before designing the new character set we must understand how a byte can represent a decimal number. Look at the following diagram — bit numbers are shown in the top line, decimal in the bottom line.

7	6	5	4	3	2	1	0	
1	0	0	1	0	1	1	0	= 150
128	64	32	16	8	4	2	1	

As you can see, a byte is made up of eight bits, each bit can contain a 1 or a 0 and, further, each bit is assigned a decimal value as



shown. This means that if a 1 was placed in bit 7 then that byte would have a decimal value of 128. In the example bit numbers 1, 2, 4 and 7 contain 1s. This makes the value of the byte equal to $2+4+16+128=150$. Each character is made up of eight bytes and so can be thought of as an eight-by-eight square and, depending on which bits in this square are at 1 and which are at 0 — that is, on or off — we can create a shape. This is illustrated by a grid diagram in figure 1.

The shaded blocks are 1s, the empty blocks are 0s and by using the decimal values of each byte as we did before we find that byte 0 = 36, byte 1 = 24, byte 2 = 60 and so on.

These decimal numbers will be used to create the character on the computer, but first decide which character the new one is to replace. If a little Invader character is to be displayed instead of the dollar sign, look up the character's number using the internal character set table on page 55 of the Atari

Basic Reference Manual. The dollar sign is character 4. Since each character is eight bytes long, to find the offset from the start of our character set it is necessary to multiply the character number by eight.

This offset value is then added to the starting address of the character set and the decimal values obtained from the eight-by-eight square are then read into the next eight bytes beginning at that address. These lines of program should make it a little clearer:

```
60 FOR M=0 TO 7 : READ D :  
   POKE N+M+(4*8),D : NEXT M  
100 DATA 36,24,60,90,90,60,36,0
```

Line 100 holds the decimal values that we are using to create our character; line 60 places these values into our new character set, overwriting the dollar sign character.

The new character has now been placed in memory but it cannot be accessed yet, because the operating system has not been told to use the new character set, so it is continuing to use the original one in ROM. Memory location 756 contains the pointer for the character set

and is automatically set to 224 on power-up, system Reset or a Graphics command.

Multiply 224 by 256; this obtains 57344, the location of the ROM character set. Now look back at line 40 of the program and you will find that $P*256$ gives the location of the character set. So, Poking 756 to P brings the brand-new custom character set into use. Now add the following line to the program or enter it as a direct command after the program has been Run.

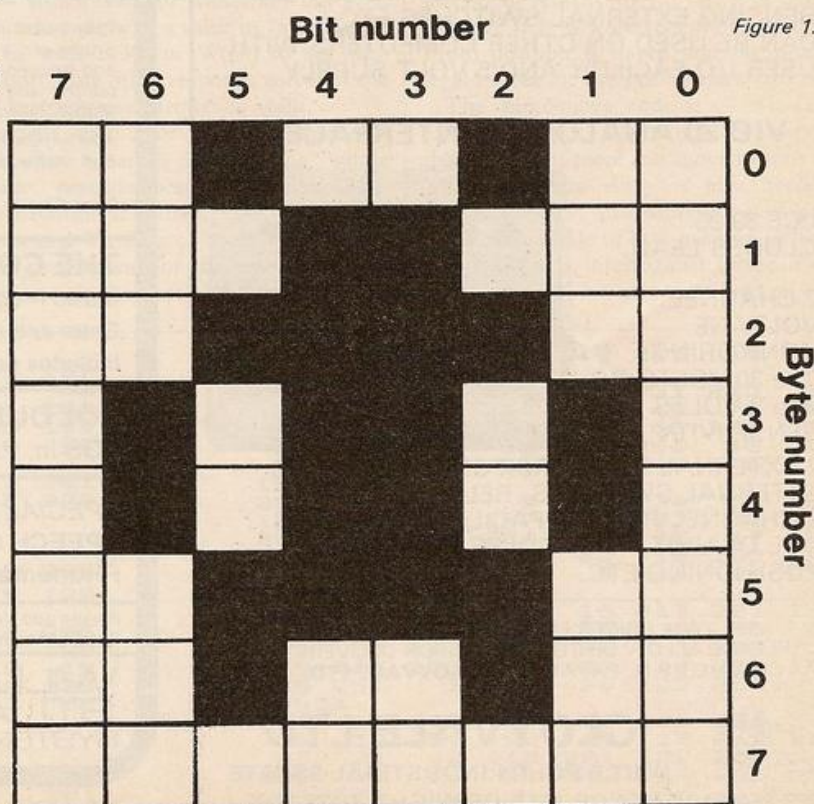
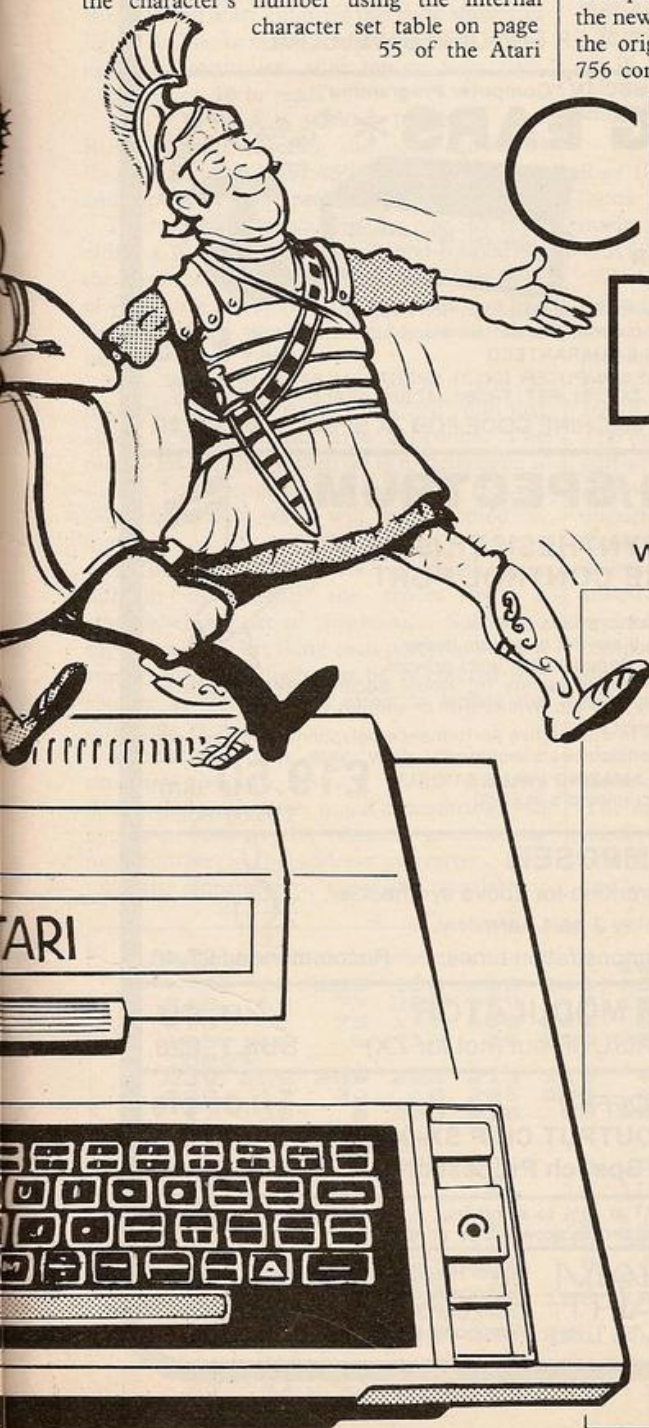
```
70 POKE 756,P
```

Once the program has been Run, try using the dollar sign; all the other keys work normally. Try the program for Modes 1 and 2, but please note if you redefine lower case or graphics characters in these Modes, remember to add 2 to P. This is the same as using 226 instead of 224 when displaying lower case with the original character set. Try the following lines to change the letter D.

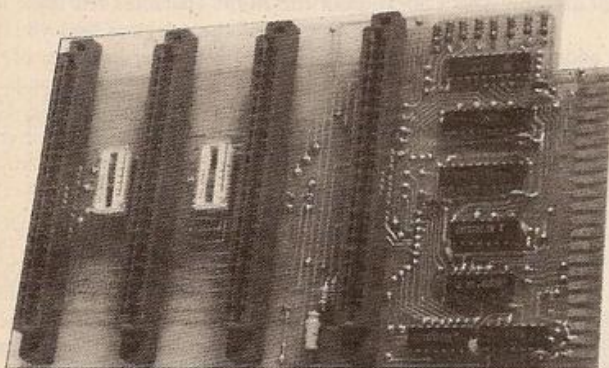
```
65 FOR M=0 TO 7 : READ D :  
   POKE N+M+(36*8),D : NEXT M  
110 DATA 24,24,24,60,126,255,153,153
```

CHARACTER DEFINITION

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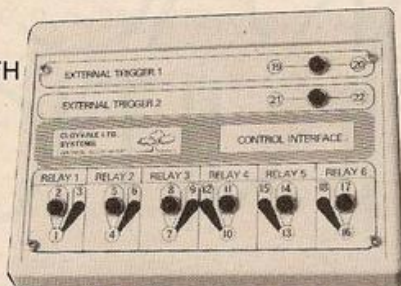


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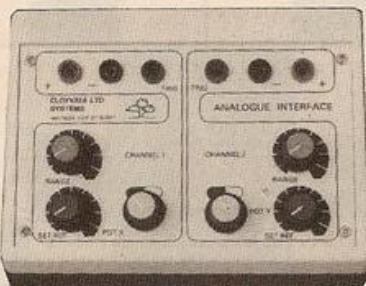


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1K CHESS

Last month David Horne showed you the board. This month he illustrates the move logic.

AS A REMINDER, figure 1 depicts the playing board and figure 2 is the Basic program used to enter the machine code. This month we will start with the main driver. Enter Fast mode and change line 10 to read:

10 FOR A = 16681 to 16779

Run 10 and start entering the code shown in figure 3. The next routine to enter will be the keyboard controller, after typing Save "4". Change line 10 to read:

10 FOR A = 16860 to 16916

Run 10, start entering the code shown in figure 4 and then Save "5". Enter Slow mode and type Run — be prepared for a crash.

The machine is waiting for you to type either a W or B, and will respond by placing the appropriate symbol towards the top right of your screen. Try entering any letter you like first, to ensure that the code rejects all other inputs.

Now enter a number between 1 and 8, followed by a letter A to H at which point just about anything could have happened. The reason for the above exercise is to determine if the keyboard controller is working, that is, selecting which keys will be accepted as inputs.

At this point, it becomes very much more difficult to provide the reader with a comprehensive set of diagnostics. Suffice to say that we are breaking each party down into small routines, which can be re-entered one routine at a time in an effort to isolate the offending error.

Alternatively you may wish to try the program given in figure 7 of last month's article. Assuming after much murmuring, you appear to have this bit correctly entered, our next routine is the address converter. This takes the alphanumeric input and translates it

to a board position. Change line 10 to read:

10 FOR A = 16801 to 16859

Run 10 and start entering the code shown in figure 5 and Save "6". The address converter has a little routine tacked on to the end which effectively checks to see whether the correct piece is being moved. So now enter Slow mode and Run the program. By the way, it will crash again. Enter your opening colour — B or W — then try spare spaces and the wrong colour positions to ensure that these entries are not acceptable. Now try a correct position, at which point the system will crash.

Finally, the move logic. This is going to be a bit of a marathon. You will be entering 170 numbers, around 15 minutes work. Change line 10 to read:

10 FOR A = 16917 to 17087

Run 10 and start entering the code shown in figure 6, and finally Save "7". Enter Slow mode, Delete lines 10 to 15, and Save "ZXCHES", type Run and hope!

To help with error corrections look for the following: if the pawns do not move correctly, then look at the code from 17021 to 17087; problems with any other pieces, look at code 16981 to 17020. There is a piece selector from 16949 to 16980, if just one appears incorrect. The move tables are at 16926 to 16941, with a part of the pawn table at 16778 to 16780.

Now for a brief outline covering the important functions of the machine-code routines presented this month. We started at address 16681 with a call to a subroutine — 16860 — which tests for which key has been pressed, returning with a value in "a" which is compared with B(39) or W(60) to see who should start. Any other response will start the test for key depressed sequence again.

Dependent upon B or W being pressed, a black or white square is placed in the "whose move now" position located by routine DP1. The next routine at address 16701 overwrites the From and To data at the bottom of the board in preparation for the new data entry and is effectively the start of the move routine.

D. Horne, 1983.



Figure 1. The board.

```
1 REM *** LOTS OF SPACES ***
2 RAND USA 16578
3 FOR A=16514 TO 17087
4 INPUT B
5 POKE A,B
6 PRINT AT 1,0;A
7 NEXT A
```

Figure 2. Machine-code entry program.

40	7	254	205	220	55	254	39
15894	62	128	205	32	245	175	24
2	205	152	65	119	43	119	205
146	65	119	43	119	35	205	161
65	254	3	32	234	34	50	64
175	50	62	64	59	205	46	66
16734	152	65	205	161	65	254	2
205	48	2	12	33	62	54	126
60	40	204	133	111	126	185	32
242	42	60	64	126	54	0	18
205	155	64	205	144	65	126	190
16774							
126	119	24	179	15	16		

Figure 3. Main driver.

Continuing, we have a call to subroutine KT, the routine — 16801 — which accepts a number between 1 and 8 followed by a letter between A and H, puts them in the From position and transforms the pair of them to an address on the board by means of the address converter routine — 16806.

The board address is then tested to see whether the contents of the address is either the current mover's piece, an opposition piece, an empty square or part of the backcloth, and, dependent upon which, "a" is set to a specific number. If it is not one of the current mover's pieces, it returns to the start of the move routine. If it is a current mover's piece, the From position is Saved and the number of legal moves for the position is set to zero.

The piece-move routine — 16942 — is called. This puts all the legal board positions that the From piece can move to into a table. The next data entry is also decoded by subroutine KT, providing a board position, and a status code of that position in "a". The "a" register is interrogated to see if the To

(continued on page 83)

Figure 4. Keyboard controller.

2	62	255	189	40	248	205	187
245	68	77	205	189	7	126	201
213	66	75	197	205	220	65	193
185	40	6	12	16	245	209	24
16894							
239	209	209	225	213	119	43	201
229	17	29	8	205	238	65	229
17	38	3	205	238	65	201	

Figure 5. Address converter.

126	214	28	71	14	15	175	129
16814							
16	253	198	31	43	70	144	205
140	65	79	9	126	229	254	128
6	1	40	23	254	0	40	19
4	254	3	40	14	4	230	128
197	205	144	65	78	185	193	40
16854							
2	6	0	120	225	201		

Figure 6. Move logic.

62	64	52	126	133	111	113	201
----	----	----	-----	-----	-----	-----	-----

1	15	255	241	242	240	16	14
15934							
17	239	29	227	225	31	243	13
126	230	127	254	53	40	72	14
1	6	8	33	38	66	254	51
40	21	33	30	66	254	48	40
14	72	254	54	40	9	6	4
16974							
254	55	40	3	33	34	66	123
134	245	229	197	203	127	32	24
205	181	65	254	2	48	17	205
21	66	254	0	40	10	193	225
121	254	1	40	5	241	24	224
17014							
193	225	241	35	16	217	201	126
230	128	40	5	33	35	66	24
3	33	140	65	22	3	123	134
229	245	203	127	32	24	205	181
65	254	1	32	24	122	254	1
17054							
32	12	205	21	66	123	254	30
56	19	254	90	48	15	241	225
43	21	32	213	201	122	254	1
196	21	66	24	241	241	225	95
24	205						

D. Horne, 1983.

(continued from page 81)

board position is empty or has an opposition piece present. If neither of these two is true the code returns to the start of move routines. If true, the board address is compared — 16745.

With each of the legal move positions tabulated by the From routine. Absence of a match restarts the routine again. A match leads on to the move routine — 16759 — which recalls the From position, gets its contents and replaces them with zero, the contents are then put in the 'To' position and routine B/W called. This rewrites all the black vacant squares and finally the "whose move now" square is changed followed by a jump back to the start-of-the-move routine.

The listing provides for a double move for pawns on their initial set-up ranks. The piece moves are controlled by the tables — 16926 — which are called — 16949 — to permit the appropriate movement associated with that piece. See figure 7.

Figure 7.

```

16681 CALL TKP      205 220 65
      CP N          254 39
      JP Z DIS      40 7
      CP N          254 60
      JP NZ DIS     32 245
      XOR A         175
      JP DIS        24 2
      LD A N        62 128
      CALL DPI      205 144 65
      LD (HL) A     119
16701 LD A N        62 8 (Move
      Routine)
      CALL DP5      205 152 65
      LD (HL) A     119
      DEC HL        43
      LD (HL) A     119
      CALL DP4      205 148 65
      LD (HL) A     119
      DEC HL        43
      LD (HL) A     119
      INC HL        35
      CALL KT       205 161 65
      CP N          254 3
      JP NZ DIS     32 234
      LD (NN) HL    34 60 64
      XOR A         175
      LD (NN) A     50 62 64
      LD E C        89
16731 CALL MOVE     205 46 66
      CALL DP5      205 152 65
      CALL KT       205 161 65
      CP N          254 2
      EX DE HL      235
      JP NC DIS     48 212
      LD HL NN      33 62 64
      DEC (HL)      53
      LD A (HL)     126
      INC A         60
      JP Z DIS      40 204
      ADD L         133
      LD L A        111
      LD A (HL)     126
      CP C         183
      JP NZ DIS     32 242
      LD HL (NN)    42 60 64
      LD A (HL)     126
      LD (HL) N     54 0
      LD (DE) A     18
      CALL B/W      205 156 64
      CALL DPI      205 144 65
      LD A (HL)     126
      ADD N         198 128
      LD (HL) A     119
      JP DIS        24 179
      LD L          15 16
16801 PUSH HL       229 (KT)
      CALL KYBD     205 6 66
      POP HL        225

```

```

16806 LD A (HL)     126 (Address
      Converter)
      SUB N         214 28
      LD B A        71
      LD C N        14 15
      XOR A         175
      ADD A C       129
      DJNZ DIS      16 253
      ADD N         198 31
      DEC HL        43
      LD B (HL)     70
      SUB B         144
16821 CALL DPZ      205 140 65 (Test)
      LD C A        79
      ADD HL BC      9
      LD A (HL)     126
      PUSH H L      229
      CP N          254 128
      LD B N        6 1
      JP Z DIS      40 23
      CP N          254 0
      JP Z DIS      40 19
      NC B          4
      CP N          254 8
      JP Z DIS      40 14
      INC B         4
      AND N         230 128
      PUSH BC       197
      CALL DPI      205 144 65
      LD C (HL)     78
      CP C          185
      POP BC        193
      JP Z DIS      40 2
      LD B N        6 0
      LD A B        120
      POP HL        225
      RET          201
16860 CALL NN       205 187 2 (TKP)
      LD A N        62 255
      CP L          189
      JP Z DIS      40 248
      CP H          188
      JP Z DIS      40 245
      LD B H        68
      LD C L        77
      CALL NN       205 189 7
      LD A (HL)     126
      RET          201
16878 PUSH DE       213
      LD B D        66
      LD C E        75
      PUSH BC       197
      CALL NN       205 220 65
      POP BC        193
      CP C          185
      JP Z DIS      40 6
      INC C         12
      DJNZ DIS      16 245
      POP DE        209
      JP DIS        24 239
16895 POP DE        209
      POP DE        209
      POP HL        225
      PUSH DE       213
      LD (HL) A     119
      DEC HL        43
      RET          201
16902 PUSH HL       229 (KYBD)
      LD DE NN      17 29 8
      CALL NN       205 238 65
      PUSH HL       229
      LD DE NN      17 38 8
      CALL NN       205 238 65
      RET          201
16917 LD HL NN      33 62 64 (ADDLIST)
      INC (HL)      52
      LD A (HL)     126
      ADD L         133
      LD L A        111
      LD (HL) C     113
      RET          201
16926 1 15 -1 -15 -14 -16 16 14
16934 17 -17 29 -29 -31 31 -13 13
16942 LD A (HL)     126 (Piece
      move)
      AND N         230 127
      CP N          254 53
      JP Z DIS      40 72
      LD C N        14 1
      LD B N        6 8
      LD HL NN      33 38 66
      CP N          254 51
      JP Z DIS      40 21
      LD HL NN      33 30 66
      CP N          254 48
      JP Z DIS      40 14
      LD C B        72
      CP N          254 54
      JP Z DIS      40 9
      LD B N        6 4
      CP N          254 55
      JP Z DIS      40 3
      LD HL NN      33 34 66
16981 LD A E        123 (Piece
      move
      routine)
      ADD A (HL)     134
      PUSH AF       245
      PUSH HL       229
      PUSH BC       197
      BIT 7 A       203 127
      JP NZ DIS     32 24
      CALL NN       205 181 65
      CP N          254 2
      JP NC DIS     48 17
      CALL ADDLIST  205 21 66
      CP N          254 0
      JP Z DIS      40 10
      POP BC        193
      POP HL        225
      LD A C        121
      CP N          254 1
      JP Z DIS      40 5
      POP AF        241
      JR DIS        24 224
      POP BC        193
      POP HL        225
      POP AF        241
      INC HL        35
      DJNZ DIS      16 217
      RET          201
17021 LD A (HL)     126 (Pawn
      move
      routine)
      AND N         230 128
      JP Z DIS      40 5
      LD HL NN      33 35 66
      JR DIS        24 3
      LD HL NN      33 140 65
      LD D N        22 3
      LD A E        123
      ADD A (HL)     134
      PUSH HL       229
      PUSH AF       245
      BIT 7 A       203 127
      JP NZ DIS     32 24
      CALL NN       205 181 65
      CP N          254 1
      JP NZ DIS     32 24
      LD A D        122
      CP N          254 1
      JP NZ DIS     32 12
      CALL ADDLIST  205 21 66
      LD A E        123
      CP N          254 30
      JP C DIS       56 19
      CP N          254 90
      JP NC DIS     48 15
      POP AF        241
      POP HL        225
      INC HL        43
      DEC D         21
      JP NZ DIS     32 218
      RET          201
      LD A D        122
      CP N          254 1
      CALL NZ ADDLIST 196 21 66
      JR DIS        24 241
      POP AF        241
      POP HL        225
      LD E A        95
      JR DIS        24 205

```

D. Horne, 1983.

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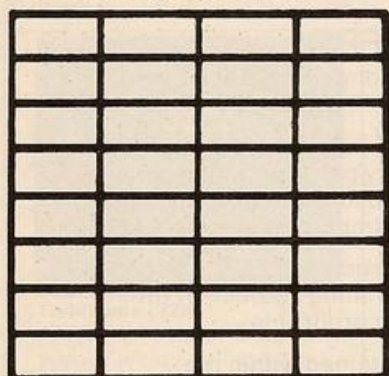


Figure 1.

MULTI-COLOUR GRAPHICS is a form of high-resolution graphics, and that is graphics defined on an eight by eight matrix of dots. However, it is different in that, unlike the high-resolution graphics which only have two colours for a dot on the matrix being lit or not lit, multi-colour characters have four colours.

There are a few limitations, in that the horizontal resolution is halved with multi-colour characters. That means that characters will be made on a four by eight matrix. Also, only four colours can be used; the border colour, the auxiliary colour, the character colour and the screen colour.

You cannot have many different characters with other colours because if you change the border, screen and auxiliary colours for a new character, the old character's colour will change. However, this may be used to produce special effects where many colours are changed very quickly.

To start defining a multi-colour character we must first decide on the colours. Since we can change the screen, border, character and auxiliary colours, we have a choice of four different colours which can be anything in the range of the Vic's first eight colours — except the border and auxiliary colours which may have 16 colours.

These colours are Poked into the Vic in the registers shown in table 1.

The codes of the character colours are found using the following table:—

- 0 Black
- 1 White
- 2 Red
- 3 Cyan
- 4 Purple
- 5 Green
- 6 Blue
- 7 Yellow

When the colours have been chosen and Poked into their appropriate memory location, you must start to design the character on a four by eight matrix. See Figure 1.

Once the colours have been put on the matrix where you want them, using, for example, A for auxiliary colour, B for border colour, C for character colour, you can set about coding the image. Each line of the

matrix will become a binary number which will be put into memory in decimal. You must go through each of the eight lines of the character matrix to do this.

To convert the line to a binary number you must start at the left-hand side of the line and work your way to the right. If you come to a position where you want a screen colour, write down 00; for a place with a character colour, 10; for a place with a border colour, 01; and for a place with an auxiliary colour, write down 11. You should end up with an eight-digit binary number, for example 00011100. Repeat this for all eight lines on the matrix. When you have finished coding the design, convert all your number to decimal and put them into memory using the following routine:

```
DATA 8 decimal numbers.
FOR F = 7168 TO 7175: READ A: POKE F, A:
NEXT
```

Now that it is in memory, we have to prevent it from being overwritten. Poke 52,28 is sufficient to do this. To use the character in

11101011 = 235

11101011 = 235

11111111 = 255

Then we Poke them into memory.

```
40 DATA 255,235,235,235,235,235,235,255
```

```
50 FOR F = 7168 TO 7175: READ 1: POKE F,A:
NEXT
```

Next we must protect the character.

```
60 POKE 52,28
```

And last we must make use of the character and Print it:

```
70 POKE 36869,255: PRINT"(shift clr-home)@"
```

To prevent the screen being messed up by "Ready" appearing in multi-colour lettering the following line may be added:

```
80 GOTO 80
```

When the program is Run a multi-colour box will appear on the screen. You will be able to define your own character as easily as this.

To end with, here is a program to demonstrate what happens when one colour code is changed.

```
10 PRINT "(shift clr-home)"
```

```
20 DATA 0,10,10,42,42,130,142,142
```

```
30 DATA 0,160,160,168,168,130,142,142
```

MULTI-COLOUR VIC GRAPHICS

Poke

Poke 36879, screen and border colours

Poke 36878, code of auxiliary colours (0-15) × 16

Poke 646, code of character colour (0-7) + 8

Poke 30720 + address of point, code of character colour.

Comments

See Vic manual for combination of screen and border colours

Used to change the character colour for a PRINT statement.

If you are poking onto the screen use this.

Table 1.

memory you must change the value of 36869,255 to use the characters. You may have more than 1 character in memory. To do this add more data in the Data statement in the routine and increase the value of F, that is, increase 7175 in the previous routine. Here is an example program going through the steps required to generate a multicolour character.

First we choose the colours: white, black, red, blue and Poke them into memory.

```
10 POKE 36879,24 put white and black
into memory
```

```
20 POKE 36878,2×16 put red into memory
```

```
30 POKE 646,14 put blue into memory
```

Then we design the character, which will be a simple multicolour box, see figure 2. Now convert it to binary.

A A A A = 11111111

A C C A = 11101011

A C C A = 11101011

A C C A = 11101011

A C C A = 11101011

A C C A = 11101011

A C C A = 11101011

A A A A = 11111111

Then we convert the binary numbers to decimal:

11111111 = 255

11101011 = 235

11101011 = 235

11101011 = 235

11101011 = 235

```
40 DATA 170,170,170,170,170,170,170,160
```

```
50 DATA 170,170,170,170,170,170,170,130
```

```
70 FOR F = 7168 TO 7199
```

```
80 READ A
```

```
90 POKE F,A
```

```
100 NEXT
```

```
110 FOR F = 7424 TO 7431: POKE F, PEEK
(25600 + F): NEXT
```

```
120 POKE 36869,255: POKE 52,28
```

```
130 FOR F = 1 TO 11
```

```
140 POKE 646,INT(RND(TI)×5)+10
```

```
150 PRINT "@A @A @A @A @A @A @A @A"
```

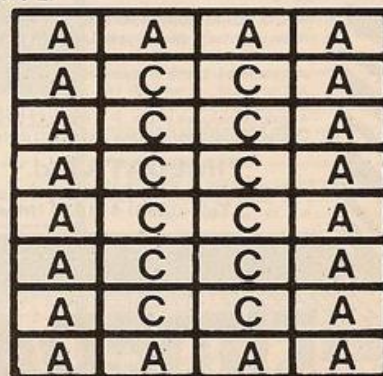
```
160 PRINT "BC BC BC BC BC BC BC BC"
```

```
170 NEXT
```

```
180 POKE 36878,(INT(RND(TI)×15)+1)×16
```

```
190 GOTO 180
```

Figure 2.



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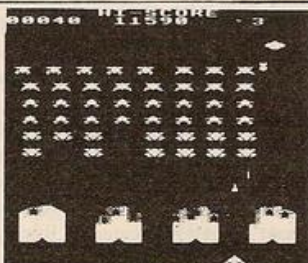
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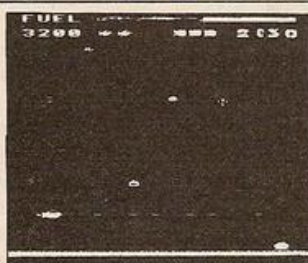
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THE FOLLOWING series of programs has been designed to compile a character set and machine-code routine enabling a ZX-81 to lineprint on a ZX Printer at 42 characters per line in place of the normal 32 characters. Other features include the option to expand to a maximum of 128 different characters — with no inverse, control of character height and width, and a self-edit lineprint at 42 characters per line, all at normal LPrint speed.

For convenience, the routine is compiled and saved in a dimensioned string array, being instantly copied into space automatically reserved above RAMtop whenever it is loaded into the computer. Although it is comprised of 1194 bytes, only some 125 need to be entered via the keyboard for the simplest version. It is left to the user to choose whether or not to expand its capabilities as described later.

The routine itself can be divided into three sections: first, the character set — 1024 bytes; second, LPrint — 118 bytes; third, Edit — 52 bytes.

Each of the 128 available characters is defined by eight 8-bit numbers, thus requiring 1024 bytes for the complete set. In order to print at 42 characters per line it is necessary to reduce character width effectively from 8 to 6 bits including spacing. Bits 7 to 2 are printed whilst bits 1 and 0 are ignored by the printer.

To avoid the tedious entry of a modified Sinclair set, one can use program 1 to do the job. This copies the character-defining codes from ROM and changes them accordingly. In effect, a chosen column of pixels — P — is removed from a character and the remaining columns to the right are shifted left by one column to close the gap created.

The graphics characters are not copied and remain as spaces. However, this gives the user an opportunity to design a new set of symbols to replace them and a character-generating program is suggested for this purpose. Consult page 78 of the ZX-81 manual for keyboard access to these characters, Codes 1 to 10.

I have also included space for a second character set which can be used, for example, to create space for a complete lower case set of

ZXTRA-WID

alphabet characters as detailed in a later section. These characters replace the ZX-81 inverse Sinclair set and are accessed by the corresponding keyboard entries.

The LPrint section is a modified version of the ROM routine, and is compiled together with the Edit section using program 2. The modifications are as follows: first, point at the address of the new character set; second LPrint bits 7 to 2 only of the characters; third, 42-character lineprint, from a newly-located printer buffer; fourth control of character height and width.

As for the Edit section, Text to be LPrinted is compiled in Basic Rem statements, each one preceded by a call to the routine. The functions carried out are: (1) Locate the start of text via the NxtLine system variable. (2) Set the new printer buffer to an address above RAMtop (32512 to 32554) (3) Examine text in lines of 42 characters to ensure that no words overlap between successive lines. (4) Feed the edited lines to the new printer buffer. (5) Call the LPrint routine. (6) Return to the Basic control program when the end of the Rem statement has been reached.

When operating the compilation programs do remember to start with the command Goto. Do not use Run as this will cause the array holding the routine to be lost and overwritten.

First power-up the computer plus printer, Clear the memory and enter as a direct command Dim A\$(1194). Having the dimensioned string array as first entry in the variables store is important because the machine-code program used to copy its contents above RAMtop assumes this to be the case.

Next enter program 1 and operate in Fast mode using Goto 10. The modified character set is completed in about 6.5 minutes. It is necessary to make further small amendments to the letters T, W and Y with the following direct commands:

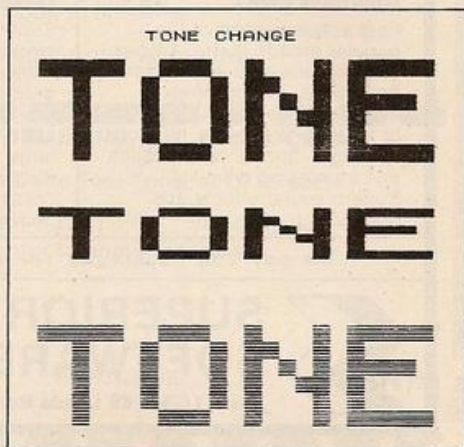
```
LET A$(458) = CHR$ 124
LET A$(485) = CHR$ 84
LET A$(498) = CHR$ 68
```

Save the program at this and any intermediate stage as your confidence dictates.

Now key in program 2 and delete lines 150 and 160 of program 1. Be careful to enter the program exactly as listed. Operate using Goto 10. The program copies the LPrint routine from ROM, except where a prompt is made for you to enter a modification. Input the value given in the list provided for this section against the number of the array element printed on the TV screen. The LPrint section is complete at A\$(1142), so entries made from A\$(1143) onwards are for the Edit section. Be careful to double-check these entries to avoid possible problems later.

Having now compiled the Deep Thought routine, you are in the position to write the short machine-code program used to copy it into memory reserved above RAMtop. It is not necessary to reset RAMtop as the program

does this automatically. Enter program 3 and then delete lines 10 to 140 of program 2. Line 1 contains 21 characters, the addresses of which are used to hold the machine code instructions. Operate program 3 by mean of Goto 2 and enter the values as given in the list of entries for this program. When this stage has been completed line 1 should have taken on the appearance of line 1 shown in the listing of program 4. Retaining line 1, replace lines 2 to 6 with the corresponding lines of program 4.



This is the final program in its most elementary form. Save it, together with the array holding the assembled routine, using the command Goto 2. In this way, the machine-code routine in line 1 is executed immediately after the program has Saved. The letters OK should appear on the TV screen, printed by line 5 to indicate that the Deep Thought routine has been located in its new position above RAMtop, now set at address 31232. Print Peek 16389 should return a value of 122. Whenever program 4 is Loaded in future, the process will be repeated. If a message other than OK is printed on the screen check that line 5 is correctly entered. Otherwise re-check your entries for program 2. Two versions of the ZX-81 8K ROM exist, which differ here in the address of one LPrint subroutine. Line 6 can be included to ensure that the program will run on a ZX-81 other than the one used to compile it.

Once the final program is safely recorded on cassette, it can be tested with the aid of program 5, which demonstrates control of both height and width of characters and also 42-character lineprint. Having accomplished its task, you may first New the Basic program 4 before entering the test program. Note that the routine is called from the start of the Edit section — address 32374 — and that addresses 32266 and 32329 control character height and width respectively. The latter are initially set at unity for normal characters.

Text to be LPrinted is set up in Rem statements, any number of which may be employed, provided each one is preceded by a call to the routine. They may also be of any

E TEXT

length within practical limits, Fast mode being recommended for ease of entry. The self-edit facility allows single spacing between all words.

When the test program is Run — there is no need to be restricted to Goto at this stage — you should see line 50 LPrinted in characters of increasing height and width, and line 90 repeated in characters of increasing height only. The number of characters allowed per line is obviously limited by character width — the edit feature only functions for normal characters — so wider-than-normal characters should be sent to the printer as single lines of suitable length. Extending such lines with enough spaces produces a striped effect which softens the tone of printing.

The maximum number of characters per line — N — is given by the expression $N = \text{INT}(42/X)$, where X is the width-multiplying factor. I have used this to good effect in test program 6, which shows one way of extending automatic line edit to wider characters, controlled by the Basic program itself. A single character can be expanded to the full paper width — $X=42$.

For those who wish to extend the character set, the character-generating program can be added to program 4. Characters can be designed on 8 by 8 graph paper grids, remembering that bits 7 to 2 only are printed and that bit 7 is set to zero to act as spacer. Simply convert the eight black and white pixels to 1 and 0 respectively to obtain the corresponding 8-bit binary number. This is entered as such directly into line 70 and then converted into the decimal equivalent in line 110. Note that a zero can be entered as a single "0".

Use Goto 10 in Fast mode when working with this program. It can be terminated after a character has been entered; mistakes can be rectified by entering Goto 20 and beginning the character again.

As stated previously, this method can be used for the unused graphics characters Codes 1 to 10, but a second set of characters can be built up between A\$(523) and A\$(1024). This could be used for lower-case letters, made equivalent to the respective inverse Sinclair upper-case letters. However, it is more convenient to have them in the position currently occupied by the modified upper-case letters between A\$(305 TO 512), and the latter made equivalent to the inverse set, since in typewriter mode they are less frequently used. The true keyboard space must also be used between words for line Edit to function, so it is helpful to avoid overuse of the graphic mode at the keyboard.

Therefore, start by transferring a copy of the upper-case letters, which is quite easy within a string variable such as the one we are using. Just enter as a direct command:

```
LET A$(817 TO 1024) = A$(305 TO 512)
```

Change line 10 of the character generating program

```
10 FOR A=38 TO 63
```

You are free to design your own set but to save

Program 1.

```
10 FOR A=11 TO 63
20 LET P=4
30 IF A<30 AND A<>15 OR A=35 O
R A=46 OR A=63 THEN LET P=6
40 IF A=28 OR A=32 OR A=51 OR
A=54 THEN LET P=2
50 FOR C=1 TO 8
60 LET L=PEEK (7679+3*A+C)
70
80 IF A=17 OR A=57 OR A=62 THE
N GOTO 140
90 FOR D=7 TO P STEP -1
100 LET N=INT (L/2**D)
110 LET L=L-N*2**D
120 NEXT D
130 LET L=L+N*2**P
140 LET A$(8*A+C)=CHR$ L
150 NEXT C
160 NEXT A
```

Program 2.

```
10 LET B=2173
20 FOR A=1025 TO 1194
30 IF A<1036 OR A>1076 AND A<1
112 OR A<1125 THEN GOTO 80
40 IF B=214 THEN LET B=2250
50 LET C=PEEK B
60 LET B=B+1
70 GOTO 120
80 SCROLL
90 PRINT "A(";A;") ";
100 INPUT C
110 PRINT C
120 LET A$(A)=CHR$ C
130 NEXT A
140 LET A$(1073)=CHR$ 42
```

Entries for program 2.

A\$	C	A\$	C	A\$	C
1025	30	1107	251	1155	0
1026	30	1108	16	1156	127
1027	107	1109	246	1157	9
1028	305	1110	163	1158	43
1029	31	1111	163	1159	237
1030	30	1112	335	1160	1600
1031	200	1113	285	1161	1990
1032	170	1114	207	1162	400
1033	200	1115	19	1163	16
1034	200	1116	31	1164	249
1035	1	1117	31	1165	176
1036	38	1118	21	1166	176
1037	30	1119	21	1167	176
1038	200	1120	32	1168	176
1039	200	1121	163	1169	176
1040	200	1122	163	1170	176
1041	135	1123	203	1171	176
1042	135	1124	91	1172	176
1043	135	1125	40	1173	176
1044	200	1126	156	1174	43
1045	20	1127	156	1175	27
1046	131	1128	156	1176	27
1047	131	1129	156	1177	40
1048	120	1130	111	1178	40
1049	120	1131	111	1179	40
1050	120	1132	111	1180	40
1051	120	1133	111	1181	40
1052	120	1134	111	1182	40
1053	120	1135	111	1183	40
1054	120	1136	111	1184	40
1055	120	1137	111	1185	40
1056	120	1138	111	1186	40
1057	120	1139	111	1187	40
1058	120	1140	111	1188	40
1059	120	1141	111	1189	40
1060	120	1142	111	1190	40
1061	120	1143	111	1191	40
1062	120	1144	111	1192	40
1063	120	1145	111	1193	40
1064	120	1146	111	1194	40
1065	120	1147	111	1195	40
1066	120	1148	111	1196	40
1067	120	1149	111	1197	40
1068	120	1150	111	1198	40
1069	120	1151	111	1199	40
1070	120	1152	111	1200	40
1071	120	1153	111	1201	40
1072	120	1154	111	1202	40
1073	120	1155	111	1203	40
1074	120	1156	111	1204	40
1075	120	1157	111	1205	40
1076	120	1158	111	1206	40
1077	120	1159	111	1207	40
1078	120	1160	111	1208	40
1079	120	1161	111	1209	40
1080	120	1162	111	1210	40
1081	120	1163	111	1211	40
1082	120	1164	111	1212	40
1083	120	1165	111	1213	40
1084	120	1166	111	1214	40
1085	120	1167	111	1215	40
1086	120	1168	111	1216	40
1087	120	1169	111	1217	40
1088	120	1170	111	1218	40
1089	120	1171	111	1219	40
1090	120	1172	111	1220	40
1091	120	1173	111	1221	40
1092	120	1174	111	1222	40
1093	120	1175	111	1223	40
1094	120	1176	111	1224	40
1095	120	1177	111	1225	40
1096	120	1178	111	1226	40
1097	120	1179	111	1227	40
1098	120	1180	111	1228	40
1099	120	1181	111	1229	40
1100	120	1182	111	1230	40
1101	120	1183	111	1231	40
1102	120	1184	111	1232	40
1103	120	1185	111	1233	40
1104	120	1186	111	1234	40
1105	120	1187	111	1235	40
1106	120	1188	111	1236	40
1107	120	1189	111	1237	40
1108	120	1190	111	1238	40
1109	120	1191	111	1239	40
1110	120	1192	111	1240	40
1111	120	1193	111	1241	40
1112	120	1194	111	1242	40
1113	120	1195	111	1243	40
1114	120	1196	111	1244	40
1115	120	1197	111	1245	40
1116	120	1198	111	1246	40
1117	120	1199	111	1247	40
1118	120	1200	111	1248	40
1119	120	1201	111	1249	40
1120	120	1202	111	1250	40
1121	120	1203	111	1251	40
1122	120	1204	111	1252	40
1123	120	1205	111	1253	40
1124	120	1206	111	1254	40
1125	120	1207	111	1255	40
1126	120	1208	111	1256	40
1127	120	1209	111	1257	40
1128	120	1210	111	1258	40
1129	120	1211	111	1259	40
1130	120	1212	111	1260	40
1131	120	1213	111	1261	40
1132	120	1214	111	1262	40
1133	120	1215	111	1263	40
1134	120	1216	111	1264	40
1135	120	1217	111	1265	40
1136	120	1218	111	1266	40
1137	120	1219	111	1267	40
1138	120	1220	111	1268	40
1139	120	1221	111	1269	40
1140	120	1222	111	1270	40
1141	120	1223	111	1271	40
1142	120	1224	111	1272	40
1143	120	1225	111	1273	40
1144	120	1226	111	1274	40
1145	120	1227	111	1275	40
1146	120	1228	111	1276	40
1147	120	1229	111	1277	40
1148	120	1230	111	1278	40
1149	120	1231	111	1279	40
1150	120	1232	111	1280	40
1151	120	1233	111	1281	40
1152	120	1234	111	1282	40
1153	120	1235	111	1283	40
1154	120	1236	111	1284	40
1155	120	1237	111	1285	40
1156	120	1238	111	1286	40
1157	120	1239	111	1287	40
1158	120	1240	111	1288	40
1159	120	1241	111	1289	40
1160	120	1242	111	1290	40
1161	120	1243	111	1291	40
1162	120	1244	111	1292	40
1163	120	1245	111	1293	40
1164	120	1246	111	1294	40
1165	120	1247	111	1295	40
1166	120	1248	111	1296	40
1167	120	1249	111	1297	40
1168	120	1250	111	1298	40
1169	120	1251	111	1299	40
1170	120	1252	111	1300	40
1171	120	1253	111	1301	40
1172	120	1254	111	1302	40
1173	120	1255	111	1303	40
1174	120	1256	111	1304	40
1175	120	1257	111	1305	40
1176	120	1258	111	1306	40
1177	120	1259	111	1307	40
1178	120	1260	111	1308	40
1179	120	1261	111	1309	40
1180	120	1262	111	1310	40
1181	120	1263	111	1311	40
1182	120	1264	111	1312	40
1183	120	1265	111	1313	40
1184	120	1266	111	1314	40
1185	120	1267	111	1315	40
1186	120	1268	111	1316	40
1187	120	1269	111	1317	40
1188	120	1270	111	1318	40
1189	120	1271	111	1319	40
1190	120	1272	111	1320	40
1191	120	1273	111	1321	40
1192	120	1274	111	1322	40
1193	120	1275	111	1323	40
1194	120	1276	111	1324	40
1195	120	1277	111	1325	40
1196	120	1278	111	1326	40
1197	120	1279	111	1327	40
1198	120	1280	111	1328	40
1199	120	1281	111	1329	40
1200	120	1282	111	1330	40
1201	120	1283	111	1331	40
1202	120	1284	111	1332	40
1203	120	1285	111	1333	40
1204	120	1286	111	1334	40
1205	120	1287	111	1335	40
1206	120	1288	111	1336	40
1207	120	1289	111	1337	40
1208	120	1290	111	1338	40
1209	120	1291	111	1339	40
1210	120	1292	111	1340	40
1211	120	1293	111	1341	40
1212	120	1294	111	1342	40
1213	120	1295	111	1343	40
1214	120	1296	111	1344	40
1215	120	1297	111	1345	40
1216	120	1298	111	1346	40
1217	120	1299	111	1347	40
1218	120	1300	111	1348	40
1219	120	1301	111	1349	40
1220	120	1302	111	1350	40
1221	120	1303	111	1351	40
1222	120	1304	111	1352	40
1223	120	1305	111	1353	40
1224	120	1306	111	1354	40
1225	120	1307	111	1355	40
1226	120	1308	111	1356	40
1227	120	1309	111	1357	40
1228	120	1310	111	1358	40
1229	120	1311	111	1359	40
1230	120	1312	111	1360	40
1231	120	1313	111	1361	40
1232	120	1314	111	1362	40
1233	120	1315	111	1363	40
1234	120	1316	111	1364	40
1235	120	1317	111	1365	40
1236	120	1318	111	1366	40
1237	120	1319	111	1367	40
1238	120	1320	111	1368	40
1239	120	1321	111	1369	40
1240	120	1322	111	1370	40
1241	120	1323	111	1371	40
1242	120	1324	111	1372	40
1243	120	1325	111	1373	40
1244	120	1326	111	1374	40
1245	120	1327	111	1375	40
1246	120	1328	111	1376	40
1247	120	1329	111	1377	40
1248	120	1330	111	1378	40
1249	120	1331	111	1379	40
1250	120	1332	111	1380	40
1251	120	1333	111	1381	40
1252	120	1334	111	1382	40
1253	120	1335	111		



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			Date
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	ZX81 Keyboard Assembled	£26.00	
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		Carriage	70
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BASIC DICTIONARY

This dictionary, compiled by Tony Edwards, will explain the function of common Basic words as used in popular machines, enabling you to work out your own machine's equivalent. A useful complement to our recent series on Basic dialect translation.

BASIC DICTIONARY

IF...GOSUB A multiple branching statement which will jump to the named subroutine if the conditions following the IF are met.

IF...GOT Used in PDP-8E Basic as an abbreviation for IF...GOTO.

IF...GOTO A multiple branching statement which will jump to the line named if the conditions following the IF are met.

IF...LET A statement which assigns a value to a named variable if the conditions following the IF are met.

IF...T Used in TRS-80 Level 1 Basic as an abbreviation for IF...THEN.

IF...THE Used in PDP-8E Basic as an abbreviation for IF...THEN.

IF...THEN A conditional statement which is implemented only if the conditions following the IF are met. The statement following the THEN can be an assignment statement, or the address of a jump. Some computers allow operating statements such as END to follow the THEN, such as IF X = 0 THEN END. An ANSI standard statement.

IF...THEN...ELSE Some compilers allow one or more ELSE to follow the THEN statement. The statement following the ELSE will be processed only if the conditions following the IF are not met. This can be simulated by the use of nested IF...THEN statements — see *Your Computer* June 1982, page 44.

IN Used in TRS-80 Level 1 and Palo Alto Tiny Basic as an abbreviation for INPUT.

IN# The command used by Apple II Basic to instruct the computer to address the peripheral designated by the argument.

INKEY\$ Used by TRS-80 Level II to input a character direct from the keyboard without the use of Enter. The program does not halt to await a key stroke and if no key is depressed, it returns an empty string — ASCII code 0. If the program is to be halted to await the key entry the INKEY\$ must be embedded in a waiting loop. Similar to the GET statement.

INP This statement reads a decimal value from a port specified by the argument. An identical statement is used in PDP-8 Basic as an abbreviation for INPUT.

INPUT A universally-used statement which causes the computer to halt and await keyboard input usually outputting a ? prompt. The program will not continue until the Enter or Newline key is used. An ANSI standard statement.

INPUTL A statement similar to INPUT, but the carriage return is suppressed.

INPUTLINE A BBC Basic statement, similar to INPUT, which uses a new line for each item input. The item is taken and assigned as is including commas, quotes and leading spaces.

INPUT# A BBC Basic statement which reads data in internal format from a file and assigns it to the variables specified as the argument.

INPUT#-x A statement which inputs a data unit from the port numbered x.

INSTR A function which returns the position of a sub-string within a string. If the sub-string is not found a 0 is returned, for example: X = INSTR(A\$,B\$) will return 2 if A\$ = "T.EDWARDS" and B\$ = "EDWARDS".

INT This function is used to round off numbers to their integer value. Numbers are always rounded down. Note that INT (-8.1) returns -9. See also CINT. A standard ANSI statement.

INVERSE This is an Apple II function which causes any text printed under it to be displayed as black letters on a white block.

L

L Used as an abbreviation for the LIST command in a number of computers including Acorn, TRS-80 level 1, and Palo Alto Tiny Basic.

LE An alternative sometimes encountered for "less than or equal to".

LEFT A function used, sometimes with a \$ appended, to isolate a specific number of characters starting at the left up to the number used for the second argument. The first argument being the string to be used. See also RIGHT\$ and MID\$.

LEN A function which will return the length of the string indicated as its argument.

LET The ANSI standard word to assign a value to a variable. For instance LET A = 10 would assign the value 10 to the variable named A. Some computers such as the ZX-81 require it, but in most cases it is optional. Some programmers use it optionally to flag the first use of a new variable.

LGT A function which calculates the common logarithm of its argument. The argument must be greater than 0. A common logarithm to the base 10.

LI Used as an abbreviation for LIST on TI-99/4 and other computers.

LIN A statement which causes a printer to skip the number of lines specified in the argument before printing the next line.

BASIC DICTIONARY

LIS The PDP-8E abbreviation for LIST.

LIST A command, also used as a statement, which causes each line of a resident programme to be printed in turn. Optional arguments cause only specific line numbers to be printed.

LLIST A command, or statement, used in some machines which operates like the LIST command but outputs to a printer.

LN A function which calculates the value of the natural logarithm of its argument. The argument must be greater than 0. A natural logarithm is the logarithm to the base e.

LOAD A command, which can be used as a statement, to cause a program to be loaded into memory from a storage medium.

LOG The ANSI standard word for the function to calculate the natural logarithm of its argument. An alternative to LN.

LOGE Another alternative to LN.

LOG 10 An alternative word with the same meaning as LGT.

LPPRINT A command and statement similar to PRINT — see PRINT — which causes the printout to appear on the printer.

LT An alternative used on some computers for "less than".

M

M Used as an abbreviation for the MEM function in Microsoft Basic level 1. It can be a command function or statement.

MAN An unusual command from the Apple II set which allows manual insertion of program line numbers. Not used in programs.

MAT A prefix to a statement to indicate that a matrix is to be operated on by the next statement. For example, MAT INPUT will cause the processor to pause awaiting the inputting of a complete matrix. The matrix dimensions will have been previously assigned with a DIM statement. Other matrix statements are MAT PRINT and MAT READ.

MEM A command or statement which returns the number of bytes of memory remaining unused when it is called. An equivalent command to FREE (0).

MID\$ A function which isolates a sub-string from within a previously defined string. The first argument is the target string or string name, the second argument is the start position, and the third argument the length of the substring. For example MID\$("PRINT", 3, 2) would return "IN". Some compilers do not have the final \$ character in the function. ■

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[illegible][illegible]

23	0350	RIA		
37	0351	DEC	H	
83	0352	LO	D	E
15	0353	RRCA		
107	0354	LO	L	E
19	0355	INC	DE	
118	0356	HALT		

PSN IN TABLE	DISPLACEMENT ADDRESS	TABLE ADDRESS
1	0	0
2	1	1
3	2	2
4	3	3
5	4	4
6	5	5
7	6	6
8	7	7
9	8	8
10	9	9
11	10	10
12	11	11
13	12	12
14	13	13
15	14	14
16	15	15
17	16	16
18	17	17
19	18	18
20	19	19
21	20	20
22	21	21
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62	61	61
63	62	62
64	63	63
65	64	64
66	65	65
67	66	66
68	67	67
69	68	68
70	69	69
71	70	70
72	71	71
73	72	72
74	73	73
75	74	74
76	75	75
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79	78	78
80	79	79
81	80	80
82	81	81
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89	88	88
90	89	89
91	90	90
92	91	91
93	92	92
94	93	93
95	94	94
96	95	95
97	96	96
98	97	97
99	98	98
100	99	99

```

0      0113      139      0252
1      0114      141      0258
2      0115      143      0160
3      0116      127      0243
4      0117      129      0246
5      0116      73      0191
6      0119      117      0236
7      0120      95      0245
8      0121      64      0198
9      0122      63      0165
10     0124      23      0147
11     0125      31      0156
12     0126      55      0181
13     0127      62      0209
14     0128      59      0197
15     0129      15      0144
16     0130      109      0239
17     0131      43      0174
18     0132      68      0250
19     0133      90      0176
20     0134      58      0228
21     0135      59      0184
22     0136      76      0212
23     0137      69      0206
24     0138      13      0151
25     0139      82      0221
26     0140      21      0230
27     0141      77      0218
28     0142      90      0163

```

PSN IN TABLE	DISPLACEMENT ADDRESS	TABLE ADDRESS
1	000000	000000
2	000000	000000
3	000000	000000
4	000000	000000
5	000000	000000
6	000000	000000
7	000000	000000
8	000000	000000
9	000000	000000
10	000000	000000
11	000000	000000
12	000000	000000
13	000000	000000
14	000000	000000
15	000000	000000
16	000000	000000
17	000000	000000
18	000000	000000
19	000000	000000
20	000000	000000
21	000000	000000
22	000000	000000
23	000000	000000
24	000000	000000
25	000000	000000
26	000000	000000
27	000000	000000
28	000000	000000
29	000000	000000
30	000000	000000
31	000000	000000

0	3113	139	3252
10	3114	141	3255
20	3115	455	3260
30	3116	1007	3243
40	3117	739	3245
50	3118	73	3191
60	3119	117	3236
70	3120	95	3215
80	3121	64	3385
90	3122	55	3388
100	3123	33	3356
110	3124	33	3347
120	3125	31	3355
130	3126	55	3361
140	3127	302	3209
150	3128	150	3197
160	3129	150	3144
170	3130	9	3239
180	3131	433	3174
190	3132	58	3200
200	3133	45	3178
210	3134	90	3224
220	3135	33	3213
230	3136	58	3212
240	3137	59	3206
250	3138	13	3151
260	3139	32	3221
270	3140	90	3230
280	3141	7	3216
290	3142	71	3216

DISASSEMBLIN SPECTRUM RO

The value of a disassembler is significant only if you can use segments of the code within your own programs.

From Address 3113 to 3143 is a list of pointers — table 1. Address 3113 is taken as the starting point and the contents of the address are added to the address to provide a pointer to another address. Figure 4 demonstrates this function provided by the Basic program in figure 3.

The result is an address which further points to the class of command being con-

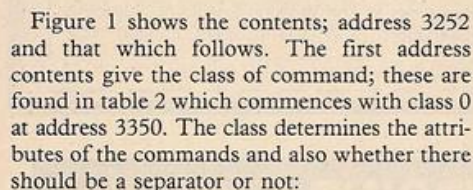


sidered and the address of the machine code for that command in ROM. The commands start at code 225 — LPrint, which is defined in ROM as command 0 up to code 255 (copy), which is defined in ROM as command 30. Therefore if we follow LPrint through, we see that it is defined as command 0 and points to address $3113 + 139 = 3252$.

10

LOC	INSTR	OP	PC	PC+1	PC+2	PC+3	PC+4	PC+5	PC+6	PC+7	PC+8	PC+9	PC+10	PC+11	PC+12	PC+13	PC+14	PC+15	PC+16	PC+17	PC+18	PC+19	PC+20	PC+21	PC+22	PC+23	PC+24	PC+25	PC+26	PC+27	PC+28	PC+29	PC+30	PC+31	PC+32	PC+33	PC+34	PC+35	PC+36	PC+37	PC+38	PC+39	PC+40	PC+41	PC+42	PC+43	PC+44	PC+45	PC+46	PC+47	PC+48	PC+49	PC+50	PC+51	PC+52	PC+53	PC+54	PC+55	PC+56	PC+57	PC+58	PC+59	PC+60	PC+61	PC+62	PC+63	PC+64	PC+65	PC+66	PC+67	PC+68	PC+69	PC+70	PC+71	PC+72	PC+73	PC+74	PC+75	PC+76	PC+77	PC+78	PC+79	PC+80	PC+81	PC+82	PC+83	PC+84	PC+85	PC+86	PC+87	PC+88	PC+89	PC+90	PC+91	PC+92	PC+93	PC+94	PC+95	PC+96	PC+97	PC+98	PC+99	PC+100	PC+101	PC+102	PC+103	PC+104	PC+105	PC+106	PC+107	PC+108	PC+109	PC+110	PC+111	PC+112	PC+113	PC+114	PC+115	PC+116	PC+117	PC+118	PC+119	PC+120	PC+121	PC+122	PC+123	PC+124	PC+125	PC+126	PC+127	PC+128	PC+129	PC+130	PC+131	PC+132	PC+133	PC+134	PC+135	PC+136	PC+137	PC+138	PC+139	PC+140	PC+141	PC+142	PC+143	PC+144	PC+145	PC+146	PC+147	PC+148	PC+149	PC+150	PC+151	PC+152	PC+153	PC+154	PC+155	PC+156	PC+157	PC+158	PC+159	PC+160	PC+161	PC+162	PC+163	PC+164	PC+165	PC+166	PC+167	PC+168	PC+169	PC+170	PC+171	PC+172	PC+173	PC+174	PC+175	PC+176	PC+177	PC+178	PC+179	PC+180	PC+181	PC+182	PC+183	PC+184	PC+185	PC+186	PC+187	PC+188	PC+189	PC+190	PC+191	PC+192	PC+193	PC+194	PC+195	PC+196	PC+197	PC+198	PC+199	PC+200	PC+201	PC+202	PC+203	PC+204	PC+205	PC+206	PC+207	PC+208	PC+209	PC+210	PC+211	PC+212	PC+213	PC+214	PC+215	PC+216	PC+217	PC+218	PC+219	PC+220	PC+221	PC+222	PC+223	PC+224	PC+225	PC+226	PC+227	PC+228	PC+229	PC+230	PC+231	PC+232	PC+233	PC+234	PC+235	PC+236	PC+237	PC+238	PC+239	PC+240	PC+241	PC+242	PC+243	PC+244	PC+245	PC+246	PC+247	PC+248	PC+249	PC+250	PC+251	PC+252	PC+253	PC+254	PC+255	PC+256	PC+257	PC+258	PC+259	PC+260	PC+261	PC+262	PC+263	PC+264	PC+265	PC+266	PC+267	PC+268	PC+269	PC+270	PC+271	PC+272	PC+273	PC+274	PC+275	PC+276	PC+277	PC+278	PC+279	PC+280	PC+281	PC+282	PC+283	PC+284	PC+285	PC+286	PC+287	PC+288	PC+289	PC+290	PC+291	PC+292	PC+293	PC+294	PC+295	PC+296	PC+297	PC+298	PC+299	PC+300	PC+301	PC+302	PC+303	PC+304	PC+305	PC+306	PC+307	PC+308	PC+309	PC+310	PC+311	PC+312	PC+313	PC+314	PC+315	PC+316	PC+317	PC+318	PC+319	PC+320	PC+321	PC+322	PC+323	PC+324	PC+325	PC+326	PC+327	PC+328	PC+329	PC+330	PC+331	PC+332	PC+333	PC+334	PC+335	PC+336	PC+337	PC+338	PC+339	PC+340	PC+341	PC+342	PC+343	PC+344	PC+345	PC+346	PC+347	PC+348	PC+349	PC+350	PC+351	PC+352	PC+353	PC+354	PC+355	PC+356	PC+357	PC+358	PC+359	PC+360	PC+361	PC+362	PC+363	PC+364	PC+365	PC+366	PC+367	PC+368	PC+369	PC+370	PC+371	PC+372	PC+373	PC+374	PC+375	PC+376	PC+377	PC+378	PC+379	PC+380	PC+381	PC+382	PC+383	PC+384	PC+385	PC+386	PC+387	PC+388	PC+389	PC+390	PC+391	PC+392	PC+393	PC+394	PC+395	PC+396	PC+397	PC+398	PC+399	PC+400	PC+401	PC+402	PC+403	PC+404	PC+405	PC+406	PC+407	PC+408	PC+409	PC+410	PC+411	PC+412	PC+413	PC+414	PC+415	PC+416	PC+417	PC+418	PC+419	PC+420	PC+421	PC+422	PC+423	PC+424	PC+425	PC+426	PC+427	PC+428	PC+429	PC+430	PC+431	PC+432	PC+433	PC+434	PC+435	PC+436	PC+437	PC+438	PC+439	PC+440	PC+441	PC+442	PC+443	PC+444	PC+445	PC+446	PC+447	PC+448	PC+449	PC+450	PC+451	PC+452	PC+453	PC+454	PC+455	PC+456	PC+457	PC+458	PC+459	PC+460	PC+461	PC+462	PC+463	PC+464	PC+465	PC+466	PC+467	PC+468	PC+469	PC+470	PC+471	PC+472	PC+473	PC+474	PC+475	PC+476	PC+477	PC+478	PC+479	PC+480	PC+481	PC+482	PC+483	PC+484	PC+485	PC+486	PC+487	PC+488	PC+489	PC+490	PC+491	PC+492	PC+493	PC+494	PC+495	PC+496	PC+497	PC+498	PC+499	PC+500	PC+501	PC+502	PC+503	PC+504	PC+505	PC+506	PC+507	PC+508	PC+509	PC+510	PC+511	PC+512	PC+513	PC+514	PC+515	PC+516	PC+517	PC+518	PC+519	PC+520	PC+521	PC+522	PC+523	PC+524	PC+525	PC+526	PC+527	PC+528	PC+529	PC+530	PC+531	PC+532	PC+533	PC+534	PC+535	PC+536	PC+537	PC+538	PC+539	PC+540	PC+541	PC+542	PC+543	PC+544	PC+545	PC+546	PC+547	PC+548	PC+549	PC+550	PC+551	PC+552	PC+553	PC+554	PC+555	PC+556	PC+557	PC+558	PC+559	PC+560	PC+561	PC+562	PC+563	PC+564	PC+565	PC+566	PC+567	PC+568	PC+569	PC+570	PC+571	PC+572	PC+573	PC+574	PC+575	PC+576	PC+577	PC+578	PC+579	PC+580	PC+581	PC+582	PC+583	PC+584	PC+585	PC+586	PC+587	PC+588	PC+589	PC+590	PC+591	PC+592	PC+593	PC+594	PC+595	PC+596	PC+597	PC+598	PC+599	PC+600	PC+601	PC+602	PC+603	PC+604	PC+605	PC+606	PC+607	PC+608	PC+609	PC+610	PC+611	PC+612	PC+613	PC+614	PC+615	PC+616	PC+617	PC+618	PC+619	PC+620	PC+621	PC+622	PC+623	PC+624	PC+625	PC+626	PC+627	PC+628	PC+629	PC+630	PC+631	PC+632	PC+633	PC+634	PC+635	PC+636	PC+637	PC+638	PC+639	PC+640	PC+641	PC+642	PC+643	PC+644	PC+645	PC+646	PC+647	PC+648	PC+649	PC+650	PC+651	PC+652	PC+653	PC+654	PC+655	PC+656	PC+657	PC+658	PC+659	PC+660	PC+661	PC+662	PC+663	PC+664	PC+665	PC+666	PC+667	PC+668	PC+669	PC+670	PC+671	PC+672	PC+673	PC+674	PC+675	PC+676	PC+677	PC+678	PC+679	PC+680	PC+681	PC+682	PC+683	PC+684	PC+685	PC+686	PC+687	PC+688	PC+689	PC+690	PC+691	PC+692	PC+693	PC+694	PC+695	PC+696	PC+697	PC+698	PC+699	PC+700	PC+701	PC+702	PC+703	PC+704	PC+705	PC+706	PC+707	PC+708	PC+709	PC+710	PC+711	PC+712	PC+713	PC+714	PC+715	PC+716	PC+717	PC+718	PC+719	PC+720	PC+721	PC+722	PC+723	PC+724	PC+725	PC+726	PC+727	PC+728	PC+729	PC+730	PC+731	PC+732	PC+733	PC+734	PC+735	PC+736	PC+737	PC+738	PC+739	PC+740	PC+741	PC+742	PC+743	PC+744	PC+745	PC+746	PC+747	PC+748	PC+749	PC+750	PC+751	PC+752	PC+753	PC+754	PC+755	PC+756	PC+757	PC+758	PC+759	PC+760	PC+761	PC+762	PC+763	PC+764	PC+765	PC+766	PC+767	PC+768	PC+769	PC+770	PC+771	PC+772	PC+773	PC+774	PC+775	PC+776	PC+777	PC+778	PC+779	PC+780	PC+781	PC+782	PC+783	PC+784	PC+785	PC+786	PC+787	PC+788	PC+789	PC+790	PC+791	PC+792	PC+793	PC+794	PC+795	PC+796	PC+797	PC+798	PC+799	PC+800	PC+801	PC+802	PC+803	PC+804	PC+805	PC+806	PC+807	PC+808	PC+809	PC+810	PC+811	PC+812	PC+813	PC+814	PC+815	PC+816	PC+817	PC+818	PC+819	PC+820	PC+821	PC+822	PC+823	PC+824	PC+825	PC+826	PC+827	PC+828	PC+829	PC+830	PC+831	PC+832	PC+833	PC+834	PC+835	PC+836	PC+837	PC+838	PC+839	PC+840	PC+841	PC+842	PC+843	PC+844	PC+845	PC+846	PC+847	PC+848	PC+849	PC+850	PC+851	PC+852	PC+853	PC+854	PC+855	PC+856	PC+857	PC+858	PC+859	PC+860	PC+861	PC+862	PC+863	PC+864	PC+865	PC+866	PC+867	PC+868	PC+869	PC+870	PC+871	PC+872	PC+873	PC+874	PC+875	PC+876	PC+877	PC+878	PC+879	PC+880	PC+881	PC+882	PC+883	PC+884	PC+885	PC+886	PC+887	PC+888	PC+889	PC+890	PC+891	PC+892	PC+893	PC+894	PC+895	PC+896	PC+897	PC+898	PC+899	PC+900	PC+901	PC+902	PC+903	PC+904	PC+905	PC+906	PC+907	PC+908	PC+909	PC+910	PC+911	PC+912	PC+913	PC+914	PC+915	PC+916	PC+917	PC+918	PC+919	PC+920	PC+921	PC+922	PC+923	PC+924	PC+925	PC+926	PC+927	PC+928	PC+929	PC+930	PC+931	PC+932	PC+933	PC+934	PC+935	PC+936	PC+937	PC+938	PC+939	PC+940	PC+941	PC+942	PC+943	PC+944	PC+945	PC+946	PC+947	PC+948	PC+949	PC+950	PC+951	PC+952	PC+953	PC+954	PC+955	PC+956	PC+957	PC+958	PC+959	PC+960	PC+961	PC+962	PC+963	PC+964	PC+965	PC+966	PC+967	PC+968	PC+969	PC+970	PC+971	PC+972	PC+973	PC+974	PC+975	PC+976	PC+977	PC+978	PC+979	PC+980	PC+981	PC+982	PC+983	PC+984	PC+985	PC+986	PC+987	PC+988	PC+989	PC+990	PC+991	PC+992	PC+993	PC+994	PC+995	PC+996	PC+997	PC+998	PC+999	PC+1000	PC+1001	PC+1002	PC+1003	PC+1004	PC+1005	PC+1006	PC+1007	PC+1008	PC+1009	PC+1010	PC+1011	PC+1012	PC+1013	PC+1014	PC+1015	PC+1016	PC+1017	PC+1018	PC+1019	PC+1020	PC+1021	PC+1022	PC+1023	PC+1024	PC+1025	PC+1026	PC+1027	PC+1028	PC+1029	PC+1030	PC+1031	PC+1032	PC+1033	PC+1034	PC+1035	PC+1036	PC+1037	PC+1038	PC+1039	PC+1040	PC+1041	PC+1042	PC+1043	PC+1044	PC+1045	PC+1046	PC+1047	PC+1048	PC+1049	PC+1050	PC+1051	PC+1052	PC+1053	PC+1054	PC+1055	PC+1056	PC+1057	PC+1058	PC+1059	PC+1060	PC+1061	PC+1062	PC+1063	PC+1064	PC+1065	PC+1066	PC+1067	PC+1068	PC+1069	PC+1070	PC+1071	PC+1072	PC+1073	PC+1074	PC+1075	PC+1076	PC+1077	PC+1078	PC+1079	PC+1080	PC+1081	PC+1082	PC+1083	PC+1084	PC+1085	PC+1086	PC+1087	PC+1088	PC+1089	PC+1090	PC+1091	PC+1092	PC+1093	PC+1094	PC+1095	PC+1096	PC+1097	PC+1098	PC+1099	PC+1100	PC+1101	PC+1102	PC+1103	PC+1104	PC+1105	PC+1106	PC+1107	PC+1108	PC+1109	PC+1110	PC+1111	PC+1112	PC+1113	PC+1114	PC+1115	PC+1116	PC+1117	PC+1118	PC+1119	PC+1120	PC+1121	PC+1122	PC+1123	PC+1124	PC+1125	PC+1126	PC+1127	PC+1128	PC+1129	PC+1130	PC+1131	PC+1132	PC+1133	PC+1134	PC+1135	PC+1136	PC+1137	PC+1138	PC+1139	PC+1140	PC+1141	PC+1142	PC+1143	PC+1144	PC+1145	PC+1146	PC+1147	PC+1148	PC+1149	PC+1150	PC+1151	PC+1152	PC+1153	PC+1154	PC+1155	PC+1156	PC+1157	PC+1158	PC+1159	PC+1160	PC+1161	PC+1162	PC+1163	PC+1164	PC+1165	PC+1166	PC+1167	PC+1168	PC+1169	PC+1170	PC+1171	PC+1172	PC+1173	PC+1174	PC+1175	PC+1176	PC+1177	PC+1178	PC+1179	PC+1180	PC+1181	PC+1182	PC+1183	PC+1184	PC+1185	PC+1186	PC+1187	PC+1188	PC+1189	PC+1190	PC+1191	PC+1192	PC+1193	PC+1194	PC+1195	PC+1196	PC+1197	PC+1198	PC+1199	PC+1200	PC+1201	PC+1202	PC+1203	PC+1204	PC+1205	PC+1206	PC+1207	PC+1208	PC+1209	PC+1210	PC+1211	PC+1212	PC+1213	PC+1214	PC+1215	PC+1216	PC+1217	PC+1218	PC+1219	PC+1220	PC+1221	PC+1222	PC+1223	PC+1224</
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Okay, so you can decode your ROM. But where does it get you? In this article, David Horne looks at practical applications.



A and B are attributes, the comma is the separator.

If the class is 0 or 5, then the next address contains the address of the routine in ROM. Otherwise further attributes or separators follow, until a class 0 or 5 is reached.

Figure 1 gives an initial breakdown of the first three parts of ROM command tables. You can decode the remainder if you wish; the same technique is used to unravel the class tables.

Where does this lead us? You can call the Basic class 0 commands from within your own machine-code programs.

201 105 8 Call 2153

will copy the screen to printer,
Call 3883 will set slow mode
Call 3875 will set fast mode

Figure 5 gives the Basic program for decoding this particular table and figure 6 the unravelled response.

As I said, the Basic programs are simplifications and really only pick out the essentials of the machine code. Figure 2 gives the ROM table decoder; if you followed the series on machine code, neglecting the RS32 and RS24, it should start to make sense.

The Spectrum tables are decoded in a similar manner, but in order not to fill the magazine with machine-code listings of the ROM, I have just presented the final decoded tables, figures 7 and 9, and the Basic programs for decoding the Spectrum ROM tables, figures 8 and 10.

Address	Disassembly	Comment
0000	LD B 0	
0003	LD B 0	
0006	LD B 0	
0009	LD B 0	
000C	LD B 0	
000F	LD B 0	
0012	LD B 0	
0015	LD B 0	
0018	LD B 0	
001B	LD B 0	
001E	LD B 0	
0021	LD B 0	
0024	LD B 0	
0027	LD B 0	
002A	LD B 0	
002D	LD B 0	
0030	LD B 0	
0033	LD B 0	
0036	LD B 0	
0039	LD B 0	
003C	LD B 0	
003F	LD B 0	
0042	LD B 0	
0045	LD B 0	
0048	LD B 0	
004B	LD B 0	
004E	LD B 0	
0051	LD B 0	
0054	LD B 0	
0057	LD B 0	
005A	LD B 0	
005D	LD B 0	
0060	LD B 0	
0063	LD B 0	
0066	LD B 0	
0069	LD B 0	
006C	LD B 0	
006F	LD B 0	
0072	LD B 0	
0075	LD B 0	
0078	LD B 0	
007B	LD B 0	
007E	LD B 0	
0081	LD B 0	
0084	LD B 0	
0087	LD B 0	
008A	LD B 0	
008D	LD B 0	
0090	LD B 0	
0093	LD B 0	
0096	LD B 0	
0099	LD B 0	
009C	LD B 0	
009F	LD B 0	
00A2	LD B 0	
00A5	LD B 0	
00A8	LD B 0	
00AB	LD B 0	
00AE	LD B 0	
00B1	LD B 0	
00B4	LD B 0	
00B7	LD B 0	
00BA	LD B 0	
00BD	LD B 0	
00C0	LD B 0	
00C3	LD B 0	
00C6	LD B 0	
00C9	LD B 0	
00CC	LD B 0	
00CF	LD B 0	
00D2	LD B 0	
00D5	LD B 0	
00D8	LD B 0	
00DB	LD B 0	
00DE	LD B 0	
00E1	LD B 0	
00E4	LD B 0	
00E7	LD B 0	
00EA	LD B 0	
00ED	LD B 0	
00F0	LD B 0	
00F3	LD B 0	
00F6	LD B 0	
00F9	LD B 0	
00FC	LD B 0	
00FF	LD B 0	

Command	Class	Sep	Address
DEF FN	5		8032
CAT	5		8033
FORMAT	10		6033
MOVE	10		
ERASE	10		6035
OPEN #	6		6035
CLOSE #	10		5942
MERGE	6		5851
VERIFY	11	*	
BEEP	11	*	
CIRCLE	5		1016
INK	5		6992
PAPER	7	*	
FLASH	7	*	
BRIGHT	7	*	
INVERSE	7	*	
OVER	7	*	
OUT	3		7802
LPRINT	3		8137
LIST	3		8139
STOP	9		7406
READ	5		7661
DATA	5		7719
RESTORE	5		7746
NEW	5		4535
BORDER	5		8552
CONTINUE	5		7775
DIM	5		11266
REM	5		7090
FOR	4	=	
	5	TO	
	5		7427
GO TO	5		7783
GO SUB	5		7917
INPUT	5		8329
LOAD	11	*	
LIST	5		6137
LET	5		573
PAUSE	5		2994
NEXT	4		7595
POKE	5		7808
PRINT	5		8141
PLOT	5		8924
RUN	5		7841
SAVE	5	*	
RANDOMIZE	5		7759
IF	5	THEN	
	5		7408
CLS	5		3435
DRAW	5		
	5		9090
CLEAR	5		7852
RETURN	5		7971
COPY	5		3756

Class	Address
0	7184
1	7198
2	7244
3	7178
4	7272
5	7160
6	7292
7	7311
8	7282
9	7349
10	7298
11	7376

```

1 FOR a=6728 TO 6777
2 LET x=x+1: IF x>16 THEN COP
Y: 3 LET y=0
4 LET b=a-6522: PRINT CHR$ b:
TAB 12:
5 LET c=a+PEEK a
5 PRINT PEEK c
6 IF PEEK c=7 OR PEEK c=11 TH
EN PRINT TAB 21;"NEXT a"
7 IF PEEK c=9 OR PEEK c=8 OR
PEEK c=4 OR PEEK c=6 OR PEEK c=1
0 THEN GO TO 16
10 PRINT TAB 24;PEEK (c+1)+256
*PEEK (c+2)
13 NEXT a
14 COPY
15 STOP
16 LET c=c+1
17 IF PEEK c=0 THEN GO TO 10
18 IF PEEK c=5 THEN PRINT TAB
12: GO TO 5
19 PRINT CHR$ PEEK c
20 LET c=c+1: PRINT TAB 12: G
O TO 5
50 PRINT "Command Class Sep
Address"
51 PRINT
52 LET x=0
53 GO TO 1

```

LPRINT	00000000	2763
LIST	00000000	1836
LTOP	00000000	3320
LOW	00000000	3383
LIST	00000000	3370
NEW	00000000	963
OCROLL	00000000	3086
CONT	00000000	3708
IM	00000000	5129
EM	00000000	3434
OR	00000000	
		=
		TO
GOTO	00000000	3513
GOSUB	00000000	3713
INPUT	00000000	3765
LOAD	00000000	3817
LIST	00000000	532
LET	00000000	1840
		=
PAUSE	00000000	3713
NEXT	00000000	3898
POKE	00000000	3630
		,
PRINT	00000000	3730
PLOT	00000000	2767
		,
RUN	00000000	2991
SAVE	00000000	3759
RAND	00000000	758
IF	00000000	3692
		THEN
CLS	00000000	3499
UNPLOT	00000000	2602
		,
CLEAR	00000000	2991
RETURN	00000000	5274
COPY	00000000	3600
		2153

```

100 FOR A=3113 TO 3144
101 LET B=A-2888
102 PRINT CHR$(B);TAB 12;
103 LET C=CHR$(PEEK A)
104 PRINT PEEK C;
105 IF PEEK C=1 OR PEEK C=6 OR
DE 106 C=4 THEN GOTO 100
107 PRINT TAB 24;PEEK (C+1)+256
108 LET C=C+2
109 NEXT A
110 LET C=C+1
111 IF PEEK C=0 OR PEEK C=5 THE
N 112 GOTO 80
113 PRINT TAB 16;CHR$(PEEK C)
114 LET C=C+1
115 IF PEEK C=2 THEN LET C=C+1
116 PRINT TAB 12;
117 GOTO 50

```

```

10 PRINT "Class      Address"
20 FOR a=7169 TO 7180
30 LET b=PEEK a
40 LET c=7169+b
50 PRINT "      ";a-7169;TAB 10;C
60 NEXT A
70 STOP

```


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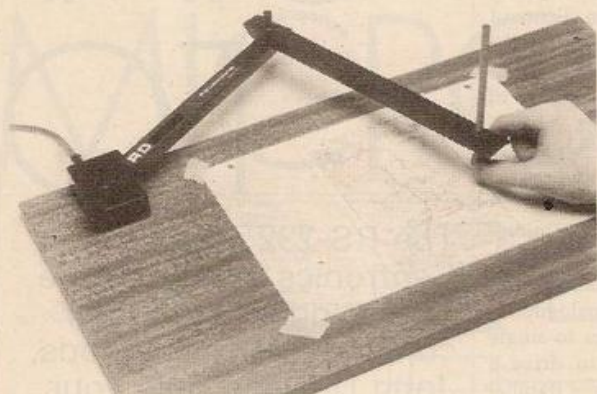
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YOU MAY not be aware that there were several earlier electrical methods of sending messages that were largely superseded and made obsolete by the Morse code. These other methods were parallel channels of communication in that they required several wires. A piece of information was transmitted by setting each of the wires on or off at the same time. The first practical telegraph system was invented in 1837 by Sir Charles Wheatstone and W F Cooke and it was known as the Five Needle System. Five wires were required for signalling, and either the earth or a sixth to complete the circuit.

Clearly, systems that needed several wires to connect one station with another were no match for a serial method in which two wires could carry a message by sending the elements of a piece of information one after another. And so the Morse code triumphed. It was the universal standard means of long distance communication between humans for many years and is still used widely in both commercial and amateur radio transmission. Morse code allows two way communication between people who cannot speak the same language and has been used for the automatic transmission of data from devices such as weather balloons as well as the transmission of free text.

Another serial system was developed in 1874 and used for machine-to-machine communication. The Baudot code has five bits that make up each piece of information and telexes and teleprinters still send and receive information using an internationally-approved version of the 19th century Baudot code.

This article concerns two standard computer methods of communication. The first is a widely-used serial interface — the RS-232, which is slowly being upgraded to the RS-432. The second is the ubiquitous Centronics interface. Both are almost universal interfaces on hundreds of thousands of domestic and commercial computers.

PCHAR	PHP	
	PHA	
PCR1	STA	\$BFE1
	LDA	\$BFE0
	AND	#4
	BEQ	PCRZ
	LDA	\$BFED
	AND	#2
	BEQ	PCR1
	PLA	
	PLP	
	RTS	
PCRZ	LDX	#8 ; /// Printer error
	JMP	ERROR
V2POP	PHP	
	PHA	
	LDA	#0
	STA	\$BFE3
	LDA	#FF
	STA	\$BFE3
	LDA	#A
	STA	\$BFEC
	LDA	#7F
	STA	\$BFEE
	LDA	\$BFE0
	AND	#4
	BNE	V21
	LDX	#8 ; /// Printer error
	JMP	ERROR
V21	PLA	
	PLP	
	RTS	

Figure 4. Program to set up a V/A.

CONTROL STAND FOR

Rather than confuse the issue by looking into the entrails of a complex micro, I intend to base a simple Centronics interface on the Microprofessor computer. The MPF-I computer is a good testbed for small programs of this sort and, like all computers, its value is increased greatly when it has the ability to produce hard copy by printing data and results on paper.

The ideas in this article apply to most microcomputers. The Acorn Atom has a VIA chip that can be used to acquire information from the real world by connecting analogue to digital converters or on/off switches to single bits, just as easily as it is used to drive a printer. If your micro does not have a Parallel Input/Output — PI/O — or Versatile Interface Adaptor — VIA — chip on the basic board it will almost certainly have a bus offering all the connections to the central processor unit — CPU — that you need to wire up a parallel port.

The Jupiter Ace falls into this class. Although the programs in this, and the subsequent article, will be in assembly language there is no reason why the few values that have to be set for either chip cannot be Poked into place with Basic. By doing this with the Oric, for example, you will be able to use the second timer for timing parts of games or to set up the machine as a frequency counter.

What is an interface? There are five elements of a complete interface specification for connections between two pieces of electronic equipment.

First, the mechanical connectors — the design of things like the diameter and shape of the pins and the plug retainers.

Second, the electrical design, the voltage levels on each pin, for example, and the permissible capacitance in the line.

Third, the functions of devices connected to the interface. The IEEE 488 interface classifies devices as "talkers", "listeners", or "controllers".

The fourth interface specification element concerns the communications protocol, which is an agreement that certain codes sent along the interface will be treated in the same way by all the devices that may be connected to the interface.

Fifth comes a higher level protocol which defines the use made of information by each machine. High-level protocols are necessary, for example, to route messages and ensure privacy.

Both the RS-232 interface and the Centronics parallel interface contain parts of both one and two in the list. Pin connections for versions of both interfaces are set out in figure 1. It is surprising that a "serial" interface should have almost as many connections as a parallel one, but the protocol for the RS-232 interface allows for a number of wired control functions as well as the transmission of data in both directions at once. Remember that the difference between serial and parallel is that information is transmitted down an RS-232 link one bit at a time, while the Centronics interface

The RS-232 and the Centronics interfaces are two standard computer communication methods. John Dawson puts your micro in touch with reality.

used in the Epson MX-80F/T and other printers carries eight bits at a time along the data bus — data 1 to 8. Many RS-232 connections can be made successfully using only four wires — a small selection from the total.

There are almost as many varieties of the RS-232 interface as there are equipment manufacturers. If a salesman ever offers you a "standard" RS-232 link, just make sure it works before you buy and do not expect to be able to connect the printer, or whatever peripheral device it is, to another machine without doing some rewiring.

You can set up a non-standard or standard serial link using the cassette port and your own software. I hope to do this in future, modelling the Computer Users' Tape System — CUTS — in software on the MPF-I and connecting this machine to an RML-380Z.

At present, though, I want to print out machine-code listings of fundamental subroutines to extend the MPF-I monitor capabilities. The basic MPF-I has a socket for a PI/O chip. The PI/O is a Zilog Z-80 range product that is matched by 6502 manufacturers with the 6522 Versatile Interface Adaptor. The main difference between the systems into which the chips fit is the memory-mapped approach taken by the 6502 as against the I/O port system used by the Z-80.

In the 6502 architecture, peripheral devices are treated simply as memory locations to which data can be sent and from which information can be read. The Z-80 uses the lower eight bits of the address bus to identify up to 255 ports for data I/O purposes. The 6502 CPU has no separate IORQ and MREQ lines.

Each PIO or PIA/VIA is essentially similar to any other. The purpose of the chip is to act as a multiport input/output device in which a port is simply a set of eight wires carrying a signal in parallel — an eight-wire needle system — Sir Charles would have been proud! In addition to the eight data bits the PI/O chip must have a way of agreeing with the peripheral device that a transfer of data has taken place. This is done by "handshaking", a process in which data is placed on the output of the PIO and one of the control lines is used as a strobe, which means that it can be made to

DARD INTERFACES MICROS

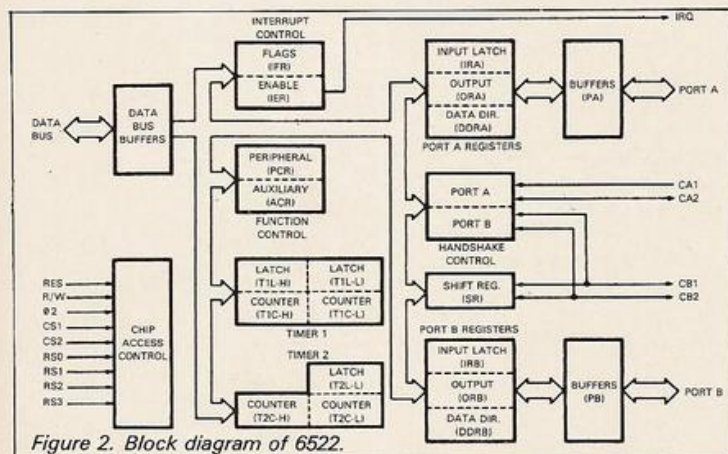


Figure 2. Block diagram of 6522.

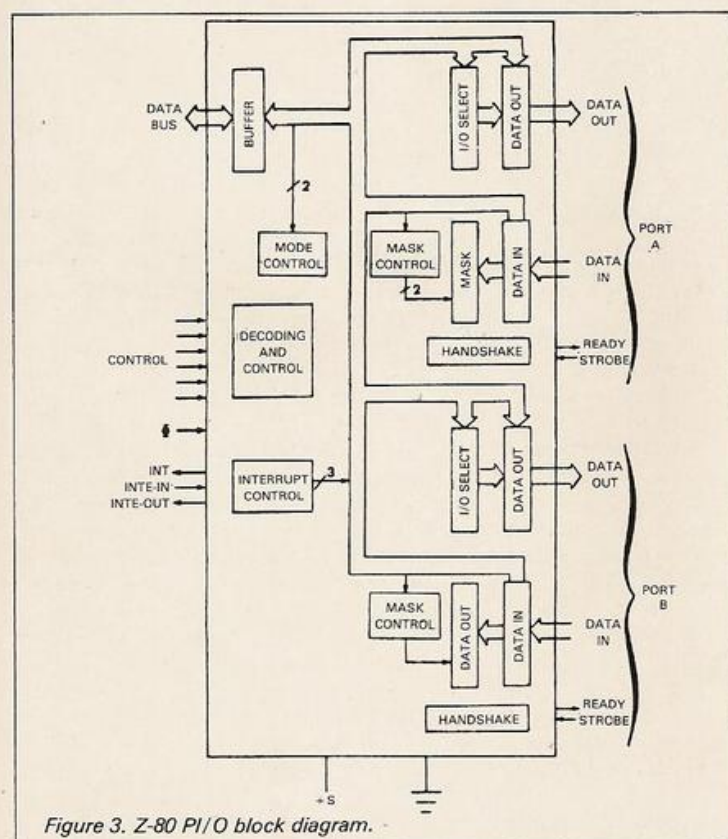


Figure 3. Z-80 P/O block diagram.

Signal Pin	Return Pin	Signal	Direction	Description
1	19	STROBE	In	Strobe pulse to read data in. Pulse width must be more than 0.5μs. at receiving terminal. The signal level is normally "High"; read-in of data is performed at the "Low" level of this signal.
2	20	DATA 1	In	These signals represent information of the first and eighth bits of parallel data respectively. Each signal is at "High" level when data is logical "1" and "Low" when logical "0".
3	21	DATA 2	In	
4	22	DATA 3	In	
5	23	DATA 4	In	
6	24	DATA 5	In	
7	25	DATA 6	In	
8	26	DATA 7	In	
9	27	DATA 8	In	
10	28	ACKNLG	Out	Around 5μs. pulse. "Low" indicates that data has been received and that the printer is ready to accept other data.
11	29	BUSY	Out	A "High" signal indicates that the printer cannot receive data. The signal becomes "High" in the following cases: 1. During data entry 2. During printing operation 3. In OFF-LINE state 4. During printer error status
12	30	PE	Out	A "High" signal indicates that the printer is out of paper.
13	—	SLCT	Out	This signal indicates that the printer is in the selected state.
14	—	AUTO FEED XT	In	With this signal being at "Low" level, the paper is automatically fed one line after printing. The signal level can be fixed to "Low" with DIP SW pin 2-3 provided on the control circuit board.
15	—	NC	—	Not used.
16	—	OV	—	Logic GND level.
17	—	CHASSIS-GND	—	Printer chassis GND. In the printer, the chassis GND and the logic GND are isolated from each other.
18	—	NC	—	Not used.
19 to 30	—	GND	—	Twisted-pair return signal GND level.
31	—	INIT	In	When the level of this signal becomes "Low", the printer controller is reset to its initial state and the print buffer is cleared. This signal is normally at "High" level, and its pulse width must be more than 50μs. at the receiving terminal.
32	—	ERROR	Out	The level of this signal becomes "Low" when the printer is in — 1. Paper End state. 2. Off-Line state. 3. Error state.
33	—	GND	—	Same as with pin numbers 19 to 30.
34	—	NC	—	Not used.
35	—	—	—	Pulled up to +5V through 4.7KΩ resistance.
36	—	SLCT IN	In	Data entry to the printer is possible only when the level of this signal is "Low". Internal fixing can be carried out with DIP SW 1-8. The condition at the time of shipment is set "Low" for this signal.

Figure 1. Centronics interface on MX-80.

output a pulse when the information on the data lines is stable and ready to be transferred to the receiving device.

Following this the data is left on the output port until the receiving device sends a signal along the other control line for that port to say that it has the data safely on board.

Block diagrams for the two chips are set out in Figures 2 and 3. In addition to acting as two eight-bit latched I/O ports the 6522 also con-

tains two very useful counter timers. On the Microprofessor computer board the hardware timers are provided by a counter timer circuit — CTC — chip.

A simple but adequate Centronics interface can be established using only the Data, Busy, Acknowledge, and Strobe lines — the Acorn Atom is an example and the Nascom 1 computer interface was even simpler, omitting to take account of the Acknowledge signal from

the printer to say that the data had been received, and using the Busy signal alone.

Figure 4 illustrates a working program — V2POP — to set up a VIA on the Tangerine computer as a parallel output for a Centronics printer interface and another subroutine — PChar — which prints a character. The memory map values — \$Bfe3 and so on — are specific to the Tangerine and will require alteration for your own system.



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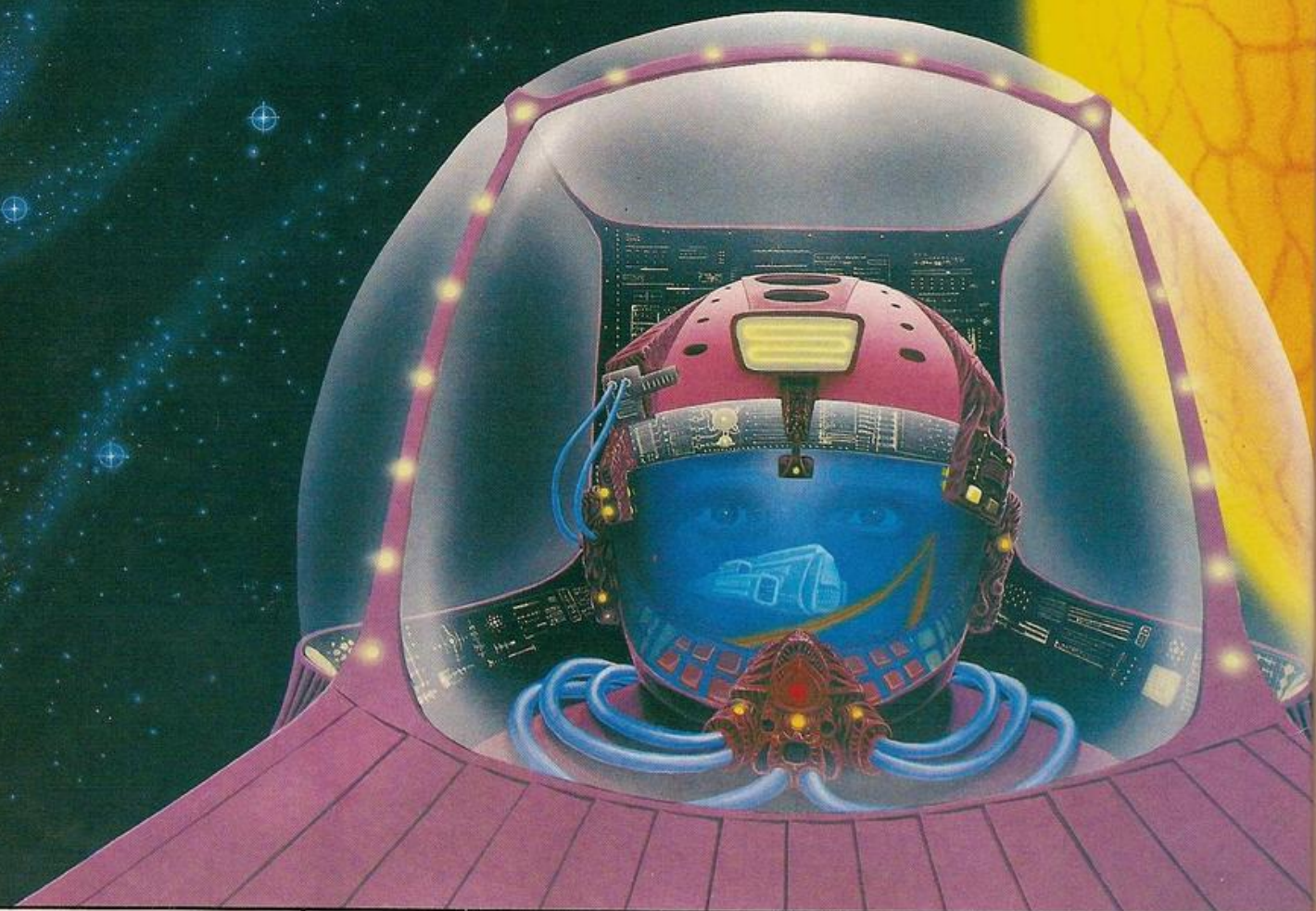
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BM3 8.2	21.1	1.10
BM4 8.7	20.4	0.99
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RESPONSE FRAME

Do you have a problem? Your manual is incomprehensible or you just cannot get the hang of that programming trick you tried — whatever it is, Tim Hartnell will do his best to answer your queries. Please include only one question per letter and mark them "Response Frame".

BREAK-IN

I am a ZX-81 owner, and have a collection of software for my machine. A few of these programs consist entirely of machine code, which makes it impossible to break into the program. Can you suggest any way in which I can break into this kind of program so it can be saved on to another tape?

*Bradd France,
Handsworth, Birmingham.*

ONE OF THE reasons the tape cannot be broken into is to stop tape-copying. Copying a program to give to someone else is, in effect, stealing the program, and depriving the programmer and the manufacturer of the tape their rightful royalties. Even though routines do exist to break into machine-code tapes, it would be highly irresponsible for us to publish them.

ZERO SET

I have a Video Genie. I have found out that by using Goto a line number, rather than Run, I can execute a program over and over again from different points, but still have the variables in the program from a previous execution. However, by inserting or deleting lines, all variables are set to zero. Is there any way to get around this?

*G Kowalczyk,
London N9.*

UNFORTUNATELY, there is no simple way to get the variables to retain their value after an edit. When you change the length of the program, it could overwrite the variables store, so to avoid error, the Genie does a Clear every time Edit is used.

CAREER CHOICE

Our son, who will shortly be 13, is considering purchasing his first computer. He favours the ZX Spectrum. He will be taking Computer Studies at a later date at school, and is considering becoming a programmer.

In your opinion, would this be a good choice of computer for him?

*Mrs Y Smith,
Tolleshunt D'Arcy,
Maldon.*

THERE IS PROBABLY not a single computer on the market in the under £400 range which would not be worth getting. Even the ZX-81 can take a person a long way into the field of computing. The only real problem facing the Spectrum has been the long delivery delays. If you

want a computer tomorrow, you can get most other models off the shelf. I suggest you work through the following checklist of questions before you make the final decision on which computer to buy. How much can I afford to pay? What are the three main things I will use the computer for? How much memory will I need for these? Which two or three computers fulfil the above requirements? Is there a store near me which sells and services these? How many of these computers have been sold? Are there letters in the magazines complaining of particular, persistent problems with the machines I am considering? Is there a range of suitable software available? How much does extra memory cost? Is Basic on-board, or will I need to "boot it up" with a plug-in cartridge or cassette? Are the machines under consideration supported by an active users' group? Do the machines under consideration save and load programs on to an ordinary cassette recorder, or would I have to buy a special recorder? If a special recorder is required, how much does it cost? Is the quality of the printer output of the computer good enough for my needs? If you work through these questions, you should find the choice of computer easy to make.

CUBEMASTER

I own a ZX Spectrum and have a problem. When trying to enter the Cubemaster program from the February, 1981 issue of *Your Computer*, written for a 16K ZX-81, I struck a serious problem. My 16K Spectrum decided to run out of memory at line 3050. I was particularly annoyed at this as it had taken about four hours solid programming to get this far. Why will this program fit in a 16K ZX-81, but not in my machine?

*Simon Hillyer,
Naseby,
Northampton.*

ALL COMPUTERS use up memory maintaining the display. About 1K is used on the ZX-81, but a massive 9K is used up for the high-resolution graphics on the Spectrum. Therefore, whereas you have, more or less, 15K to play with on a 16K ZX-81, you have only 7K on a Spectrum. Many other high-resolution computers — like the BBC Microcomputer — allow you to decide if you want the memory to be used for the display, or whether you will accept a lower screen resolution in return for more program memory. You do not have this option on the Spectrum. Although I doubt if you

will squeeze Cubemaster into a 16K Spectrum, many other programs which are marked 16K ZX-81 are, in fact, far less than this, so you should be able to convert them for the Spectrum. If you are in doubt, leave out the instructions, and all Rem statements. You may well find you can put the instructions back in later, but I suggest you omit them the first time you try a ZX-81 program on the Spectrum.

NO LICENCE

I would like to know how the law stands on using a television with a computer. I have purchased a Sony 14 in. portable TV to use with my Spectrum. Do I have to pay £46 for a TV colour licence to watch my Spectrum?

*Philip Graham,
Dallas Road, Lancaster.*

THE LAW on use of television sets only relates to their being used to receive broadcast signals. Although I not not believe the use of a television as a visual display unit for a computer has been tested in court, a recent decision was made in favour of a man who had been taken to court for watching video tapes on an unlicensed set. The court found in his favour, that is no licence was required if the set was not used to pick up broadcast signals.

GREEN SCREEN

I would like to know if a green screen monitor may be connected to a ZX-81. If it can, how do I do it? I would like a green, 9 in. or 12 in. monitor, preferably under £100. I have been looking at the Zenith monitor. Would this be suitable for the ZX-81? Do I need additional hardware?

*J A Capless,
Mickleford, Leed.*

YOU'LL FIND, of course, that a monitor will give better results than a domestic television. The Timedata ZX-81 Magic Book gives details of the hardware modifications needed to connect a monitor to a ZX-81. You may well find that you get a perfectly acceptable result without actually making the modifications.

NEAT FIGURES

I own a ZX-81. As you know, the computer prints from left to right, starting at the left-hand margin. This is fine for text, but produces very untidy-looking columns of figures. Could you please help me with a routine to produce neat rows of figures?

*E Matos,
Sparkhill,
Birmingham.*

THE EASIEST way to do this is to treat the number as a string, and from the length of the string, determine where across a line printing should begin. Run the following program, and you will see that no matter how large or small the number, the computer lines the numbers up correctly.

Exit from the program by entering any letter except A.

```
10 INPUT A
20 LET A$ = STR$ INT A
30 PRINT TAB 15-LEN A$;
40 IF A = .09999 THEN PRINT " ";
50 PRINT A
60 GOTO 10
```

HELP WITH FORTH WRITING

I own a Jupiter Ace, and am gradually getting to grips with Ace Forth. However, I was wondering if there was a simple way to remember which words are in the language on board, rather than having to constantly refer back to several different pages in the manual.

*Ian King,
Pollokshields,
Glasgow.*

THE FORTH command VList will cause the Ace to fill the screen with its words. It also makes an instant demonstration of the Ace, for when you feel frustrated and think you will never be able to master the language.

FULLER EXCUSE

I ordered a Fuller FD-42 keyboard for my ZX-81 at the Computer Fair on April 24, for which £37.50 was paid. Fuller Micro systems cashed the cheque on April 29, and sent me an acknowledgement on May 1, asking me to allow them 28 days delivery. After writing them many letters and finally informing them I was preparing to take them to the Small Claims Court the keyboard arrived on July 5. It was found to be faulty within an hour. The keyboard with a letter was returned to Fuller asking for a refund. The keyboard was sent back to me with no changes to my knowledge, as it still had the same fault. Please could you help me.

*A R Weaver,
Swindon,
Wiltshire.*

I SENT FULLER a copy of your letter, asking for comments, and the reply from Keith Archer did not explain the long delay in delivery, nor did he say why he did not refund your money when you asked for it. I am not sure what the law says, but I would think that as a courtesy if nothing else, a customer unhappy with a mail-order product should be able to return it in good condition and get his money back, no questions asked. Mr Archer believes the fault displayed by your keyboard — the 8, 1, K and M keys not working — is due to an RP-2 resistor pack missing from the ZX-81. He says he has offered to replace yours free if you send your ZX-81 to him, but this you have decided not to do. I suggest you show them this answer in the magazine, and request your money back again. If you do not get it, please write to us again. ■

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

LET ME BEGIN this month by reminding you that there is now a fully-fledged Hewlett-Packard users club in the United Kingdom. Membership entitles you to the bi-monthly publication of the society, *Datafile*, which is crammed with contributions from some of the current 130 UK members. I'm glad to say that sometime contributor to this column, Frank Wales, features prominently in the articles.

Subject matter tends to vary from analysis of new HP machines like the 15C and 75C, to full explanations of synthetic programming. As expected the HP-41C figures prominently in contributed programs and not all communications are as esoteric as "I am planning to properly document a program I have recently written to design or analyse storm sewers by the Wallingford Procedure Modified Rational Method." Anyone interested in this highly-recommended club should contact: PPC-UK, Astage, Rectory Lane, Windlesham, Surrey.

I used to recite poems about the Grand Old Duke of York to help me remember resistor colour coding — those days are now gone. Not only have I forsaken electronics but Stephen Godfrey of Hayling Island has written a conversion program for colours to resistance and vice-versa for the Sharp PC-1211. Stephen adds the following space-saving tip for the PC-1211; When entering

lines which have the following format.
10 INPUT "INPUT VALUE OF X:"; X

You can save several steps by reserving the keyword INPUT to a key, say Shift-M and then entering:
10 Shift-M "Shift-M of X:"; X.

The computer then stores the word Input inside the quotes as one step which saves five as it includes a space at the end, too.

Nigel Gerdes of Dorset encloses a program which "takes the Casio FX-3500P to the limit of its programming ability!" He uses it in teaching students about communications networks, where the one sticky formula is inverse Cosh in the otherwise straightforward solution of networks. Continuing our efforts to provide useful "workhorse" programs, here is a Bessel function program for the TI-59 from L Weaver of Sussex.

Engineers and physicists who require Bessel functions for their work can often waste a great deal of time searching for sufficiently extensive tables. The attached short program for the TI-59 will calculate $J_r(x)$ to five figure accuracy for values of r between zero and 15, and x equal to or less than 6.

The basis is the recurrence relation $J_{n+1}(x) = (2n/x)J_n(x) - J_{n-1}(x)$. The trick is to realise that $J_0(x)$ tends to zero rather quickly as n increases. The program assumes that $J_{15}(x)$ and $J_{14}(x)$ are both zero, then starting

```
5 PAUSE "RESISTOR CONVERTER"
10 CLEAR :N:=SILVER:T:=GOLD:P:=BLACK:O:=BROWN:R:=RED:S:=ORANGE
20 T:=YELLOW:U:=GREEN:V:=BLUE:Y:=VIOLET:X:=GREY:W:=WHITE
25 K=1E3:M=1E6
30 PAUSE "YOU MAY FIND: PAUSE "1 - VALUES FROM COLOURS"
40 PAUSE "2 - COLOURS FROM VALUES" PAUSE "3 - END
45 INPUT "INPUT OPTION: ";A:GOTO 50
46 BEEP 1:GOTO 30
50 IF A#="1" THEN 80
60 IF A#="2" THEN 220
62 IF A#="3" THEN
65 BEEP 1:GOTO 30
80 INPUT "FIRST COLOUR: ";B#
90 INPUT "SECOND COLOUR: ";C#
100 INPUT "THIRD COLOUR: ";D#
110 FOR L=2 TO 4
120 FOR J=1 TO 25
130 IF A#(L)=A#(J):LET A(L+3)=J-16:GOTO 160
140 NEXT J
150 BEEP 1:PAUSE A#(L):" IS INVALID." :INPUT "PLEASE RE-INPUT " :A#(L):GOTO 120
160 NEXT L
170 IF (C#<0)+(C#>9.9E10) THEN 230
180 IF H#KLET I#="":GOTO 210
190 IF H#KLET I#="K":H=H/K:GOTO 210
200 H=H/M:I#="M"
210 PRINT H: " ";I: " OHMS."
220 INPUT "VALUE: ";H:IF (H>0.1)+(H<9.9E10) THEN 230
225 BEEP 1:PAUSE "INVALID DATA":GOTO 220
230 FOR J=10 TO -1 STEP -1
240 IF H>= 10:LET H=H/10:J:GOTO 270
250 NEXT J
270 D#=(A#(J+15)
280 C#=(A#(H-INT H)+10+16)
290 B#=(INT H+16)
300 PRINT B#: " ";C#: " ";D#
310 GOTO 45
```

PLEASE NOTE: VALUES MAY BE ENTERED IN THE FOLLOWING FORMS:

2200 OHMS CAN BE ENTERED AS a) 2200 or b) 2.2K BUT NOT 2K2.

4700000 OHMS CAN BE ENTERED AS a) 4700000 or b) 4.7M BUT NOT 4M7.

THE RANGE OF VALUES IS (WHERE U IS VALUE): 0.1<U<99000 MEG OHMS.

Resistor converter for Sharp PC-1211 by S Godfrey.

from these trial values all other orders down to $J_0(x)$ can be calculated. These are individually stored.

However, these values are wrong by a factor which is calculable from the fact that $J_0(x) + 2J_2(x) + 2J_4(x) + \dots = 1$. This is also computed and divided into the original value.

To use, insert x and press A. After a few seconds the calculator stops with a value in the display which must be retained. Then insert r and press B, which will print out the required $J_r(x)$.

This program can easily be adapted to other calculators, or in

fact to micros. A better accuracy can be obtained by starting with a higher original value of n than 15.

Finally we have a learning program from P Preece of Shropshire. Perhaps someone can develop the idea for more complex uses.

This program, designed for the Casio FX-180P, will test all four basic binary operations that is, addition, subtraction, multiplication, division and can suit people of different ages and help solve their difficulties in particular areas.

There is a round of questions which you have to answer. To get to the next round you must give the correct answer for a number of questions — preset by you — in a row. So getting the ninth question wrong, for example, resets your score to zero. This is best explained by the following diagram:

- a) ROUND 1
X+X=
Get answer correct for Y times in a row
ROUND 2
X+X+X=
etc.
b) SEQUENCE FOR LOADING PROGRAM
MODE 0
INV PCL Clear
INV KAC all
INV MIN memories

Press the AC key, tap the value of u then press the P1/P2 key (the program should have been loaded in P1 store). At the first Ent display tap the value of v and then the run key. At the second Ent, display the value of u , and at the third and last the value of v . Press the Run key to continue as before.

The first displayed result will be the value of v . When ready press the Run key and the final result will be the value of V .

Note. Make sure the calculator is in Mode 5 (ie radians) for the correct results. (continued on next page)

Calculation of inverse Cosh of a complex number.

Let $U \pm jV = \text{inv cosh } (u \pm jv)$

$$U = \cosh^{-1} \left\{ \frac{\sqrt{(1+u)^2 + v^2} + \sqrt{(1-u)^2 + v^2}}{2} \right\}$$

$$\pm jV = \pm j \cos^{-1} \left\{ \frac{\sqrt{(1+u)^2 + v^2} - \sqrt{(1-u)^2 + v^2}}{2} \right\}$$

Press AC, tap value of u . Press P1/P2 — having loaded program in P1 store. At first ENT display, tap value of v and Run. At second ENT, display the value of u . At final ENT, display the value of v . Press Run to continue as before.

1. +	10. Kin 1	20. =	30. INV HLT
2. 1	11. ENT	21. INV v	31. Kout 1
3. =	12. +/-	22. Kin 2	32. -
4. INV x ²	13. +	23. +	33. Kout 2
5. +	14. 1	24. Kout 1	34. =
6. ENT	15. =	25. =	35. /
7. INV x ²	16. INV x ²	26. /	36. 2
8. =	17. +	27. 2	37. =
9. INV v	18. ENT	28. =	38. INV COS
	19. INV x ²	29. INV HYP COS	

L Weaver's Bessel functions program.

```

000 76 LBL
001 11 A
002 42 STD
003 25 25
004 00 0
005 32 X:Y
006 01 1

007 05 5
008 42 STD
009 23 23
010 01 1
011 04 4
012 42 STD
013 22 22
    
```

EXAMPLE RUN
PRESS P1
"DISPLAY" DEG

5
PRESS RUN
"DISPLAY" DEG

5
PRESS RUN
RAD

0
ENTER ANSWER
IF YOU MADE A MISTAKE
PRESS C AND RE-ENTER.
PRESS RUN

DISPLAY NOTES:

DEG Indicates your previous answer was correct
ERR Indicates your previous answer was incorrect
RAD Indicates that your score is in the display

Step	Program	Comments
1	P1	Select Program Number
2	MODE 70	
3	INV RAN	Generate random number
4	INV X>K1	
5	Kin X1	
6	INV X>K1	
7	INV RND	
8	INV HLT	Stop and display number
9	+, -, x, ÷	Designate type of operations
10	Kin 5	Store pending result
11	1	Reduce counter by 1 and check if 0. If C>0 go to step 2 IF C30 continue
12	Kin -2	
13	Kout 2	
14	INV X>0	
15	1	
16	=	Finish off calculation so as not to affect the next one.
17	Kout 3	Reset counter
18	INV X>K2	
19	INV X>K4	
20	Kin 6	
21	MODE 5	Bring score into display register and store in K6 and clear K4 register
22	ENT	
23	Kin -5	
24	Kout 5	
25	MODE 6	Stop to allow user to enter answer. Subtract user answer from calculator total if 0 continue if not go to step 2.
26	INV X>0	
27	+/-	
28	INV X>0	
29	MODE 4	
30	1	Add 1 to score, if it is less than or equal to memory register go to step 2 if not continue.
31	Kin +6	
32	Kout 6	
33	Kin 4	
34	INV X M	Add 1 to counter for next round
35	Kin -4	
36	1	
37	Kin +2	
38	Kin +3	
39	INV RTN MODE	

Memories

K1 Maximum number to be displayed by calculator
K2 2 K4 0 K6 0
K3 2 K5 0
M= Number of questions to get right.

P Preece's Casio education program.

```

014 01 1
015 03 3
016 42 STD
017 21 21
018 01 1
019 42 STD
020 14 14
021 65 x
022 02 2
023 08 8
024 55 ÷
025 43 RCL
026 25 25
027 54 )
028 42 STD
029 13 13
030 01 1
031 94 +/-
032 44 SUM
033 23 23
034 44 SUM
035 22 22
036 44 SUM
037 21 21
038 73 RC*
039 22 22
040 65 x
041 02 2
042 65 x
043 43 RCL
044 22 22
045 55 ÷
046 43 RCL
047 25 25
048 54 )
049 75 -
050 73 RC*
051 23 23
052 54 )
053 72 ST*
054 21 21
055 43 RCL
056 21 21
057 67 EQ
058 79 x
059 61 GTD
060 00 00
061 30 30
062 76 LBL
063 79 x
064 43 RCL
065 00 00
066 42 STD
067 26 26
068 43 RCL
069 14 14
070 85 +
071 43 RCL
072 12 12
073 85 +

074 43 RCL
075 10 10
076 85 +
077 43 RCL
078 08 08
079 85 +
080 43 RCL
081 06 06
082 85 +
083 43 RCL
084 04 04
085 85 +
086 43 RCL
087 02 02
088 54 )
089 65 x
090 02 2
091 54 )
092 44 SUM
093 26 26
094 92 RTN
095 76 LBL
096 12 8
097 42 STD
098 27 27
099 04 4
100 04 4
101 69 DP
102 04 04
103 43 RCL
104 25 25
105 69 DP
106 06 06
107 00 0
108 01 1
109 03 3
110 05 5
111 01 1
112 06 6
113 03 3
114 05 5
115 69 DP
116 04 04
117 43 RCL
118 27 27
119 69 DP
120 06 06
121 73 RC*
122 27 27
123 55 +
124 43 RCL
125 26 26
126 54 )
127 99 PRT
128 92 RTN
129 00 0
130 00 0
131 00 0
132 00 0
133 00 0
134 00 0
    
```


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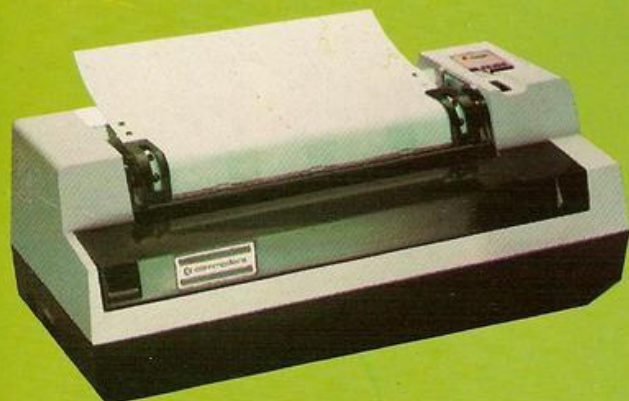
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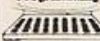
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Worry maze

Andrew Spencer,
Cape Town,
South Africa.

2X-81

THE FAST GAME in which the player weaves through a maze to defuse bombs is not only an exciting game, but shows the speed of Poke instead of Print At. It also illustrates a few handy techniques.

The first of these is the use of Boolean algebra to make the decisions in lines 140 and 450. These do away with If-Then lines and thus increase speed.

The internal walls of the maze are positioned in lines 230 to 260. The whole screen is used — line 150 — and thus the wall positions must be put within the boundaries. The same goes for the bombs and the player's piece — lines 280 and 330. Lines 290 and 340 check for boxing in of a piece or two pieces in the

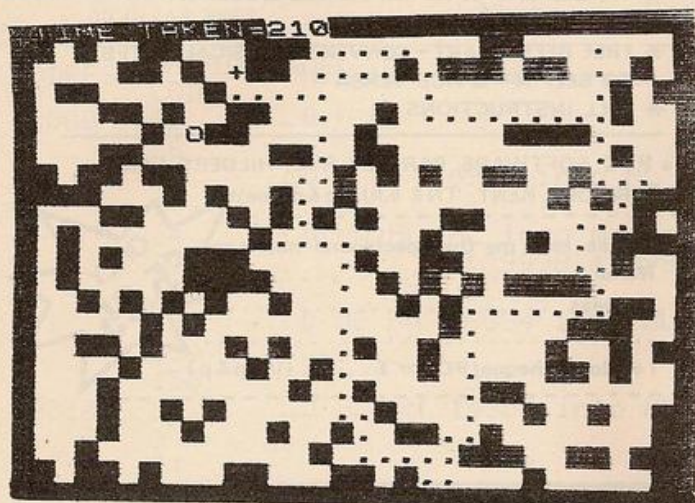
same place. B\$ tells if the bomb arrived at is the correct one. One character in B\$ is the bomb and if you reach a dud bomb it is represented by a D.

If you take too long to find the correct bomb you will explode — line 730. The full set of single-space characters is cycled through, alternating between inverse and normal.

A record is kept of the lowest time taken, and this is displayed at the end of each successful game.

The recruit mode allows you to backtrack but if you are not careful you can box yourself in on the "veteran" mode. If this does happen, pressing E will immediately put you out of your misery.

The direction-controlling keys can be changed, if desired, to suit your fingers: lines 450 and 90.



```

10 REM MAZE OF WORRY
   BY A.N. SPENCER
   AUGUST 1982
20 LET DF=PEEK 16396+256*PEEK
16397
30 LET LSF=1000
40 DIM B$(5)
50 LET T=0
60 CLS
70 REM INSTRUCTIONS
80 PRINT "WELCOME....."
   " TO THE MAZE OF WORRY"
90 PRINT AT 4,0;"MOVE YOUR PIE
   CE AROUND BY USING THE ""Z""
   C"" "" AND ""P"" KEYS"
100 PRINT "YOU MUST TRY TO DE
   FUSE THE CORRECT BOMB BEFOR
   E IT BLOWS UP"
110 PRINT "YOU ARE A :
   ,1: RECRUIT BOMB DISPOSAL OFFIC
   ER""
   ,2: VETERAN BOMB DISPOSAL
   OFFICER"
120 LET A$=INKEY$
130 IF A$<>"1" AND A$<>"2" THEN
   GOTO 120
140 LET TRAIL=27*(A$="1")+128*(
   A$="2")
150 POKE 16418,0
160 FAST
170 REM PRINT THE MAZE
180 PRINT AT 0,0;"
190 FOR N=1 TO 22
200 PRINT
210 NEXT N
220 PRINT
230 FOR N=1 TO 225
240 LET BLOCK=DF+INT (RND*22)*3
   +INT (RND*30)+35
250 POKE BLOCK,128

```

```

260 NEXT N
270 REM PLAYER POSITION
280 LET GP=DF+INT (RND*22)*33+I
   NT (RND*30)+35
290 IF PEEK (GP-33)=128 AND PEE
   K (GP+33)=128 AND PEEK (GP-1)=12
   8 AND PEEK (GP+1)=128 THEN GOTO
   280
300 POKE GP,21
310 REM BOMB POSITIONS
320 FOR N=1 TO 5
330 LET BP=DF+INT (RND*22)*33+I
   NT (RND*30)+35
340 IF (BP=GP) OR (PEEK (BP-33)
   =128 AND PEEK (BP+33)=128 AND PE
   EK (BP-1)=128 AND PEEK (BP+1)=12
   8) THEN GOTO 330
350 POKE BP,52
360 NEXT N
370 REM SET "LIVE" BOMB
380 LET B$(INT (RND*5+1))="B"
390 SLOW
400 FOR N=1 TO 50
410 NEXT N
420 REM MOVE ROUTINE
430 POKE GP,21
440 IF INKEY$="E" THEN GOTO 740
450 LET GNP=GP+(INKEY$="")*33-
   (INKEY$="P")*33+(INKEY$="C")-(IN
   KEY$="Z")
460 IF PEEK GNP=128 THEN GOTO 4
   30
470 LET T=T+2
480 IF PEEK GNP=52 THEN GOTO 53
   0
490 POKE GP,TRAIL
500 LET GP=GNP
510 IF T>450 THEN GOTO 730
520 GOTO 430
530 REM REACHED A BOMB
540 POKE GP,TRAIL
550 LET GP=GNP
560 POKE GP,21
570 LET P=INT (RND*5+1)
580 IF B$(P)=" " THEN GOTO 560
590 IF B$(P)="D" THEN GOTO 570
600 PRINT AT 0,1;"TIME TAKEN=";
   T
610 IF T<LSF THEN LET LSF=T
620 PRINT AT 23,1;"LOWEST SO FA
   R"
630 IF INKEY$<>" " THEN GOTO 630
640 IF INKEY$=" " THEN GOTO 640
650 GOTO 40
660 REM DUD BOMB
670 PRINT AT 0,1;"DUD BOMB"
680 LET B$(P)="D"
690 FOR N=1 TO 50
700 NEXT N
710 PRINT AT 0,1;"
720 GOTO 430
730 REM TIME UP,EXPLOSION
740 LET N=0
750 POKE GP,N
760 LET N=N+129

```

(continued on page 109)

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SOFTWARE FILE

(continued from page 107)

```
770 IF N>255 THEN LET N=N-256
780 IF N<>62 THEN GOTO 750
790 POKE GP,0
800 PRINT AT 23,0;"YOU HAVE FR
```

```
FILED."
810 GOTO 630
1000 REM AUTOMATIC RUN
1010 SAVE "MAZE"
1020 RUN
```

Slide show

Stewart Stallworthy,
Rickmansworth,
Hertfordshire.

SPECTRUM

THIS ROUTINE can be used to Poke to the screen any pre-defined picture or pictures. Whilst a Basic program would take approximately 60 seconds, this routine takes less than one second, and can therefore be usefully incorporated in Basic program. First draw a picture on the screen, then save it on tape —

```
SAVE "Picture" SCREEN
10 CLEAR 39997
```

```
20 FOR f=40000 TO 40048
30 INPUT a
40 POKE f,a
50 PRINT f,a
60 NEXT f
```

Run the program entering the appropriate decimal codes, and then Save on tape
SAVE "Slide" CODE 40000,48

The next step is to load the picture bytes into memory. The routine is written to look for them at memory address 40100.

```
CLEAR 39997
LOAD "Slide" CODE 40000,48
LOAD "Picture" CODE 40100,6912
```

Now type

RANDOMISE USR 40000

and all should be revealed. Each picture takes 6912 bytes, and additional pictures may be located at other memory addresses, for example 47013 and 53926. If these are used, it will be necessary to make the routine look at the correct starting address, and this is done as follows. For picture starting at memory address 47013,

```
POKE 40008,165
POKE 40009,183
```

For picture starting at memory address 53926,

```
POKE 40008,166
POKE 40009,210
```

ADDRESS	MACHINE CODE	MNEMONIC	COMMENT	ADDRESS	MACHINE CODE	MNEMONIC	COMMENT
40000	38	LD H N		5	30	LD(NN)A	POKE 39998,A
1	28			6	52		
2	46	LD L N	6912 into HL	7	156		
3	1			8	24	JR DIS	Jump to 40013
4	34	LD(NN)HL	HL into memory	9	238		
5	62		at 39998 & 39999	40030	38	LD A(NN)	A=PEEK 39999
6	156			1	63		
7	17	LD DE NN	16384 into HL	2	156		
8	164			3	71	LD B A	B=A
9	156			4	61	DEC A	
40010	33	LD HL NN	16384 into HL	5	5	DEC B	
1	0			6	40	JRZ DIS	Jump to 40048 if
2	64			7	10		
3	26	LD A (DE)	A=PEEK DE	8	30	LD(NN)A	Poke 39999,A
4	119	LD (HL)A	POKE HL,A	9	63		
5	35	INC HL		40040	156		
6	19	INC DE		1	62	LD A N	255 into A
7	38	LD A(NN)	A=PEEK 39998	2	255		
8	62			3	30	LD(NN)A	Poke 39998,A
9	156			4	62		
40020	71	LD B A	B=A	5	156		
1	61	DEC A		6	24	JR DIS	Jump to 40013
2	5	DEC B		7	221		
3	40	JRZ DIS	Jump to 40030 if B=0	8	201	RET	Back to Basic
4	5						

Sounds familiar

David Rees,
Weybridge,
Surrey.

VIC-20

IF YOU HAVE been gazing enviously all year at the BBC's Envelope command and have come home to the flat tones of a Vic-20, this program should cheer you up. It creates sounds at machine-code speed and gives an extra 11 registers for sound control.

Program 1 Pokes the machine code into memory, as the basic Vic has no assembler. Care must be taken when you type in the program, as one error in the code can cause the computer to stay in machine-code mode until you switch it off. The best method for dealing with this is to Save the program before you Run it. Then, if there is a mistake, you can load the program and check it through.

After running program 1, you can New it as

the machine code is all that is needed. It is located in the 256 bytes between 7424 and 7679, and the RAMtop has been moved down by this amount so that variables do not erase the program.

To use the command, you must first set the registers. There are 11 registers which have to be Poked to, and program 2 shows a convenient way of doing this.

The registers are as follows:
DATA S,FR(1),FR(2),FR(3),T(1),T(2),T(3),
V(1),V(2),V(3),DT

S is the voice chosen, 0 is the low sound, 1 is the medium sound, 2 is the highest sound and 3 is the white noise generator.

FR(1), FR(2) and FR(3) are the numbers that are added to the frequency of the voice chosen each cycle. If the number of the frequency rises above 255, the command wraps it around so that the value becomes 128 plus the value by which it exceeded 255. This means that if you want the command to play several scales of notes there will be no gap

in sound once the top of the scale is reached. The number that can be stored in these registers lies between 0 and 255.

T(1), T(2) and T(3) are the number of cycles through which the registers of each of the three parts are added to the sound and volume chosen. Again, the range of values lies between 0 and 255.

V(1), V(2) and V(3) are the numbers which change the volume of the sound each cycle. If 16 is Poked in here, volume does not change. A number lower than 16 lowers the volume, and a number greater than 16 raises it. The effective number can be calculated using 16-V(n).

DT is the delay time after each cycle is completed and can be between 0 and 255, with 0 having a delay time of 0.1ms. and the other numbers are measured in the computer in increments of 0.5ms.

If this seems complicated, program 3 gives the Basic equivalent of the main routine. You

(continued on next page)

SOFTWARE FILE

(continued from previous page)

can also use this routine to demonstrate how much faster machine code is compared with Basic. Now all you have to do is type in SYS 7424 and the command will start. The registers will not change so SYS 7424 can be used any-

where and as many times as you want in a program. Registers can also be Poked individually so you can change a sound quickly.

You are now ready to create your own sound effects. The main advantage of this command is its speed. Basic cannot run faster than when

30 is Poked into the DT register. Lower numbers down to 5 can create fast, smooth sounds. When DT is 4 or less, sounds merge. These speeds are the most useful as you can mix tones and volume to create your own wave forms.

```
5 REM***PROGRAM 1***
10 POKE 51,255:POKE 52,28:POKE 55,255:POKE 56,28
20 FOR N=0 TO 152
30 READ A
40 POKE 7424+N,A
50 NEXT
60 DATA 24,173,252,29,41,31,141,252,29
70 DATA 173,253,29,41,31,141,253,29
80 DATA 173,254,29,41,31,141,254,29
90 DATA 173,245,29,41,31,141,245,29
100 DATA 169,10,133,1,169,144,133,2,169,0
110 DATA 141,241,29,141,242,29,169,246
120 DATA 133,251,169,29,133,252
130 DATA 172,245,29,177,1,172,241,29,24,113,251
140 DATA 144,3,24,105,128,24,172,245,29
150 DATA 145,1,172,241,29,200,200,200
160 DATA 238,242,29,200,200,200,177,251
170 DATA 24,109,14,144,233,15,24,184
180 DATA 141,14,144,172,255,29,192,0,240,8
190 DATA 162,120,202,208,253,136,208,248
200 DATA 172,241,29,200,200,200,177,251
210 DATA 205,242,29,208,181,238,241,29
220 DATA 169,3,205,241,29,208,6,169,0
230 DATA 141,241,29,96,169,0,76,46,29
```

```
999 REM***PROGRAM 2***
1000 FOR N = 0 TO 10:READ A:POKE 7669+N,A:NEXT N
1010 DATA 2,2,0,191,1,211,224,30,16,24,2
1020 SYS 7424:POKE 36876,0
```

```
99 REM***PROGRAM 3***
100 FOR A = 1 TO 3
110 FOR B = 1 TO T(A)
120 F = PEEK(36874 + S)+FR(A)
130 POKE 36874+S,(F AND 127)+128
140 V=PEEK(36878)-16+V(A)
150 POKE 36878,V AND 255
160 FOR T=0 TO DT:NEXT
```

TABLE 1

position	variable	range	function
7669	S	0-3	Voice choice(36874+S)
7670	FR(1)		Frequency + FR(n)
7671	FR(2)	0-255	each cycle
7672	FR(3)		
7673	T(1)		Number
7674	T(2)	0-255	of
7675	T(3)		cycles
7676	V(1)		Volume-16+V(n)
7677	V(2)	0-31	each
7678	V(3)		cycle
7679	DT	0-255	Delay time each cycle

EXAMPLES:

Helicopter

```
1010 DATA 0,2,4,1,8,8,200,30,15,15,1
1020 FOR N=0 TO 70:POKE 36874,240-N:SYS 7424:
NEXT:POKE 36874,0
```

Laser Gun

```
1010 DATA 2,2,4,1,8,8,200,30,16,0,2
1020 POKE 36876,99:POKE 36878,15:SYS 7424
```

Footsteps(walking)

```
1010 DATA 2,6,0,0,8,8,200,18,16,16,2
1020 POKE 36878,0:FOR N=0 TO 10:SYS 7424:NEXT
For running,use 1 as last number in data
```

Echo

```
1010 DATA 2,0,127,1,0,8,9,16,16,16,0
1020 FOR N=0 TO 9:POKE 36876,225
1030 FOR A=0 TO 28:SYS 7424
1040 NEXT A,N
```

Field-gun

B Pearce,
Bath,
Avon.

BBC

THIS PROGRAM has been written for the BBC Model A Micro and uses almost all the available memory. Although it uses procedures which are, I believe, peculiar to the BBC Micro, there is no reason why it should not be adapted for Basic on other micros.

The game is for two players. There are two horizontal blocks representing a plain and a plateau, separated by mountains. The form of the mountains and the height of the plateau are both random, and the plateau may be right or left of the screen. Sited at a random position on the plain is a gun position, and another on the plateau. At the top of the screen a cross wind is specified, random left or right, random strength five to 40 mph in steps of 5 mph.

Player to start is specified, random left or right. The player is required to enter the gun elevation angle, which will be any angle between one to 90°, followed by muzzle velocity — any number from 1 to 20. On the second return his gun fires a shell along the correct trajectory taking account of the effect of the wind. Each player fires in turn until one hits the others gun, when there is a flash and a bang. During the exchange, previous elevation and velocity settings are listed at each side of the screen for reference.

```
>L.L.
10REM "FIELD-GUN" by B.Pearce
20*TV255,1
30CLEAR:CLS:MODE4:VDU19,1,3,0:DIMA1(4):A%=32+4*RND(96):B%=832+4*RND(96):C%=256+4*RND(32)
40D%=INT(16*(RND(1)-0.5))*5:IFD%=0THEN40
50EX=2:FX=2:GX=RND(2):HX=1:IX=SGN(RND(1)-0.5):IFIX=1THEN80
60PROCFLAT(0,96,128,448):PROCSLOPE(448,1,832):PROCFLAT(832,96,C%,1280)
70MOVEAX,128:PROCFORT:MOVEBX,CX:PROCFORT:GOTO100
80PROCFLAT(1280,96,128,832):PROCSLOPE(832,-1,448):PROCFLAT(448,96,C%,0)
90MOVEAX,CX:PROCFORT:MOVEBX,128:PROCFORT
100PRINTTAB(1,1):"E V":PRINTTAB(33,1):"E V":IFD%>1THEN120
110PRINTTAB(12,1):"<- Wind ":-1*D%:" mph":GOTO130
120PRINTTAB(12,1):"Wind ":+D%:" mph ->"
130G%=3-GX:IFGX=2THEN150
140EX=EX+1:GOTO160
150FX=FX+1
160HX=HX+1:IFHX=2THEN170ELSE180
170IFGX=2THENPRINTTAB(35,10):"RIGHT":TAB(35,11):"FIRES":TAB(35,12):"FIRST"ELSEPRINTTAB(0,10):"
LEFT":FIRES":FIRST"
180IFHX=3THENPRINTTAB(0,10):"
"
190INPUTTAB(8,4)"Elevation (1-90) = "J%:IFJ%<10RJ%>90THEN190
200IFGX=2THEN220
210PRINTTAB(0,EX):J%:GOTO230
220PRINTTAB(32,FX):J%
230PRINTTAB(8,4):"
"
240INPUTTAB(8,8)"Velocity (1-20) = "K%:IFK%<10RK%>20THEN240
250IFGX=2THEN270
260PRINTTAB(3,EX):K%:GOTO280
270PRINTTAB(35,FX):K%
280PRINTTAB(8,8):"
"
290IFGX=2THEN330
300IFIX=1THEN320
310MOVEAX,128:PROCSHOT(1,A%,128)
320MOVEAX,CX:PROCSHOT(1,A%,CX)
330IFIX=1THEN350
340MOVEBX,CX:PROCSHOT(-1,B%,CX)
350MOVEBX,128:PROCSHOT(-1,B%,128)
360IFGX=2THEN380
370IFAX>BX-16ANDAX<BX+16THEN390ELSE130
380IFAX>AX-16ANDAX<AX+16THEN390ELSE130
390PROCSOUND:PROCBANG:TIME=0:REPEAT:UNTILTIME=200:PRINTTAB(4,30):"Press SPACE BAR for another
game":C=GET:IFC=32THEN30
400DEFPROCFLAT(K,L,M,N):MOVEK,L:PLOT5,K,M:PLOT85,N,L:PLOT85,N,M:ENDPROC
410DEFPROCSLOPE(O,P,Q):FORR=1TO5:S%=0+64*P*R:T%=128+(CX-128)*R/5+(RND(128)-64)*R/2:PLOT85,S%,9
```


SOFTWARE FILE

```
6:PLOT85,S%,T%:NEXT:PLOT85,Q,96:PLOT85,Q,C%:ENDPROC
420DEFPROC FORT:PLOT65,-16,0:PLOT65,8,16:PLOT81,8,-16:ENDPROC
430DEFPROC SHOT(U,V,W):X=6*COS(RAD(J%))*K:Y=6*SIN(RAD(J%))*K:Z=1:REPEAT:a%=U*X*Z+D%*Z^2/100+V:b
%=Y*Z-Z^2/0.48+W:A1(2)=A1(1):A1(1)=a%:A1(4)=A1(3):A1(3)=b%:IFPOINT(a%,b%)<>0ANDb%<512THEN360
440PLOT69,a%,b%:PLOT71,A1(2),A1(4):Z=Z+0.5:UNTILb%<120:ENDPROC
450DEFPROC BANG:PLOT1,-64,64:PLOT81,48,-32:PLOT1,-8,32:PLOT81,24,-32:PLOT1,32,96:PLOT81,-8,-64:
PLOT1,24,8:PLOT81,-48,-72:ENDPROC
460DEFPROC SOUND:SOUND0,1,6,60:ENVELOPE1,5,0,0,0,0,0,30,-2,-5,-5,120,80:ENDPROC
>VDU1
```

Acorn pilot

Roy Pincott,
Mansfield,
Nottinghamshire.

ATOM

THIS FLIGHT simulation program, written for the Acorn Atom, gives you a pilot's eye view of aerobatic manoeuvres.

Use this Basic program to learn to fly the plane as though you were sitting inside it. The program has the facility to enable the user

to perform victory rolls, loop the loop and fly upside down. A word of advice. It is necessary to remember which direction you are flying — towards or away from the screen — as this has a fundamental effect on the way the plane banks.

```
10GOS.1000
15DIMR(7)
22G=£1740
25S=£8000
100CLEAR4
101H=17;GOS.144
104GOS.a
120IF H=1;GOS.c;G=£100;GOS.2010
121IF H=2;GOS.c;GOS.2020
122IF H=3;GOS.c;G=£100;GOS.2030
123IF H=5;GOS.c;G=£100;GOS.2050
124IF H=6;GOS.c;GOS.2060
125IF H=7;GOS.c;G=£100;GOS.2070
128IF H=20;GOS.c;GOS.2200
129IF H=24;GOS.c;GOS.2240
130IF H=4;GOS.c;G=£200;GOS.2040
132IF H=8;GOS.c;G=£200;GOS.2080
134IF H=18;GOS.c;G=£200;GOS.2180
136IF H=22;GOS.c;G=£200;GOS.2220
140IF H=10;GOS.c;G=£1;GOS.2100
142IF H=14;GOS.c;G=£1;GOS.2140
144IF H=17;GOS.c;G=£FF;GOS.2170
146IF H=23;GOS.c;G=£FF;GOS.2230
150IF H=12;GOS.c;G=£1;GOS.2120
152IF H=16;GOS.c;G=£1;GOS.2160
154IF H=19;GOS.c;G=£101;GOS.2190
156IF H=21;GOS.c;G=£101;GOS.2210
160IF H=9;GOS.c;G=£20;GOS.2090
162IF H=11;GOS.c;G=£20;GOS.2110
164IF H=13;GOS.c;G=£20;GOS.2130
166IF H=15;GOS.c;G=£20;GOS.2150
295IF S+G<£8000;G.m
296IF S+G>£98FF;G.m
300F.B=1T05;?£B000=?£B000 &£F0 +B
310B?£7F=?£B001 &B;N.B
330IF ?£B1=0;GOS.d
340IF ?£B2=0;GOS.e
350IF ?£B3=0;GOS.f
360IF ?£B4=0;GOS.g
999G.120
1000CLEAR0
1010P.$12''
1020P." pilot """" BY roy pincott""""
1100P."C BANK LEFT B BANK RIGHT""
1110P."E NOSE DOWN D NOSE UP""""
1200LINK £FFE3
1999R.
2010GOS.c;!R=£18E70000;R!4=£000000;H=1;GOS.a;R.
2020GOS.c;!R=£003C7EC3;R!4=£000018;H=2;GOS.a;R.
2030GOS.c;!R=£E7180000;R!4=£000000;H=3;GOS.a;R.
2040GOS.c;!R=£7E3C0018;R!4=£0000C3;H=4;GOS.a;R.
2050GOS.c;!R=£18E70000;R!4=£000000;H=5;GOS.a;R.
2060GOS.c;!R=£003C7EC3;R!4=£000018;H=6;GOS.a;R.
2070GOS.c;!R=£E7180000;R!4=£000000;H=7;GOS.a;R.
2080GOS.c;!R=£7E3C0018;R!4=£0000C3;H=8;GOS.a;R.
2090GOS.c;!R=£18040606;R!4=£060604;H=9;GOS.a;R.
2100GOS.c;!R=£7B7B70E0;R!4=£00E070;H=10;GOS.a;R.
2110GOS.c;!R=£06081818;R!4=£181808;H=11;GOS.a;R.
2120GOS.c;!R=£DEDE0E07;R!4=£00070E;H=12;GOS.a;R.
2130GOS.c;!R=£18040606;R!4=£060604;H=13;GOS.a;R.
2140GOS.c;!R=£7B7B70E0;R!4=£00E070;H=14;GOS.a;R.
2150GOS.c;!R=£06081818;R!4=£181808;H=15;GOS.a;R.
2160GOS.c;!R=£DEDE0E07;R!4=£00070E;H=16;GOS.a;R.
2170GOS.c;!R=£7B60C000;R!4=£000000;H=17;GOS.a;R.
2180GOS.c;!R=£18180018;R!4=£605838;H=18;GOS.a;R.
2190GOS.c;!R=£0306DE00;R!4=£000000;H=19;GOS.a;R.
2200GOS.c;!R=£181C1A06;R!4=£180018;H=20;GOS.a;R.
2210GOS.c;!R=£DE060300;R!4=£000000;H=21;GOS.a;R.
2220GOS.c;!R=£18180018;R!4=£061A1C;H=22;GOS.a;R.
2230GOS.c;!R=£C0607B00;R!4=£000000;H=23;GOS.a;R.
2240GOS.c;!R=£18385860;R!4=£180018;H=24;GOS.a;R.
```

(continued on page 113)

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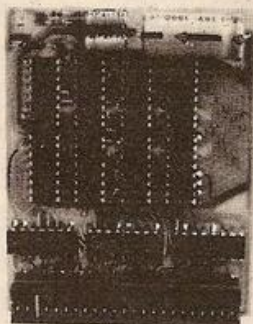
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(continued from page 111)

```

4000d1F H=1;60S.2020;R.
40021F H=2;60S.2030;R.
40041F H=3;60S.2040;R.
40061F H=4;60S.2010;R.
40081F H=5;60S.2060;R.
40101F H=6;60S.2070;R.
40121F H=7;60S.2080;R.
40141F H=8;60S.2050;R.
40161F H=9;60S.2120;R.
40181F H=10;60S.2090;R.
40201F H=11;60S.2100;R.
40221F H=12;60S.2110;R.
40231F H=13;60S.2160;R.
40241F H=14;60S.2130;R.
40261F H=15;60S.2140;R.
40271F H=16;60S.2150;R.
40281F H=17;6=6-£100;60S.2200;R.
40301F H=18;60S.2170;R.
40321F H=19;60S.2180;R.
40341F H=20;60S.2190;R.
40361F H=21;60S.2240;R.
40381F H=22;60S.2210;R.
40401F H=23;60S.2220;R.
40421F H=24;60S.2230;R.
4050R.
5000e1F H=1;60S.2040;R.
50021F H=2;60S.2010;R.
50041F H=3;60S.2020;R.
50061F H=4;60S.2030;R.
50081F H=5;60S.2080;R.
50101F H=6;60S.2050;R.
50121F H=7;60S.2060;R.
50141F H=8;60S.2070;R.
50161F H=9;60S.2100;R.
50181F H=10;60S.2110;R.
50201F H=11;60S.2120;R.
50221F H=12;60S.2090;R.
50231F H=13;60S.2140;R.
50241F H=14;60S.2150;R.
50261F H=15;60S.2160;R.
50271F H=16;60S.2130;R.
50281F H=17;6=6-£100;60S.2180;R.
50301F H=18;60S.2190;R.
50321F H=19;60S.2200;R.
50341F H=20;60S.2170;R.
50361F H=21;60S.2220;R.
50381F H=22;60S.2230;R.
50401F H=23;60S.2240;R.
50421F H=24;60S.2210;R.
5050R.
6000f1F H=1;60S.2150;R.
60021F H=2;60S.2240;R.
60041F H=3;60S.2110;R.
60061F H=4;60S.c;6=6-£200;60S.2180;R.
60081F H=5;60S.2130;R.
60101F H=6;60S.2200;R.
60121F H=7;60S.2090;R.
60141F H=8;60S.c;6=6-£200;60S.2220;R.
60161F H=9;60S.2010;R.
60181F H=10;60S.2170;R.
60201F H=11;60S.2050;R.
60221F H=12;60S.2210;R.
60231F H=13;60S.2030;R.
60241F H=14;60S.2230;R.
60261F H=15;60S.2070;R.
60271F H=16;60S.2190;R.
60281F H=17;60S.2140;R.
60301F H=18;60S.c;6=6-£200;60S.2080;R.
60321F H=19;60S.2120;R.
60341F H=20;60S.2020;R.
60361F H=21;60S.2160;R.
60381F H=22;60S.c;6=6-£200;60S.2040;R.
60401F H=23;60S.2100;R.
60421F H=24;60S.2060;R.
6050R.
7000g1F H=1;60S.2090;R.
70021F H=2;60S.2200;R.
70041F H=3;60S.2130;R.
70061F H=4;60S.c;6=6-£200;60S.2220;R.
70081F H=5;60S.2110;R.
70101F H=6;60S.2240;R.
70121F H=7;60S.2150;R.
70141F H=8;60S.c;6=6-£200;60S.2180;R.
70161F H=9;60S.2070;R.
70181F H=10;60S.2230;R.
70201F H=11;60S.2030;R.
70221F H=12;60S.2190;R.
70231F H=13;60S.2050;R.
70241F H=14;60S.2170;R.
70261F H=15;60S.2010;R.
70271F H=16;60S.2210;R.
70281F H=17;60S.2100;R.
70301F H=18;60S.c;6=6-£200;60S.2040;R.
70321F H=19;60S.2160;R.
70341F H=20;60S.2060;R.
70361F H=21;60S.2120;R.
70381F H=22;60S.c;6=6-£200;60S.2080;R.
70401F H=23;60S.2140;R.
70421F H=24;60S.2020;R.
8000aF.V=0T07;S?6=R?V;6=6+32;N.V;R.
8010bF.V=0T07;S?H=R?V;H=H+32;N.V;R.
8100c!R=£00000000;R!4=£000000;H=6-£120;60S.b
8110R.
8200mCLEAR0;P.$12;P."you crashed"
9999LINK £FFE3;6.15

```

Accelerator

Bob Boffin,
Woking,
Surrey.

DRAGON

DRAGON OWNERS may be interested in this simple way to speed up their Basic programs.

The technique uses the ability of the Motorola 6809E microprocessor to run in three different modes. The first mode uses a clock rate of 0.9 MHz and is the one used by the Dragon by default. The second mode uses a clock rate of 1.8 MHz but the processor does not output addresses for the video chip so no display is produced, hence this mode is not very useful. It is the third mode which is of interest. In this mode the processor runs at either 0.9 MHz or 1.8 MHz, depending on the address being accessed. Addresses in the range 0000-7FFF hexadecimal or FF00-FF1F hexadecimal are accessed at 0.9 MHz. All other addresses are accessed at 1.8 MHz.

Since the Basic interpreter is located starting at address 8000 hex, if dual rate is selected it will run at 1.8 MHz except when it is accessing RAM. This gives a very significant improvement in Basic performance.

Selection of the processor mode is simple.

POKE &HFFD7,0 will switch dual rate on
POKE &HFFD6,0 will switch dual rate off

Pressing the Reset button on the side of the Dragon will also Reset the processor mode to normal. Any value may be Poked. It is the act of writing to the location which toggles the switch. If you Peek at these locations they always return the same result.

When you try this on your Dragon the first thing you will notice is that the cursor blinks very much faster. This is an easy way to tell which mode you are in.

A few simple benchmarks will show that the Dragon is now running appreciably faster. The biggest improvement will be found in number-crunching programs where most of the accesses will be at the faster rate. These can show up to 70 percent improvement.

There are some side-effects to using the dual rate. The notes produced by the Sound command will be about an octave higher. Do not use CLoad, CSave or any commands which use the cassette interface while in dual rate as the port address used is accessed at the higher rate. You can switch between the two rates within your Basic program if necessary.

Array sort

Alan Stevens,
Alvaston,
Derbyshire.

MZ-80K

THIS BASIC listing of the Quicksort algorithm is for sorting an array, A(x), of elements, x, into order. The first part of the program simply generates 100 random numbers for the sort routine to work on. The sort subroutine itself consists of lines 1000-1130.

One of the interesting features of the program is that the sort subroutine calls itself recursively — a feature widely regarded as being not possible in Basic.

Those who believe that recursion is not possible in Basic are perhaps being confused by the fact that Basic does not support local variables — recursion is generally much more useful when local variables are available within the subroutine. The other interesting feature of my program, therefore, is the simulation of local variables by the use of subscripted variables. The subscript, S, is increased by one at each entry to the subroutine, and decreased by one at each exit.

(continued on next page)

SOFTWARE FILE

(continued from previous page)

The program takes about 17 seconds to sort 100 random numbers, about 13 seconds for 100 numbers in reverse order.

The number of nested subroutines required depends on the ordering of the elements in, and the size of the array. For 100 randomly arranged numbers the average number of nested subroutines is 12 — found from experience, though occasionally, as many as 15 are needed.

The MZ-80K allows 15 nested subroutines, which is why arrays L(S) and HI(S) are Dimensioned as shown in line 20. The program may be simply modified for machines which support M nested subroutines by Dimensioning L(M+1) and HI(M+1).

If 15 (or M) nested subroutines are not sufficient, the following lines may be added to the program to extend its range:

```
105 F=0
165 IF F=1 THEN 100
1005 IF S>15 THEN F=1
1006 IF F=1 THEN 1130
```

These lines effectively reinitialise the sort which restarts with an already partly sorted array.

Blitz

Shingo Sugiura,
Tokyo,
Japan.

BBC

THIS PROGRAM is for the BBC Micro model B. It is similar to the Vic-20 game Blitz, although there are a few extras in this imple-

```
10 REM N=NUMBER of ELEMENTS TO BE SORTED:N=100
20 DIM L(16),HI(16),A(N)
30 REM GENERATE AND PRINT N RANDOM INTEGERS
40 FOR R=1 TO N
50 A(R)=INT(N*RND(1))
60 PRINT A(R);
70 NEXT R
80 PRINT:PRINT
90 REM SET INITIAL CONDITIONS AND CALL QUICKSORT
100 LO=1:HI(1)=N:S=0
110 GOSUB 1000
120 REM PRINT SORTED ARRAY
130 FOR R=1 TO N
140 PRINT A(R);
150 NEXT R
160 PRINT
170 END
900 REM QUICKSORT SUBROUTINE
1000 S=S+1
1010 L=LO:HI=HI(S)
1020 M=(L+HI)/2
1030 IF A(L)<M THEN L=L+1:GOTO 1030
1040 IF A(HI)>M THEN HI=HI-1:GOTO 1040
1050 IF L>HI THEN 1100
1060 T=A(L):A(L)=A(HI):A(HI)=T
1070 L=L+1:HI=HI-1
1080 GOTO 1030
1090 REM SET CONDITIONMS AND RECALL QUICKSORT IF NECESSARY
1100 L(S)=L
1110 IF LO<HI THEN HI(S+1)=HI:GOSUB 1000
1120 IF HI(S)>L(S) THEN LO=L(S):HI(S+1)=HI(S):GOSUB 1000
1130 S=S-1:RETURN
```

mentation. You are in control of an aeroplane rapidly losing altitude. Below you are skyscrapers which you must bomb and flatten enough to land. It plays a nice little tune when

you succeed but when you crash the effect is spectacular. If you find the game too fast or too slow, change the speed value given in line 350.

```
30 SETS F0 KEY
40~140 DEFINES CHARACTERS
150 SOUND FOR BOMBING
160,170 INSTRUCTIONS
180 DEFINES BOMB#
190~300 SET SCREEN
310 INITIALISE STRINGS AND VARIABLES
320 TESTS FOR SPACE BAR
330 PRINTS AEROPLANE
340 CHECK IF PLANE HAS LANDED
350 SLOW DOWN THE PLANE
360 CHECKS IF PLANE HAS CRASHED
370 CALCULATES PLANE'S NEXT POSITION
380 SEE IF BOMB IS ON THE SCREEN
390 PRINT BOMB
400 SEE IF BOMB HAS HIT BUILDINGS
410 EMPTY KEYBOARD BUFFER
420 GOTO320
430~550 INSTRUCTIONS PROCEDURE
560~600 CRASHING PROCEDURE
610~630 BOMB PROCEDURE
640~660 DESTRUCTING PROCEDURE
670~720 INITIALISING STRINGS AND VARIABLES
730~740 POSITION CALCULATING PROCEDURE
750~790 LAND PROCEDURE
800~870 SMASHING PROCEDURE
```

```
10 REM BLITZ
20 REM (C) SHINGO SUGIURA
30 *KEY0"RUNIM"
40 VDU23,224,90,126,90,126,90,126,90,126
50 VDU23,225,90,126,90,90,126,90,90,126
60 VDU23,226,102,126,102,126,102,126,102,126
70 VDU23,227,0,0,24,24,36,126,90,126
80 VDU23,228,60,60,24,24,60,90,126,90
90 VDU23,229,24,24,24,24,60,126,102,126
100 VDU23,230,0,32,112,248,252,127,63,0
110 VDU23,231,0,0,0,1,241,255,253,1
120 VDU23,232,126,60,24,60,126,126,60,24
130 VDU23,233,32,124,254,127,63,31,31,31
140 VDU23,234,0,8,4,102,249,248,252,252
150 ENVELOPE1,1,11,-6,1,10,30,60,127,0,0,-127,126,0
160 MODE7
170 PROCINSTRUCTIONS
180 IF DL=1 THEN DESTRUCT#=" "+CHR$(10)+CHR$(8)+" " ELSE DESTRUCT#=" "+CHR$(10)
+CHR$(8)+" "+CHR$(10)+CHR$(8)+" "
190 MODE2
200 COLOUR134:CLS
210 VDU23,10,32,0,0,0;
220 FOR BUILD%=2 TO 18
230 COLOUR0
240 A=RND(3)+223
250 FOR HEIGHT%=29 TO RND(C*4)+(20-C*2) STEP-1
260 PRINT TAB(BUILD%,HEIGHT%);CHR$(A)
270 NEXT HEIGHT%
280 PRINTTAB(BUILD%,HEIGHT%+1);CHR$(A+3)
290 SOUND1,-15,RND(200),1
300 NEXT BUILD%
310 PROCINIT
320 FIRE#INKEY#(0):IF FIRE#="" THEN PROCBOMB
330 COLOUR1:PRINTTAB(X,Y);AERO#SOUND0,-5,100,2
340 VDU26:IF POINT((X+2)*64+32,(30-Y)*32)=0 AND POINT((X+3)*64+32,(30-Y)*32)=0
AND POINT((X+4)*64+32,(30-Y)*32)=0 THEN PROCLAND
350 FOR SPEED=1 TO 80:NEXT SPEED
360 IF POINT((X+4)*64+32,(31-Y)*32)=0 THEN PROCCRASH:PROCDROP
370 PROCMOVE
380 IF FIRE=0 THEN 320
390 COLOUR3:PRINTTAB(XB,YB);BOMB#
400 YB=YB+1:IF YB>28 OR POINT(XB*64+32,(30-YB)*32)=0 THEN PROCDESTRUCT ELSE 3
30
410 *FX15.0
420 GOTO320
430 DEFPROCINSTRUCTIONS
440 PRINTTAB(13,10);CHR$(141);CHR$(132);"BLITZ"
450 PRINTTAB(13,11);CHR$(141);CHR$(132);"BLITZ"
460 PRINTTAB(2,13);CHR$(135);"YOU MUST DESTROY THE BUILDINGS FLAT"
470 PRINTTAB(3,14);CHR$(135);"ENOUGH TO LAND YOUR AEROPLANE"
480 PRINTTAB(5,18);CHR$(135);"PRESS SPACE BAR TO DROP BOMB"
```


SOFTWARE FILE

```

490 INPUT"      INPUT DESTRUCT LEVEL(1 TO 2)";DL
500 IF DL<1 OR DL>2 THEN 490
510 INPUT"      INPUT DIFFICULTY LEVEL(1 TO 5)";C
520 IF C<1 OR C>5 THEN 510
530 PRINT TAB(5,21);"PRESS F0 TO RESTART"
540 PRINTTAB(5,22);"PRESS ANY KEY TO START":ST#=GET#
550 ENDPROC
560 DEFPROC CRASH:SOUND0,-15,100,18
570 FOR CRASH=1 TO 10
580 FOR RIGHT=1 TO 10:VDU23;13,RIGHT,0;0;0;:NEXT RIGHT
590 FOR LEFT=10 TO 1 STEP-1:VDU23;13,LEFT,0;0;0;:NEXTLEFT
600 NEXT CRASH:ENDPROC
610 DEFPROC BOMB
620 FIRE=1:XB=X+2:YB=Y:IF XB>=20 THEN PROCDESTRUCT
630 ENDPROC
640 DEFPROCDESTRUCT
650 SOUND1,1,100,2:FIRE=0:PRINTTAB(XB,YB);DESTRUCT#:SOUND0,-5,100,2
660 ENDPROC
670 DEFPROCINIT:X=1:Y=3:FIRE=0
680 BOMB#="" "+CHR#10+CHR#8+CHR#232
690 AERO#="" "+" "+CHR#230+CHR#231
700 DROPT#="" "+CHR#10+CHR#8+CHR#233
710 DROPT#="" "+CHR#10+CHR#8+CHR#234
720 ENDPROC
730 DEFPROC MOVE:X=X+1:IF X>=20 THEN X=0:Y=Y+1
740 ENDPROC
750 DEFPROC LAND
760 PRINTTAB(1,2);"WELL DONE":RESTORE780:FOR MUSIC=1 TO 10:READ A,B
770 SOUND2,-10,A,B:NEXTMUSIC:END:ENDPROC
780 DATA129,10,117,5,121,5,129,10,101,10
790 DATA121,5,129,5,137,5,145,5,149,5
800 DEFPROC DROP:X=X+2:XDT=X+3:YD=Y-2:YDT=Y-2
810 FOR DELAY=1 TO 300:NEXT DELAY
820 YD=YD+1:PRINTTAB(XD,YD);DROPT#
830 VDU26
840 IF POINT(XD*64+32,(29-YD)*32)=0 OR YD>=28 THEN 850 ELSE 820
850 YDT=YDT+1:PRINTTAB(XDT,YDT);DROPT#
860 VDU26
870 IF POINT(XDT*64+32,(29-YDT)*32)=0 OR YDT>=28 THEN END ELSE 850:ENDPROC

```

Quick copy

Peter Hintjens,
Edinburgh.

VIC-20

THIS BASIC program will load into a chosen area of memory a routine that, whenever Ctrl P is pressed, will produce a quick copy of the Vic screen.

The machine-code routine becomes part of the system interrupt — IRQ — and is called 60 times a second when it can look at the keyboard and take whatever action is necessary.

Enter, check and Save the program, then Run it. At the start you will be asked where the code should go. Normally this will be at the top of memory, but in some cases, for example when using machine code that needs this area, you will want to specify somewhere else. In the first case the program will lower the memory pointers to protect the code, but if you specify a location you must protect it as necessary. A useful free area of memory is the

3K expansion block, if both a 3K and 8K or 16K expansion are fitted.

As the program loads the machine-code data, you may get a number of error messages of the form

?DATA ERROR IN

showing that that data line has been incorrectly entered. If the check sum at the end of each data line fails to pick up the error, the total count — TT — should catch it. When any data error is found, a flag ER is set and the program continues, perhaps to find more errors. After the load, if ER is set then the run is aborted and the memory pointers restored to their initial value, line 570.

As the program is relocatable, certain values must be altered to suit its start — specifically the start of the IRQ wedge. The screen page is also Poked into the routine so that the code will run in any memory size.

When the data has been loaded and assuming that there have been no errors, you will be told the actual start of the routine.

Make a note of this number because to prime the code you must type: SYS, then the start address, then press Return. Pressing Stop/Restore will stop the effect of CtrlP.

You can alter the printing parameters — normally double-width and minimum line feed — by the following Pokes:

POKE (START)+99, 15:
POKE (START)+176, 15

for single-width printing and

POKE (START)+161, 15

for normal line feeds, useful when dealing only with screens of text. The machine-code routine will automatically print in upper or lower case as set by the shift keys.

Once you have the program working you may take out the data checks — remove the ninth data byte of each line and change lines as follows. 310 to 460 replaced by:

```

310 FOR J = 0 TO 207
320 READ DA:POKE PO + J, DA
330 NEXT J

```

Lines 540 to 570 would be deleted.

```

10 REM** VIC SCREEN DUMP **
20 REM** BY **
30 REM** P. HINTJENS **
40 REM
50 REM
60 M1 = PEEK (56): M2 = PEEK (55): REM** INITIAL MEMORY POINTERS
70 REM
80 REM** GET CODE START
90 REM
100 PRINT "WHERE SHOULD THE CODE RESIDE ?"

```

```

110 PRINT "M1 - TOP-OF-MEMORY"
120 PRINT "M2 - SOMEWHERE ELSE"
130 PRINT "CHOICE ?"
140 GET A$:IF A$ = "2" GOTO 240
150 IF A$ <> "1" GOTO 140
160 REM
170 REM** DEALLOCATE TOP OF MEMORY BY 256 BYTES
180 REM
190 PO = 256 * M1 + M2 - 256:POKE 56, M1 - 1:POKE 52, M1 - 1
200 PRINT "J":GOTO 270

```

(continued on page 117)

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SOFTWARE FILE

(continued from page 115)

```

210 REM
220 REM** USER CHOOSES LOCATION FOR CODE
230 REM
240 PRINT "ALLOW 208 BYTES FOR CODE."
250 INPUT "START POSITION"; PO: PO = INT (ABS (PO))
260 PRINT "PLEASE PROTECT MEMORY AS REQUIRED."
270 PRINT "START OF CODE =" PO
280 REM
290 REM** LOAD CODE INTO 208 BYTE BLOCK STARTING AT 'PO'
300 REM
310 TT = 0: REM** CHECK TOTAL FOR ALL DATA
320 FOR LINE = 0 TO 25: REM** SPLIT DATA INTO LINES FOR CHECKING
330 CS = 0: REM** CHECKSUM FOR DATA LINE
340 FOR J = 0 TO 7: READ DA: CS = CS + DA
350 POKE PO + LI * 8 + J, DA
360 NEXT J: TT = TT + CS
370 CS = CS AND 255: REM** CHECKSUM MOD 256
380 READ DA: TT = TT + DA
390 REM
400 REM** IS THE LINE OKAY? (LOCATIONS 63-64 HOLD DATA LINE NUMBER)
410 REM
420 IF CS <> DA THEN PRINT "DATA ERROR IN"PEEK (63) + 256
  * PEEK (64): ER = 1
430 REM** DON'T STOP AFTER FIRST ERROR BUT SET FLAG 'ER'
440 NEXT LINE
450 IF ER THEN PRINT "PROGRAM ABORTED": GOTO 570: REM** ABORT
  AND RESTORE MEMORY
460 IF TT <> 30196 THEN PRINT "DATA ERROR, POSITION UNKNOWN.":
  GOTO 570: REM** ABORT
470 REM** ALTER POSITION-SPECIFIC LOCATIONS
480 POKE PO + 2, (PO + 13) AND 255: REM** NEW IRQ VALUES (LOW)
490 POKE PO + 7, (PO + 13) / 256: REM** (AND HIGH)
500 POKE PO + 84, PEEK (648): REM** SCREEN LOCATION

```

```

510 PRINT "TYPE 'SYS'PO' <RET> TO PRIME THE CODE."
520 PRINT "PRESS CTRL-P ONCE FOR A DUMP AT ANYTIME."
530 END: REM** CODE OKAY AND IN MEMORY
540 REM
550 REM** ABORT SEQUENCE - RESTORE MEMORY POINTERS
560 REM
570 POKE 56, M1: POKE 52, M1: POKE 55, M2: POKE 51, M2
580 REM** DATA FOR MACHINE CODE
590 DATA 120, 169, 13, 141, 20, 3, 169, 29, 151
600 DATA 141, 21, 3, 88, 96, 72, 152, 72, 133
610 DATA 138, 72, 165, 197, 197, 253, 240, 13, 251
620 DATA 133, 253, 201, 13, 208, 7, 173, 141, 105
630 DATA 2, 201, 4, 240, 8, 104, 170, 104, 65
640 DATA 168, 104, 76, 191, 234, 120, 169, 0, 38
650 DATA 32, 189, 255, 173, 5, 144, 160, 255, 189
660 DATA 162, 4, 41, 15, 240, 2, 160, 7, 119
670 DATA 169, 4, 32, 186, 255, 32, 192, 255, 101
680 DATA 162, 4, 32, 201, 255, 176, 114, 169, 89
690 DATA 0, 133, 251, 169, 30, 133, 252, 32, 232
700 DATA 237, 255, 134, 1, 134, 0, 132, 2, 127
710 DATA 160, 0, 169, 14, 32, 210, 255, 177, 249
720 DATA 251, 201, 128, 144, 9, 41, 127, 72, 205
730 DATA 169, 18, 32, 210, 255, 104, 201, 34, 255
740 DATA 208, 2, 169, 39, 201, 32, 144, 8, 35
750 DATA 201, 64, 144, 7, 9, 128, 208, 3, 252
760 DATA 24, 105, 64, 32, 210, 255, 169, 146, 237
770 DATA 32, 210, 255, 200, 208, 2, 230, 252, 109
780 DATA 198, 1, 208, 203, 198, 2, 240, 27, 53
790 DATA 169, 8, 32, 210, 255, 169, 13, 32, 120
800 DATA 210, 255, 169, 15, 32, 210, 255, 169, 35
810 DATA 14, 32, 210, 255, 166, 0, 134, 1, 44
820 DATA 24, 144, 172, 169, 13, 32, 210, 255, 251
830 DATA 32, 231, 255, 104, 170, 104, 168, 104, 144
840 DATA 88, 76, 191, 234, 234, 234, 234, 245

```

Graphic aid

John Buchanan,
East Horsley, Surrey.

SPECTRUM

THIS IS a machine-code routine to overcome an annoying feature of Sinclair Basic: the CLS command must follow a global Paper Ink,

Flash or Bright command or statement. This means that if you have created a screenful of high-resolution graphics and you want to make the whole screen flash or change the Ink or Paper colour over the whole screen, you have to execute a global colour statement then clear your display and then redraw it.

This can be undesirable especially if your

display took a long time to draw. The machine-code routine can be called during or after the program execution. The new attributes for the screen are set using the Randomise N sequence where N is chosen, according to page 116 of the manual. Then the routine is executed by a call to 1+RAMtop - this is 32570 on the 16K machine.

```

10 REM GRAPHICS UTILITY #1/C
20 REM © J.N.Buchanan 1982
30 REM
40 CLEAR (PEEK 23730+256*PEEK
23731)-15
50 LET P=PEEK 23730+256*PEEK 2
3731: FOR F=1 TO 15: READ A: POK
E P+F,A: NEXT F
60 DATA 62,91,237,75,118,92,33
,0,68,113,35,188,200,24,-6
70 NEW

```

```

10 REM Demonstration Program
20 REM
30 LET A=INT (256*RND)-128
40 LET B=INT (172*RND)-85
50 PLOT 128,86: DRAW A,B,PI/2*
RND+0.1
60 BEEP 0.3,50*RND-25
70 RANDOMIZE
80 LET I=USR 32570
90 PAUSE 45
100 GO TO 10

```

Function copy

John Crombie,
Lisburn,
County Antrim.

ATOM

THIS SHORT program for the Acorn Atom simulates the function keys of the BBC Micro. The functions to be executed are held in strings and executed by pressing Shift plus the string name so the string will be executed as if \$A="PRINT""ATOM FUNCTION KEYS"" typed from the keyboard by typing Shift A. If a carriage return is required at the end of the function a Ctrl A should be substituted in the function string so

\$L="LIST(CTRL A)"

will execute List(CR) every time Shift L is pressed.

Line 130 sets up where the functions are going to be stored: in this case #8200. Each function string is limited to 63 characters, so total storage for the 26 functions is 1,008 bytes. Line 290 changes the character input vectors. Lines 310-330 dimension the other strings and default them to a single space, while lines 170-265 contain the actual machine-code routine required.

```

10REM*****
20REM* ATOM FUNCTION KEYS
30REM*
40REM* (C) J.CROMBIE 1982
50REM*
60REM* FUNCTION KEYS
70REM* SHIFT A - SHIFT Z
80REM* FUNCTION HELD IN
90REM* $A - $Z
100REM*****
110REM
120REM
130 A=#8200
140 DIM VV6:VV2=#2800:P,#21
150 FOR I=1 TO 2:P=#2800
160[
170:VV0 JSR#FE94:CMPE#61:BMIVV1:CMPE#7B:BPLVV1
180JSRVV2:VV1RTS
190:VV2SEC:SBC#61:STY#AD:TAY:STX#AC:LDX#AD
200 LDA#322,Y:STA#AE
210 LDA#33D,Y:STA#AF
220 LDY#0

```

(continued on next page)

SOFTWARE FILE

(continued from previous page)

```
230:VV3 INY: LDA(#AE),Y: CMP#D: BEQVV4
240DEY: LDA(#AE),Y: STA#100,X: INX
250 INY: JSR#FE32: JMPVV3
260:VV4DEY: LDA(#AE),Y: CMP#1: BNEVV5: LDA#D
265:VV5 STX#AE: LDY#AE: LDX#AC: RTS
```

```
2701
280N, P, #6
290?#20A=0: ?#20B=#28
310FOR @=0 TO 25: @?#322=?#322+@*63
320@?#33D=(?#322+@*63)/256+?#33D
330! (@?#33D*256+@?#322)=#2020D20:N,
340END
```

Screen scroll

Martin Layley,
Wokingham,
Berkshire.

DRAGON

ACCORDING TO the Dragon manual, when using Get and Put to move blocks of graphics, an array has to be Dimensioned to the same size or greater than the area of the graphics

block. This is not so. In fact, you can get away with much less space in the array. The manual says that to Get a 20 by 20 block from the screen you need an array of (19,19). But you only need:

(0,100) in modes 3 and 4
(0,50) in modes 1 and 2
(0,25) in mode 0

The reason for this is that each element in an array takes five bytes, and that the computer stores more than one pixel in each byte.

The way of working this out is as follows: first, multiply the horizontal size of the graphics block, by the vertical size, then divide this by five and round up to the next nearest whole number. Next, for modes 3 and 4, divide by eight; for modes 1 and 2, divide by 16; for mode 0 divide by 32. Now round up to the next whole number. Finally, dimension the array with 0 as the first parameter, and the number which you have just arrived at as the second.

```
1 '**SCREEN SCROLLER
2 '
3 '**MARTIN LAYLEY 1982
4 '
5 '**SET GRAPHICS SCREEN
6 PMODE 4: SCREEN 1,1: COLOR 0,5: PCLS
7 '**DIMENSION ARRAYS
8 DIM L(0,76),S(0,1190)
9 '**DRAW ELLIPSE
10 CIRCLE (128,95),128,0,.75
11 'SHIFT SCREEN 10 PIXEL TO THE LEFT
12 GET (0,0)-(9,191),L
13 GET (10,0)-(255,191),S
14 PUT (245,0)-(255,191),L
15 PUT (0,0)-(244,191),S
16 GOTO 12
```

Relocate screen

Paul Dunning,
Bristol,
Avon.

ATARI

THIS PROGRAM demonstrates how it is possible to relocate the screen in any part of memory on the Atari computer. It does this by Poking two addresses near the beginning of the display list with the high and low bytes of the memory location that you wish the screen to be placed at. Unfortunately the position of the display list varies depending on the graphics mode.

If you Peek memory locations 560 and 561 they will give you the high and low bytes of the address of the display list. You then add four to this in order to get the address to Poke the new screen location. Line 10 does this.

The variables are as follows: SP is the location to Poke low byte of screen; SP+1 is the location to Poke high byte of screen.

```
5 GRAPHICS 7:POKE755,1
6 ?:"SMOOTH SCROLLING IN
  GRAPHICS 7"
10 SP=PEEK(560)+PEEK(561)*256+4
12 POKESP,176:POKESP+1,163
20 S=176:H=163
25 GOTO60
30 S=S+40:IFS>255 THEN S=S-256:
  H=H+1
40 POKESP,S:POKESP+1,H
50 RETURN
60 ST=STICK(0)
70 IFST=14 AND H>163 THEN GOSUB100
80 IFST=13 AND H<191 THEN GOSUB30
90 GOTO60
100 S=S-40:IFS<0 THEN S=S+256:H=H-1
110 POKESP,S:POKESP+1,H
120 RETURN
```

Use a joystick in port 1 to scroll the screen up and down memory.

Tight security

Andrew Ho,
Leicester.

ZX-81

IDEAS FOR maintaining program confidentiality have been published before in Basic, requiring the user to input a secret codeword before the program will run. Such security checks are easily bypassed in Basic by the use of Break or Stop keys. This code routine cannot be circumvented. The machine code is stored in a Rem statement containing 50 characters, as the first line of the program. Since many hexadecimal machine-code loading programs have been published, it is not necessary to repeat one here.

The routine starting at 16516 prints a screen prompt, then calls the key-scan subroutine in ROM many thousand times, seeking for a secret combination of keys to be pressed. If this is not found within 27 seconds, it jumps to the New subroutine in ROM and erases the program, thus preventing unauthorised access. To be effective, this idea should be incorporated in a program which auto-runs on loading from cassette.

The line following the program line containing Save should enter the machine-code routine at 16516 immediately, as illustrated in the sample program. The routine will work in both 1K and 16K machines, although it will probably find more use in 16K programs which might store confidential information. The screen is cleared and the counter reset before entry to the main program, so that further copies of the program will still feature this security check.

The secret codeword may be two, three or any number of any keys to be simultaneously pressed, thus making it impossible for uninformed users to breach the security check.

Your own secret codeword can be used if you understand how the key-scan routine operates in ROM. For those who do not, here are some possibilities:

16535	16536	codeword
9D	D9	AHO
7D	F1	ASM
7B	F3	WM
AE	E6	Shift X 7J

Address	Hexa- decimal code	Explanation
16514	FF 63	Set counter
	3E 28 D7	
	3E 34 D7	
	3E 29 D7	Print screen prompt
	3E 2A D7	
	3E 0F D7	
16531 loop	CD BB 02	Call Keyscan
	11 9D D9	LD DE, secret code
	AF	XOR A
	ED 52	SBC HL, DE
	28 0D	JR Z, +13
16542	2A 82 40	LD HL, (16514)
	2B	DEC HL
	22 82 40	LD (16514), HL
	BC	CP H
	20 EB	JR NZ, loop
	C3 C3 03	JP NEW
	CD 2A 0A	Call CLS
	3E 63	LD A, 63
	32 83 40	LD (16515), A
16563	C9	RET

Andrew Ho's protection program.

```
9000 SAVE "program name"
9010 RAND USR 16516
9020 RUN or GOTO start of program
Sample program.
```


SOFTWARE FILE

Code machine

Kenneth Hart,
New Crofton,
Wakefield.

ZX-81

THIS PROGRAM turns a sentence into a series of blocks of five-figure code.

There are 65,535 different codes available and the code can be a different length to the original message.

I have built into the program a copy routine which is only marginally slower than the inbuilt copy routine.

The advantage is that it only prints one blank line and therefore saves paper.

```

REM A K.HART PROGRAM FOR
THE 16K ZX81 22-6-82
THE CODE MACHINE
10 PRINT AT 1,7;"THE CODE MACH
INE"
20 PRINT "PLEASE PRESS ""C"" T
O CODE OR""TAB 13;""D"" TO DECO
DE"
40 LET A$=INKEY$
50 IF NOT (A$="C" OR A$="D") T
HEN GOTO 40
60 CLS
70 PRINT AT 1,3;"PLEASE INPUT
CODE NUMBER";TAB 8;"( 1 TO 65535
)"
80 INPUT A
90 IF A<1 OR A>65535 THEN GOTO
80
100 CLS
110 RAND A
120 IF A$="D" THEN GOTO 1000
130 PRINT AT 1,3;"PLEASE INPUT
YOUR MESSAGE";TAB 7;"( MAX. 14 L
INES )"
140 INPUT B$
150 LET B=LEN B$
160 IF B<453 THEN GOTO 220
170 PRINT AT 4,3;"THIS MESSAGE
IS TOO LONG"
180 FOR F=1 TO 100
190 NEXT F
200 PRINT AT 4,3;"
210 GOTO 140
220 IF B/5<>INT (B/5) THEN LET
B$=B$+
230 IF B/5<>INT (B/5) THEN GOTO
150
240 CLS
250 PRINT "CODE ""A
260 PRINT "YOUR MESSAGE IS: -"
270 PRINT B$
280 GOSUB 2000
290 FAST
300 DIM C$(B)
310 FOR I=1 TO B
320 IF B$(I)="" THEN LET B$(I)

```

```

=" "
330 LET C=CODE B$(I)+INT (RND*5
5)
340 IF C>63 THEN LET C=C-37
350 LET C$(I)=CHR$ C
360 NEXT I
370 LET L=0
380 PRINT "CODE ""A
390 PRINT "THE CODE IS: -"
400 FOR I=1 TO B STEP 5
410 FOR F=0 TO 4
420 LET L=L+1
430 PRINT C$(I+F);
440 NEXT F
450 PRINT " "
460 IF L/25=INT (L/25) THEN PRI
NT
470 NEXT I
480 SLOW
490 GOSUB 2000
500 GOTO 1400
1000 PRINT AT 1,1;"PLEASE INPUT
THE CODED MESSAGE"
1010 PRINT " ( MAX 18 LINES BY 2
5 LETTERS )"
1020 INPUT B$
1030 LET B=LEN B$
1040 IF B<577 THEN GOTO 1100
1050 PRINT AT 4,8;"THIS IS TO LO
NG"
1060 FOR F=1 TO 100
1070 NEXT F
1080 PRINT AT 4,8;"
1090 GOTO 1020
1100 CLS
1110 PRINT "CODE ""A
1120 PRINT "CODED MESSAGE IS: -"
1130 PRINT B$
1140 GOSUB 2000
1150 FAST
1160 DIM C$(B)
1170 LET C=0
1180 FOR I=1 TO B
1190 IF B$(I)="" THEN GOTO 1250
1200 LET C=C+1
1210 LET D=CODE B$(I)-INT (RND*2
5)

```

```

1220 IF D<27 AND D<>0 THEN LET D
=D+37
1230 LET C$(I)=CHR$ D
1240 IF C$(I)="" THEN LET C$(I)
=" "
1250 NEXT I
1260 CLS
1270 PRINT "CODE ""A
1280 PRINT "THE MESSAGE IS: -"
1290 PRINT C$
1300 SLOW
1310 GOSUB 2000
1400 PRINT "PRESS ANY KEY TO CON
TINUE"
1410 PRINT " OR ""NEULINE"" TO S
TOP"
1420 LET E=CODE INKEY$
1430 IF E=0 THEN GOTO 1420
1440 CLS
1450 IF E<>118 THEN RUN
1460 STOP
2000 PRINT AT 21,0;" DO YOU WAN
T A COPY (Y OR N)? "
2010 LET Q$=INKEY$
2020 IF NOT (Q$="Y" OR Q$="N") T
HEN GOTO 2010
2030 IF Q$="N" THEN GOTO 2160
2040 PRINT AT 21,0;" I AM MAKI
NG A COPY FOR YOU "
2050 LET F=0
2060 LET G=PEEK 16396+256*PEEK 1
6397
2070 LET G=G+1
2080 LET H=PEEK G
2090 IF H=118 THEN GOTO 2070
2100 IF H=0 THEN LET F=F+1
2110 IF H<>0 THEN LET F=F+1
2120 LPRINT CHR$ H;
2130 IF F<33 THEN GOTO 2070
2140 LPRINT
2150 LPRINT "-----"
2160 CLS
2170 RETURN
2200 SAVE "CODE"
2210 RUN

```

Renumbering

G J Cocks,
Great Rollright,
Oxfordshire.

SPECTRUM

HERE IS a renumbering facility for the ZX Spectrum, and it will easily fit into the 16K model. The Basic program loads the machine code above a reset RAMtop, then Saves it on to tape, verifies it, and then clears the Basic program out of the memory.

Whenever you need to renumber, just enter the command:

PRINT USR 32550 : LIST

To load the machine code from tape, just type the command:

CLEAR 32549 : LOAD "renumber"
CODE 32550, 40

The machine-code program is listed with comments to help understand how it works.

```

10 CLEAR 32549
20 FOR a = 32550 TO 32589
30 READ n : POKE a,n : a
40 DATA 17,10,00,58,83,92,111,58,84,92,103,24
14,114,35,115,6,10,19,16,253,35,78,35,
70,9,35,58,75,92,189,32,236,58,76,92,
188,32,230,201
50 SAVE "renumber" CODE 32550,40
60 VERIFY "renumber" CODE 32550,40
70 NEW

```

DECIMAL CODE MNEMONIC

COMMENTS

17,10,00	Ld DE,10	Load first line no. into DE registers
58,83,92	Ld A,(23635)	Load L.S.B. of address of start into A
111	Ld L,A	Load A into L
58,84,92	Ld A,(23636)	Load M.S.B. of address of start into A
103	Ld H,A	Load A into H
24,14	Jr,14	Jump to test for end of program
114	Ld (HL),D	Alter M.S.B. of line number
35	Inc HL	Move to L.S.B. of line number
115	Ld (HL),E	Alter L.S.B. of line number
5,10	Ld B,10	Create next line number
19	Inc DE	By incrementing DE
16,253	Dnz 253	Until B = 0
35	Inc HL	Move to L.S.B. of length
78	Ld C,(HL)	Load L.S.B. of length of line into C
35	Inc HL	Move to M.S.B. of length of line
70	Ld B,(HL)	Load L.S.B. of length of line into B
9	Add HL,Bc	Add length of line to HL
35	Inc HL	Move to start of next line
58,75,92	Ld A,(23627)	Load L.S.B. of address of start of variables into A
189	Cp L	Compare with L
32,236	Jnz 236	Jump back to alter line number if O.K.,continue if not
58,76,92	Ld A,(23628)	Load M.S.B. of address of start of variables into A
188	Cp H	Compare with H
32,230	Jnz 230	Jump back to alter line number if O.K.,continue if not
201	Ret	Return to Basic

Speed scroll

Munir Zaman,
Levenshulme,
Manchester.

ZX-81

THIS PROGRAM performs the scroll function at speed without disrupting the display file. ZX-81 users will notice that clearing the screen after a scroll function takes a long time if the program is long; also printing takes a long time after a scroll function.

This program does not have these disadvantages, and it only occupies 15 bytes compared to Per Nielsen's program although it does not have the special features. The program can be stored anywhere. If in line 1 — Rem — the program can be called RAND USR 16514. Do not use the program if you have less than 3.25K of memory or if you have used SCROLL — CLS will negate this.

Z-80 assembler hex decimal
LD HL, (16396) 2A, 0C, 40 42, 12, 64
PUSH HL E5 229

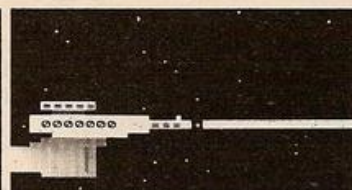
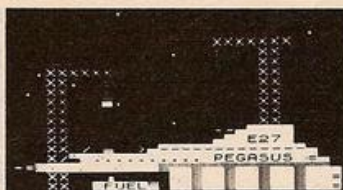
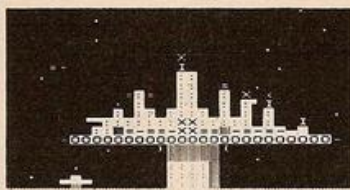
LD DE, 33 11, 21, 00 17, 33, 0
ADD HL, DE 19 25
POP DE D1 209
LD BC, 726 01, D6, 02 1, 214, 2
LD IR ED, B0 237, 176
RET C9 201

The following routine will load the program:

```

10 LET X = 16514 (starting address)
20 INPUT A$
30 POKE X, CODE A$*16+CODE A$(2) -476
40 IF A$ = "C9" THEN STOP
50 LET X = X+1
60 GOTO 20

```

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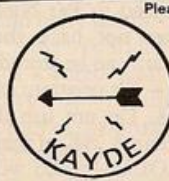
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A £15 book token will be awarded to the first correct solution drawn from the competition bag. All entries must be at the *Your Computer* offices by the last working day in January. The name of the winner, the solution, and a competition report will be published in the March, 1983 issue of *Your Computer*.

If you want to set a competition for Competition Corner, remember that the simplest solution should be calculable by a short program rather than by any other form of reckoning.

Competition results

THE PRIZE for the November competition was a Jupiter Ace, currently unique among micros in having Forth rather than Basic as its resident language. No less than 128 people hit upon "go Forth and multiply" to complete the sentence "The Ace would help me ...". Some people introduced a touch of variety by tagging "by Jupiter" or "by Jove" on the end. A single dissident voice rang out from P Riley with "go Forth and mystify".

But still reeling from this torrent of identical entries we made the winner R Gibson, 39 Lisburne Lane, Offerton, Stockport, Cheshire for his straightforward "go Forth and become an Ace programmer".

Other notable entries, which also managed to break away from the standard formula, were J Gearing's "in Jupiterly" and "play my other cards better — especially my graphics packs" from L Unstead-Joss. In an allusion to a claim Sinclair once made for the ZX-81, G Mason suggested that the Ace would "help me run my nuclear power station".

The Catfighter's problem was perhaps too easy. It only required a simple program to provide the solution — 2,025 Wo'ny ships and 89 lenses. A mathematical approach involved noticing that the number of ships destroyed must be a square and that there is only one square between 2,000 and 2,100.

The winning solution, picked at random, was provided by P Sayer, 15 The Chase, Worlingham, Beccles, Suffolk NR34 7DW.

10 REM CATFIGHTER SOLUTION

15 REM BY PETE SAYER

20 C = 1999

30 C = C + 1: L = -1: W = 0

40 L = L + 2: W = W - 1

50 ON SIGN(W) + 2 GOTO 30,60,40

60 PRINT "WO'NY " ; C: " LENSES " ; L

VARIABLES: L = LENSES

C = INITIAL NO. OF WO'NY

W = RUNNING TOTAL OF WO'NY

Solution to the November Ace crossword.



STAR STONE

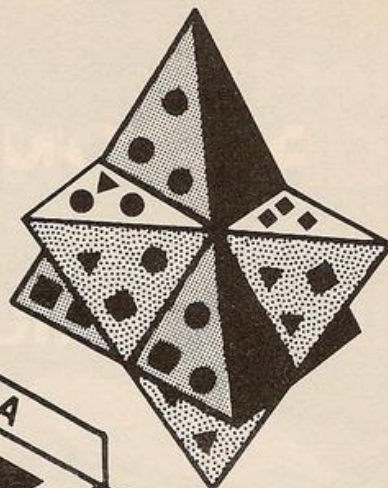
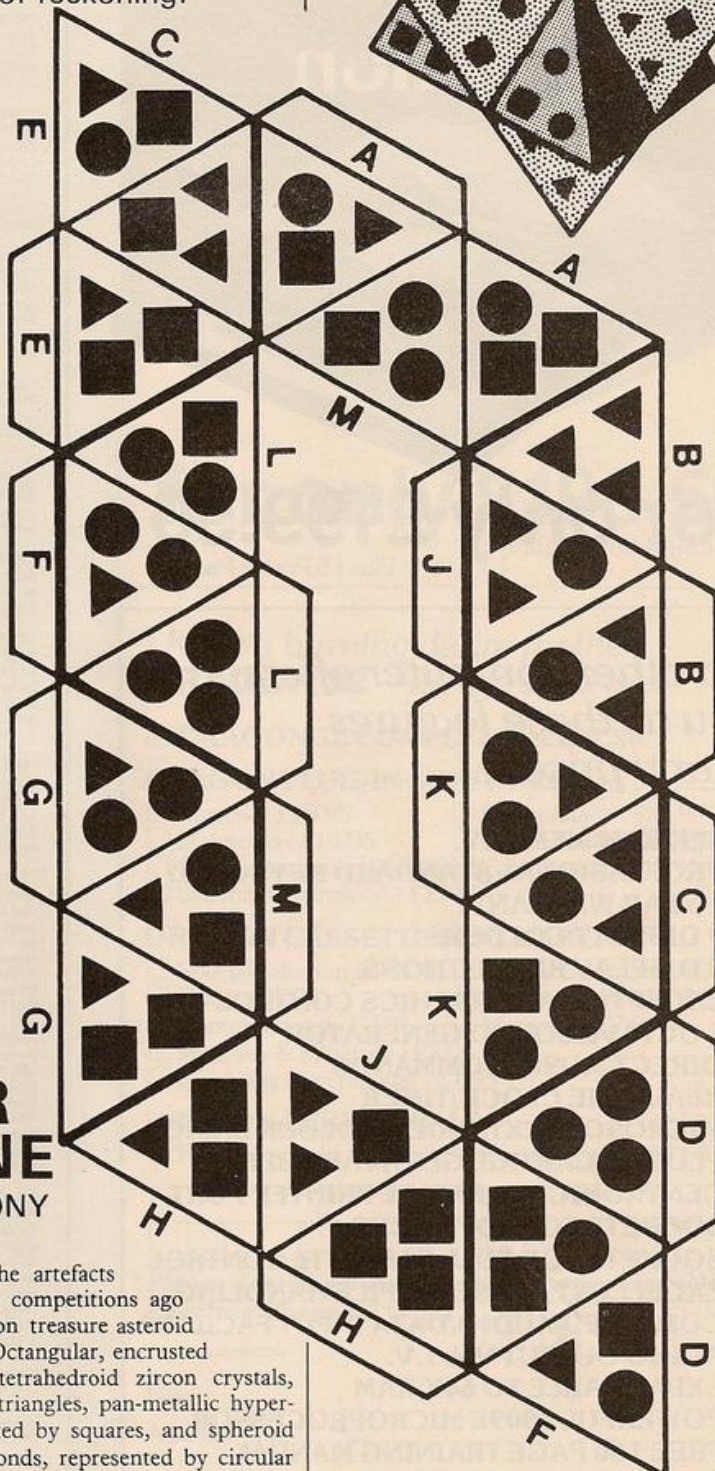
BY ANTHONY ROBERTS

ANOTHER of the artefacts you won a few competitions ago from the Klingon treasure asteroid was this Stella Octangular, encrusted with fabulous tetrahedroid zircon crystals, represented by triangles, pan-metallic hypercubes, represented by squares, and spheroid megacarat diamonds, represented by circular dots.

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one jewel — their positions on the face are immaterial.

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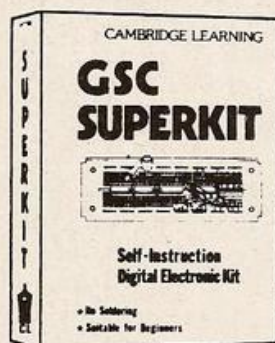
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Bob Maunder is co-author of 'The ZX80 Companion' and author of 'The ZX81 Companion'. He is a Senior Lecturer in Computer Science at Teesside Polytechnic, holds an MSc degree in Computer Science, and is a Member of the British Computer Society.

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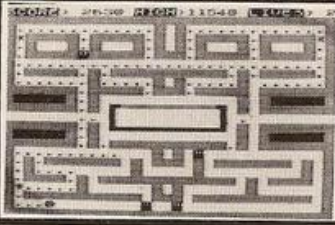
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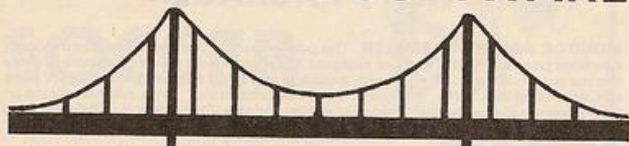
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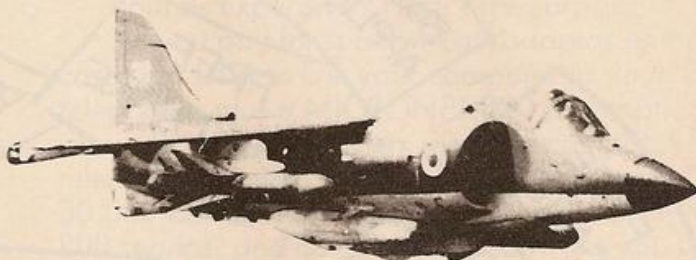
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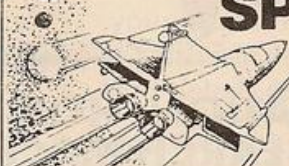
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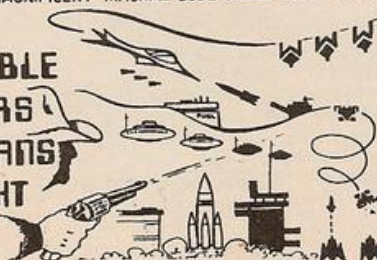
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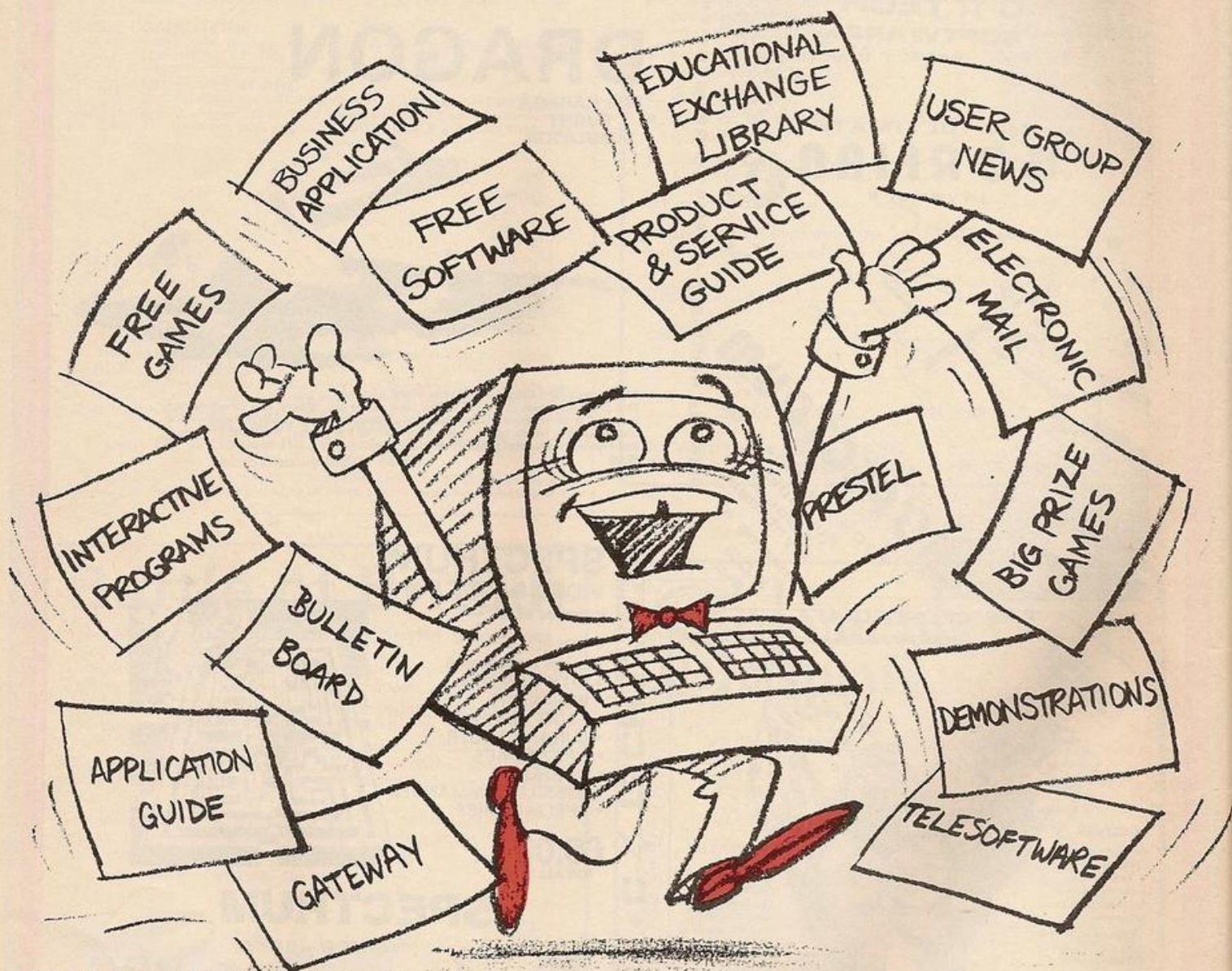
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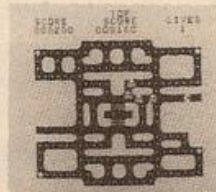


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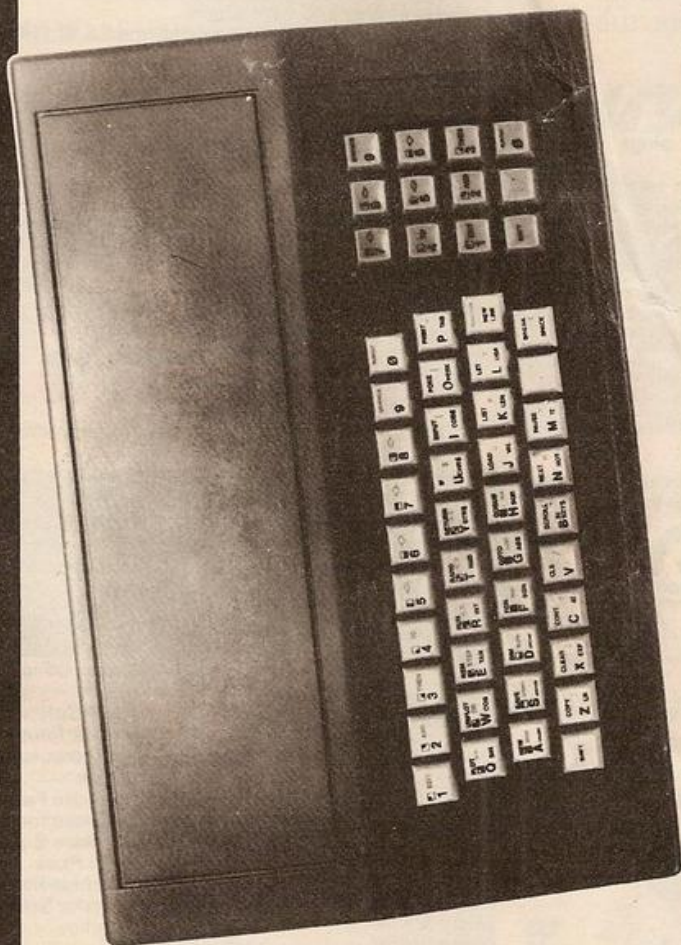
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EXPANSIBILITY: The SPECIAL RAM PACK is not only compatible with all software and hardware produced for the ZX 81, such as the ZX printer, but it also has the edge over other packs with its expansibility. You will find it interesting that the keyboard sounder option is already included in the SPECIAL RAM PACK. It also has expansion pins, ready to receive — in the same case — the most advanced add-on ever designed for the ZX 81 — the X ROM CARD (see figure 2).

WHAT DOES THE X-ROM CARD OFFER?

1. The X-ROM CARD has a built in autostart ROM. Programs can be run automatically every time the ZX 81 is switched on. This will result in a huge increase factor for ROM based software, since all software houses are currently very aware of copyright piracy problems.

2. The X-ROM CARD has a built in printer interface, necessary if you wish to use a printer other than the ZX printer. This is invaluable for any serious applications, including word processing, where careful presentation is of the utmost importance.

3. The X-ROM CARD has a built in EPROM burner. This means that you can save Basic or Machine code programs onto silicon chips and play them back at any time.

4. You may of course buy the X-ROM CARD to use with other Ram Packs such as the Sinclair Ram Pack. However, when you purchase the X-ROM CARD with the SPECIAL RAM PACK, you will have the advantage of lower cost, greater reliability and neatness, since the whole system is nicely housed within a single case.

IN CONCLUSION: The SPECIAL RAM PACK, is the best immediate investment for your ZX 81. The availability of the X-ROM CARD opens the way to new software development such as languages programming and is the guarantee that your system will never be obsolete.

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fig. 1



fig. 2

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- **X-ROMCARD:**
 - Autostart ROM: 4K byte, exchange for 8K bytes and software switch possible. Displays memory size, checks for byte "00" (identifies ZX basic) @ 2000H. Loads program if found, checks for byte "C3" and jumps (2000H) if found. Checks for presence of ROM in socket n.3 and ROM catalog, displays catalog if found. Contains also machine code monitor and printer utility.
 - Preprogrammed ROM: Catalog available on request. Use only 2732 or 2764 ROM/EPROM.
 - Blank EPROM: Use only 2764 — 8K bytes per device — in socket n.3. 3 x 9V, PP3 size batteries are needed to burn EPROM.
 - Printer connection: 16 pin DIL output, use standard IDC ribbon cable. Outputs include DO to D7, Strobe, Reset, Inputs include No-fault and Busy.
 - Documentation: Schematic diagram included, full listings of Autostart ROM extra (only for X-ROMCARD user, £1.50 + large SAE)

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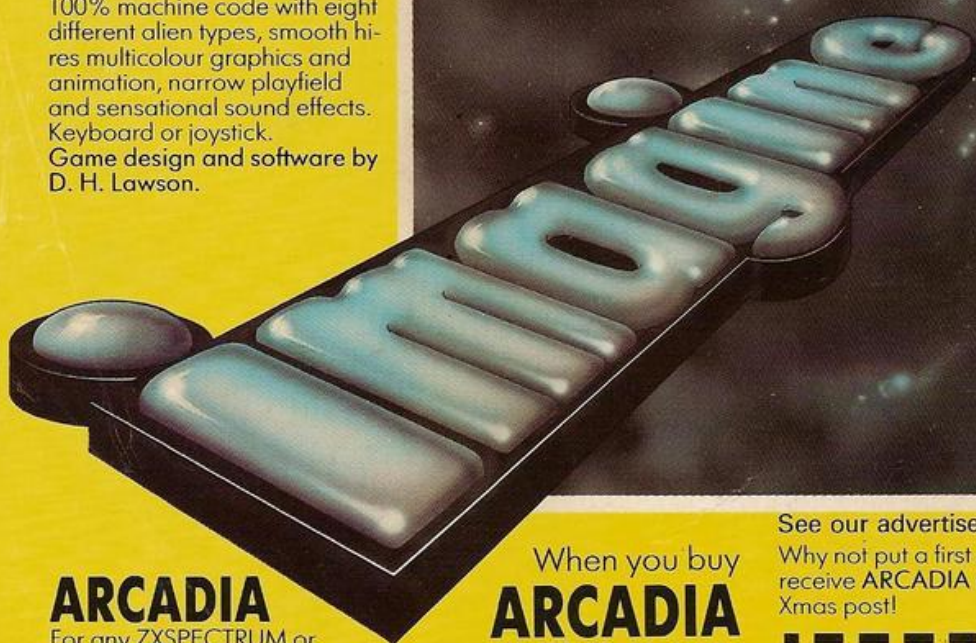
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