60p

YOUR COMPUTER

NOVEMBER 1982 BRITAIN'S BIGGEST-SELLING HOME COMPUTER MAGAZINE Vol.2 No.11

Gunpowder plotting: make light work of Dragon, BBC and Spectrum graphics

Clive Sinclair interview – his plans for 1983

Ace reviewed

ZX-81 software survey

Music for Acorns

Vic Night Racer

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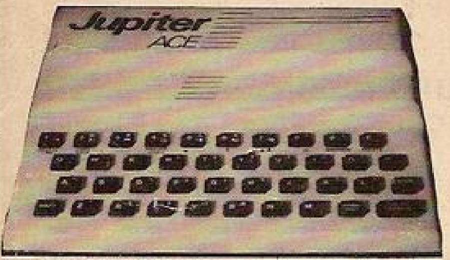
Feature	Texas Instruments TI 99/4A
Microprocessor	TMS 9900 16 BIT
Graphics	16 colour, high resolution
Languages	TI-BASIC (built-in), extended BASIC, UCSD-PASCAL, TI-LOGO, Assembler
Memory	16K RAM standard–expandable to max ROM/RAM of 110K
Keyboard	Full size, standard typewriter style
Software	1000 programs to choose from worldwide
Solid State Speech Capability	Yes

TEXAS INSTRUMENTS

YOUR COMPUTER



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EDITORIAL

"Have you finished your homework yet?". It is half past eight as Mrs Smith calls up to her son for the fifth time that evening. As soon as he arrives home from school, he shuts himself away in his room which flickers blue as his ZX-81 sluggishly accepts lines of Basic. Still, she reassures herself, he will soon grow out of it. Last year it was Rubik's cube; next year it will be something different. It is just another one of his fads.

But is home computing just another fad? It is impossible to say exactly how many of the half million ZX-81s sold world-wide are already gathering dust beside the skateboards and Kung Fu magazines. But what is clear is that falling prices have turned home computers into disposable consumer products. If your foray into computing has cost you only £50, you can abandon it with greater equanamity than if you had spent £300.

Nevertheless the parallel between the home computer and the likes of the Hoolahoop breaks down because the micro represents the domestic face of a technology which will pervade our society for many years to come. Unfortunately the aspect of computing which, month after month, will continue to be subject to the whims of fashion is exactly what you use your machine for. We have already seen Pac-Man succeed Space Invaders as the vogue game, in the same way that Space Invaders pushed out the ball and paddle games before it. The original spur for many who decided to buy a computer was that they could save their money from the insatiable appetites of arcade machines by playing the games at home on their own micros. Consequently this has meant that the investment behind the development of the latest arcade games forces home-computer software houses to follow in their path.

Only when new applications are designed specifically to take advantage of the micro's facilities will they be able to cast off their role of dedicated followers of the fashions of other and sometimes older technologies and applications. Once software suppliers overcome the limitations of existing computer languages and, more importantly, start using their imaginations the home computer will come into its own. If this is done home computing may still be a fad but it should be good at least to the end of the century.

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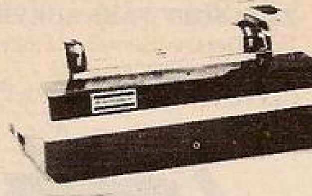

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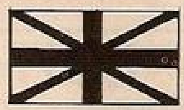

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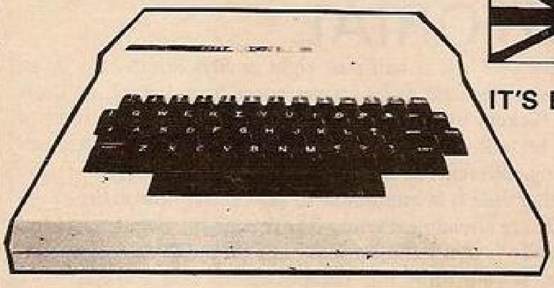

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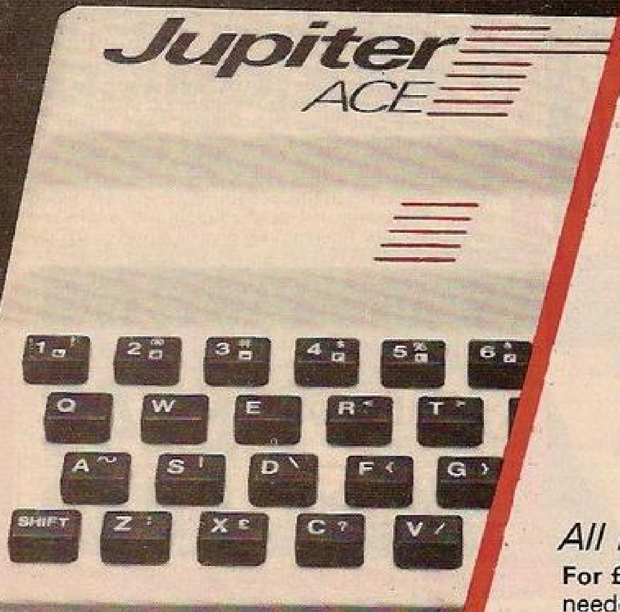
Jupiter ACE



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.

"The Ace is an excellent way of using FORTH"
Popular Computing Weekly

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.

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

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"FORTH is an easy language"
Byte

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

"FORTH is very flexible"

"FORTH is compact"

Electronics and computing

"FORTH is in general very much faster than BASIC"

Computing Today

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, unplotted 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.

Programming in FORTH

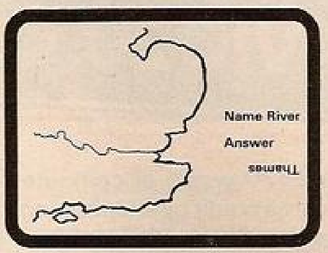
Programming in FORTH

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.

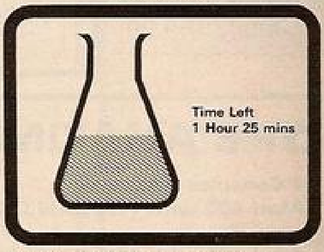
```
: STARS          (: starts word definition)
  " *** "        (print 3 asterisks)
  200 100 BEEP   (play a note for
                  100 mSecs)
;
```

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.)

The Jupiter Ace already has 140 FORTH words defined in ROM.

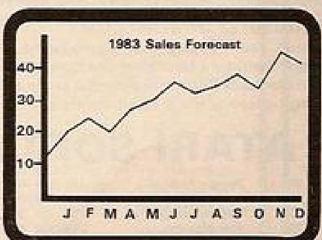


In Schools Teachers already know how quickly children take to computing, and the Jupiter Ace is an ideal introduction. FORTH is an easy and important language to learn and by making learning fun, the Ace can help to teach science, music and many other subjects.

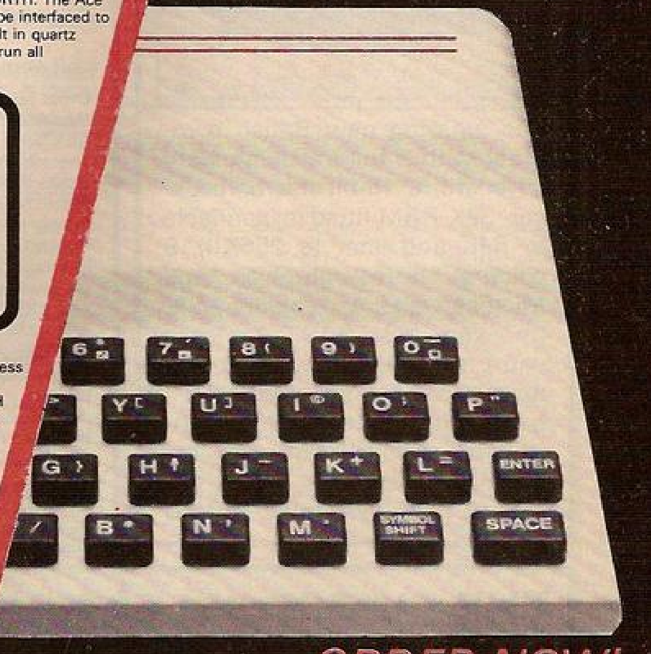


In Laboratories For monitoring and controlling experiments, the Jupiter Ace has many advantages. The language is perfect, even the Jodrell Bank Radio Telescope is controlled in FORTH. The Ace expansion port enables it to be interfaced to almost anything, and the built in quartz timer allows experiments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



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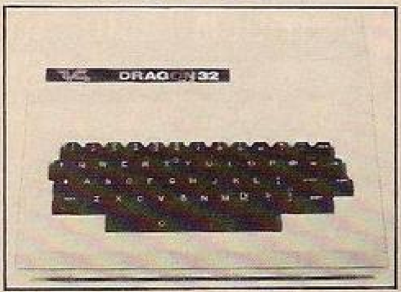
DRAGON 32



The amazing new British computer with a full-travel standard keyboard, a 16-bit microprocessor, 32K RAM fitted (expandable to 64K and later to 256K!!), 9 colours, hi-res graphics and Microsoft extended colour BASIC (the very best BASIC to learn with). It can be used with virtually any ordinary cassette recorder, it has a printer interface (Centronics-type), joysticks are available and it's incredible value for money. **(AF57M) Only £199.50**

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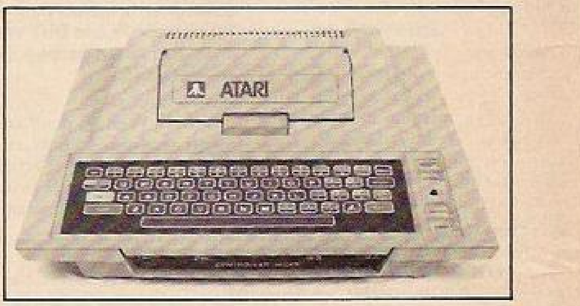
★All above with BASIC & handbooks



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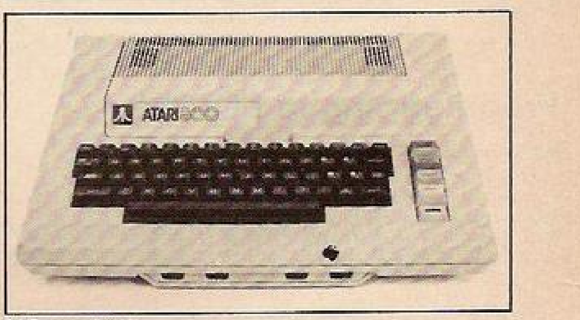

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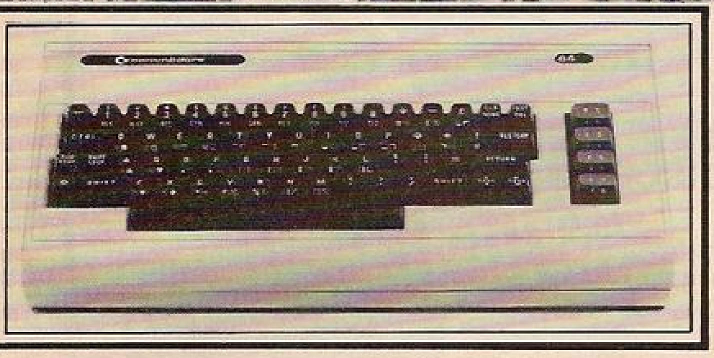

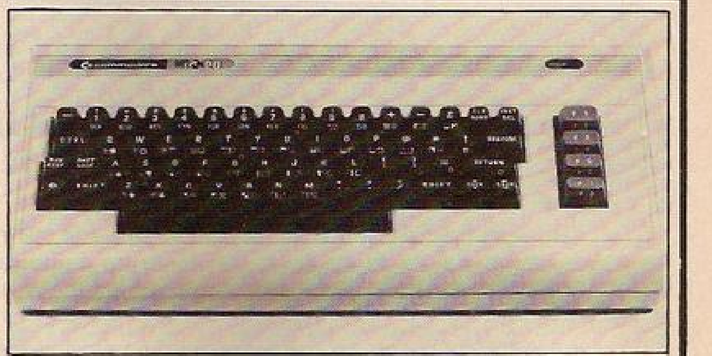

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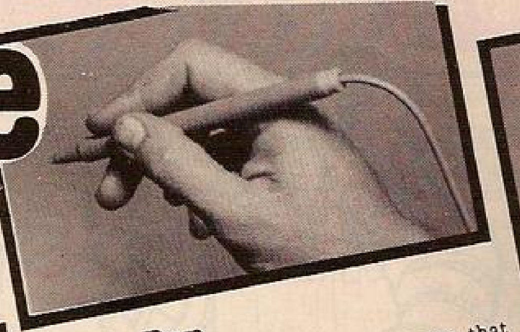

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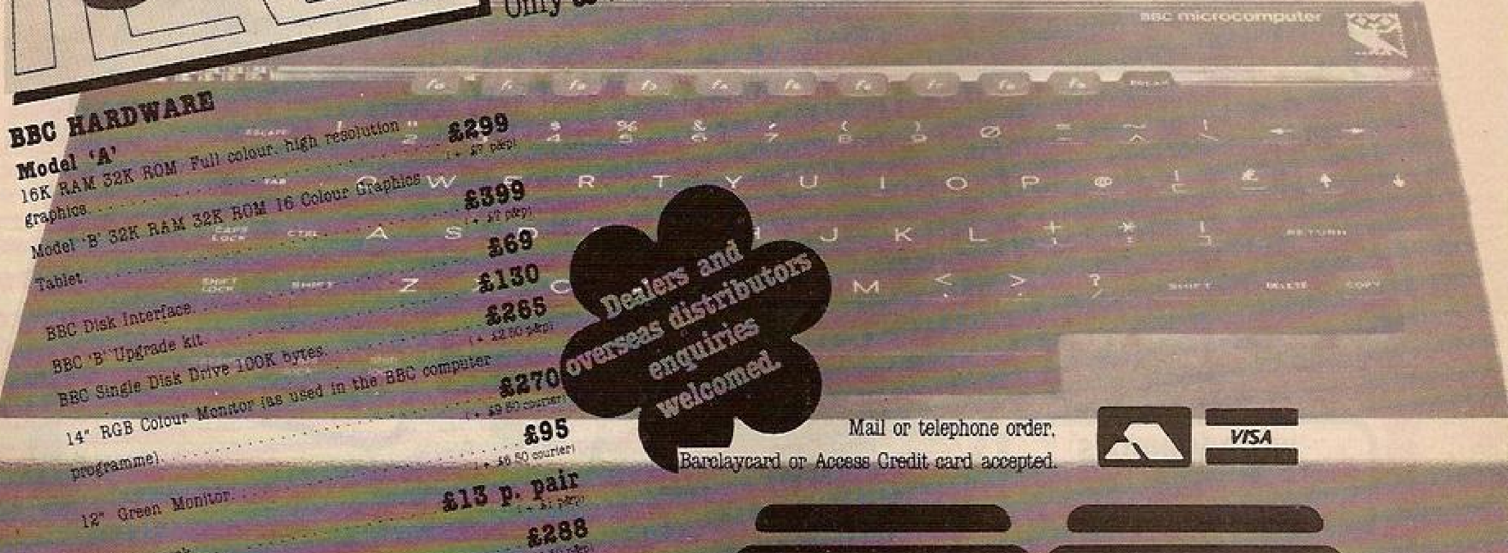

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SWISS HELP

Much has been written about problems met by ZX-81 owners during loading and saving programs. I learned the following three rules the hard way, after trouble-free loading since August 1981:

First, if the cassette recorder can run on batteries as well as the main supply, remove the batteries when loading/saving with the mains electric supply. The batteries cause the signal to be very blunt and the ZX does not accept them.

Second, never store your cassettes too near the TV set — the TV set has a magnet in it!

Third, use a cassette-tape head-cleaner regularly. I very nearly lost my favourite game because of a dirty tape head. The signal gets distorted and is incorrectly transmitted.

I must thank your contributors: C J Young for his fantastic Assault Craft, June 82, Julian Stradling for his addictive Patience, August 82 — my favourite game almost lost — and your third contributor on my list Garry Owens for his very clever Landscape, September 82. Your magazine gives me immense pleasure, and I shall definitely renew my order next Spring, whether my Spectrum, ordered by a pal in England in June, is here or not.

Mrs Dane Kurth-Rowe,
Busswil,
Switzerland.

6502 ERRORS

The listing of my 6502 assembler in *Your Computer* September issue contained three errors. The following lines should read:

```
50 IF LEFT$ (C$ (F),1)="B"AND
LEFT$ (C$(F),3) <> "BIT" THEN...etc.
2540 IF LEFT$(A$(A),1)="B"AND
LEFT$ (A$(A), 3)<>"BIT" THEN... etc.
2500 IF D2 >=65535 THEN GOSUB
720: GOTO 1440
```

I would also like to point out that other commands can easily be added to the assembler in the routine from line 1410 to line 1640 — for example a routine could be added to verify tape saves.

Philip Horton,
Evesham,
Worcestershire.

DISGRUNTLED

Two things annoy me: the attitude of schools to the computer they choose, and letters to *Your Computer* from owners of Atom or BBC machines.

First the educational authorities' attitude. Where is the logic in buying a machine such as the Pet at around £350 when several cheaper machines could be bought for the same price? It is obvious that the Pet is superior to, say, the ZX-18, But the idea of computers in schools is to enable as many pupils as possible to learn something about computers and programming.

Regrettably the education authorities will still plump for machines such as the Pet merely because they are dearer. The reason for this is simply that the schools are given a grant for items and if the grant isn't spent in one year, then next year the estimate of the grant is reduced. The simplest, and best, way for the pupils, is to allow schools to spend the grant on more than one machine.

The superior attitude of Atom and BBC owners would appear to be based on the fact that they have purchased an expensive machine. But these machines have a non-standard language which is therefore of little use as far as learning to program is concerned. Whilst admitting that Atom Basic is very fast, it is still too slow for Space Invader games.

G A Bobker,
Bury,
Lancashire.

ZX SNATCHER

I wonder low long Mrs Thatcher had to wait for the Spectrum that she gave to the Japanese. I ordered mine at the end of May, and still there is no expected delivery date put on my order. So, at least in my case, Mr Sinclair cannot even fulfill his promise of delivery 12 weeks after receipt of the confirmation of the order. With the prevailing sellers' market, roll on a serious competitor to Sinclair Research Ltd.

I hope Mrs Thatcher did not receive the computer intended for me.

Gordon Scott,
Sheffield.

SAVING GRACE

When programs are to be Saved with new or changed data after operation, on ZX-81s this routine is useful. In the example, the Saving part of the program takes place at Lines 190 to 210. Line 2 can be typed in as it reads — no Loader routine is required in this case:

```
01 GOTO VAL "100"
02 REM 11625258550040525053585742
   55110045385600515257005338 4641
   00504200435255005062005552 5857
   46514256005358394946564542 4100
   46510000000011565243576038 5542
   0 043464942271 1TAN
100 SLOW
110 FOR J=1 TO 159 STEP 2
120 LET K=USR 16686
130 LET X$=CHR$ PEEK (16525+J)
    +CHR$ PEEK (16526+J)
140 PRINT CHR$ VALX$;
150 NEXT J
160 PRINT ,,,
170 IF INKEY$="" THEN GOTO 170
180 REM SAVE PROGRAM
190 LET X$=""
200 IF INKEY$="S"THEN INPUT X$
210 IF X$<>"" THEN SAVE X$
220 IF INKEY$=" STOP " THEN
STOP
999 RUN
```

To Save, when the program is running, press key S. This gives a string input, into which a program name is entered. The tape recorder should then be turned on before Newline is pressed. Note that, in this case, pressing Stop will Stop the program, and any other Control Lines can be written in after Line 220.

Nick Godwin,
Eyemouth,
Berwickshire.

BBC FREEZE

In my opinion one of the most useful facilities on the BBC Micro is that while scanning through a listing, it is possible to freeze the screen by holding down Ctrl & Shift at the same time. The screen will stay in the same position as long as the keys are depressed, and Scrolling will continue when they are let go. The other tip is concerning a fault in the BBC machine. A command word like List, or New cannot be put into a program line, so:

```
100 LIST
```

would give a Syntax Error message. There is, however, a way of getting round this, which is as follows:

```
100 ON ERROR LIST
110 ERROR
```

This method can also be used for New.

David Machin,
Longton,
Stoke-on-Trent.

ATARI IDEAS

It was interesting to see Graphic recall for the Atari in *Your Computer's* October issue, page 93; but it requires more explanation.

First, the program as printed does not draw a rectangle, it draws two straight lines. The listing here does draw a rectangle:

```
10 GRAPHICS 8
15 SETCOLOR 2,2,2:COLOR 1
20 PLOT 20,20:DRAWTO 200,20:
   DRAWTO 200,150:DRAWTO
   20,150:DRAWTO 20,20
```

Note that I have added a Setcolor command to provide a red background. The Color 1 instruction in the original program could be deleted. In Atari Basic, there's no point in using a Color command unless you already have a Setcolor command.

Typing Graphics 1000 does indeed reveal the disappeared rectangle, though more by accident than design.

The Atari uses a Graphics instruction from 0 to 11 to set the Screen Mode — colours available and resolution. In Modes 0 to 8 inclusive the straightforward Graphics command leaves a four line text window at the bottom of the screen. Adding 16 to the graphics command removes this window. The command could be issued as GR.8+16, or as GR.24.

Now, adding 32 to the graphics command removes the text window but also protects the Screen RAM, where the image is stored, so that it is just refreshed. Thus to get the effect noticed by Tony Gillett, you just need to use GR.8+32.

With regard to the comments about Get, some readers may be confused by Com, which Tony Gillett uses in his Line, but this only means Dim, which is the preferred word. In Atari Basic, Get always returns a numeric value. However, it is not necessary to assign the value to a string if a letter is required: Print CHR$(A) will often do. For example:

```
10 OPEN # 1,4,0,"K:":GET
# 1,A:PRINT CHR$(A):CLOSE
# 1
```

Goodness knows why anyone would want to do this.

However, it is interesting to find someone who can tear himself away from the world's best computer game, Star Raiders, for long enough to look at Atari Basic. Maybe some more readers will now send in their ideas.

Jack Schofield,
Sutton,
Surrey.

REASSEMBLE

There are four mistakes in the YC October Spectrum assembler tables. The corrections are as follows:

Line 1801: 15th item along was: "D=M": this should be "D@M": 38th item along was "7HG" this should read "7HJ".
Line 1804: last item was "07L" should be "0L7"
Line 1805: 20th item along was "7XD": should be "HXD".

Chris Lam,
Redhill,
Surrey.

SMALL PRINT

I have a little advice for your readers to do with software adverts, after having been taken for a ride by a software house.

I ordered three games but got back two totally different programs. I sent the packages back two months ago and have only just got my money back, after many phone calls and letters.

My first piece of advice is read the advert thoroughly, especially small print — for example, add 50p for postage and packing and 15 percent. for VAT. Second, always ring the company concerned before ordering the program, making sure the software is still available and not out of circulation. Finally, ask if there is a money-back guarantee.

Mark Wilkinson,
Brighouse,
Yorkshire.

Home doctor needs Vic

EASTMEAD COMPUTER Systems has released six cassettes in a Home Doctor series. Each cassette contains 18 programs which give advice on a variety of symptons and health topics. Diagnosis is given on most complaints. The list of topics leads off with abdominal pains, alcoholism, backache and bad breath.

The content of these programs has been prepared by Dr Vernon Coleman, author of a number of books on home medicine.

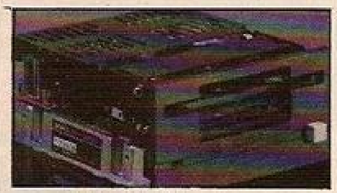
The cassettes cost £6.75 each or £33.95 for all six. They are available by mail order for the Vic-20 and ZX-81 from Eastmead Computer Systems Ltd, Eastmead House, Lyon Way, Camberley, Surrey GU16 5E2.

Microdrives break the £200 price barrier for home mass storage

ALTHOUGH BUDAPEST Radio Engineering invented the micro-cassette disc-drive in 1974 the rest of the computer world stayed with 5in. drives or bigger. Now Sinclair, Sony, and Hitachi are all launching micro-drives in the next few months and BATS-NCI is importing the Hungarian drive.

Sinclair's Microdrive appears next month, and Sony is selling a 3.5in. floppy disc to other computer manufacturers which will have twice the capacity of traditional 5.25in. discs yet costs about £200. Hitachi's 3in. disc system will be even faster but more expensive.

Bill Musker of BATS-NCI dis-



covered the MCD1 micro-cassette drive by chance on a trip to Hungary: "I happened to notice one sitting on someone's desk". He was convinced that the Hungarian drive which takes a 3in. floppy-disc protected by rigid cassette was ideal for low-cost micros.

Now Commodore wants to use the drive for the Vic-20. David Briggs, head of the hardware support division says that Commodore is acting as a catalyst between BRE and BMB Computers who will be developing the system. If tests of the prototypes prove favourable Commodore will market a twin-drive 300K system after Christmas; but Briggs is still cautious: "The Hungarian company is a totally unknown factor in this market."

Meanwhile Premier Publications has already adapted the BATS-MCD1 for use with the Video Genie and UK-101. A Dragon version will be available for less than £200 by the end of the month from Premier Publications. Telephone 01-659-7131.

Fast Spectrum 16K compiler

SOFTEK'S COMPILER for the 48K Spectrum enables Basic programs to run up to 10 times faster than normal. In contrast to the standard Basic interpreter which converts Basic to machine code while a program is running, a compiler produces a machine code version of a program prior to run time.

The compiler takes up around 16K at the top of RAM. The present version can cope with about 80 percent of Spectrum Basic commands. Compiled code is not quite as efficient as tailor-made machine code.

The program is available from Softek, 329 Croxted Road, London SE24.

Painting the Mary Rose made easy with Spectrum digital tracer

DIRECT INPUT of images to screen is no longer a dream since the release of a digital tracer for the Spectrum.

The RD Laboratories Spectrum digitiser consists of an arm which you use to trace the picture you want displayed on screen, and software routines which allow you to change colours or shade in parts of the display on screen or to save the picture as a display file or copy direct to a printer.

At £49.95 the RD Digital Tracer could save hours wasted plotting in individual points or lines to build up complicated pictures. RD's tracer will also work on the ZX-81 although with less spectacular results. Details from RD Laboratories: telephone 0920-84380.

Open sesame for dial-a-game and electronic mail for £60 from Oric

JANUARY'S LAUNCH of the Oric modem will bring telesoftware and electronic mail within the budget of home computer owners. The £60 modem will plug in to Oric's £100 16K microcomputer which was revealed in October's *Your Computer*.

An autodialler for telephones, and Prestel and viewdata facilities can be easily added to the modem. Sinclair had hoped to be first on the market, but his low-cost adaptor for the Spectrum will now not be available till the spring after Oric and Micronet. Oric's Peter Harding says "Sinclair will probably copy ours."

Oric will launch the modem with a free dial-a-game service which will allow users to download a variety of programs at any time of day or night under a name which could be tempting providence. Microcomputing already resembles a pantomime, complete with wicked uncle, without Oric calling this facility Aladdin's Cave.

Peter Harding is enthusiastic about sending programs down the telephone wires. "Telesoftware is going to be the medium of the future for software." The combination of Oric 1 and the modem will convert a television into a receiving station which can display pictures and text sent by any other Oric owner with a phone, for just £160.

Disabled computer enthusiasts now have their own version of the Spectrum. Possum's system allows the handicapped to direct a light scan around an indicator panel by using an expanded keyboard or pneumatic input to select the computer function they require. Details from Possum Controls: telephone 0753-79234.

Micronet offers Prestel for £50

BRITISH TELECOM leads a consortium hoping to draw 100,000 micro users into the Prestel network by offering adaptors for £50 to £100. When it opens on January 1, 1983, Micronet 800 will also provide a 30,000 page database for those micros linked to Prestel through the telephone system. The subscription fee to Micronet will be around £1 a week.

On top of the 200,000 pages of information already on Prestel, the service will include buyer's guides, user-group news, a bulletin board, magazine features and advertising, games and prizes, and an electronic mail facility. But of greater interest to micro users will be the 20,000 pages of downloadable software, some of it free of charge.

At the same time, Prism Microproducts will supply Prestel adaptors for the ZX-81, the Spectrum, BBC, and later the Vic and the Dragon.

Audiogenic is chess Boss

AUDIOGENIC CLAIMS that Boss, a Vic-20 chess game, has triumphed against programs for the Pet, Apple and Texas TI-99/4. Boss requires a minimum of 8K memory and costs £14.99 from Audiogenic, PO Box 88, Reading, or from most Commodore dealers.

Epson's £500 portable could be the shape of things to come

EPSON'S PORTABLE computer, the HX-20, is the shape of things to come. Within a few years portable machines will capture at least 40 percent of the microcomputer market, say the experts.

For less than £500 the HX-20 includes a built-in printer, an LCD screen and a full-size typewriter keyboard, but weighs under four pounds. The use of CMOS circuitry allows 50 hours battery operation from built-in NiCad batteries which can be recharged overnight. Programs and data can be retained in RAM when the power is switched off.

The liquid-crystal display gives four lines of 20 characters or 120 by 32 dot graphics. It can act as a window on a larger screen 255 characters wide. Like the Amber 2400, which has the same Epson mechanism, the dot-matrix printer uses an inked ribbon to give 24 columns on plain paper.

The 32K ROM containing the operating system and Microsoft Basic can be expanded to 64K, while another 16K RAM can be added to the 16K present on board. The compartment to the right of the screen can take a micro-cassette drive or ROM and RAM cartridges.

RS-232C and serial interfaces provide for connections to a Modem, disc drive and larger printers. Other features include a clock-calendar with an alarm and a four-octave sound generator.

BBC smashes the system

MOST BBC MICROS to date have been supplied with the 0.1 operating system which cannot support disc drives. Among its other shortcomings is a bug which causes occasional problems in saving to tape and the inability of the RS-423 port to receive data. Now Acorn is supplying the new 1.2 ROM free of charge to owners with the 0.1 system in EPROM and also to people who buy peripherals which require the new ROM. Owners with the 0.1 system in ROM will have to pay a replacement fee of £10.

Disc drives for the BBC also need a disc interface. This will cost £70 plus up to £15 fee for fitting. Acorn's BBC disc drive costs £264 and has a capacity of 100K. A rather cheaper 163K Control Data drive is available from Microware, 637 Holloway Road, London N19. Telephone 01-272-6398.

Sord reveals £100 4K colour micro

NOW SORD, one of Japan's biggest computer manufacturers, is joining the battle for Britain's home micro market. Sord describes the £100 M5 as a "variety computer" which is supposed to be capable of anything from "playing intellectual games" to "data processing". Software will be supplied on cassettes and cartridges.

The all-singing, all-dancing machine will have 4K user RAM plus 16K video RAM, and 8K ROM with built-in monitor, with full colour graphics including 32 types of sprites. The Z-80A based M5 is about the same size as an Atom with a Spectrum-style keyboard. It should start appearing in Britain from January.

Plug-in cartridges for the M5 will include PIPS, a home version of the management package which has helped Sord to 20 percent of the Japanese market.

Manchester stages bigger and better Northern Computer Fair

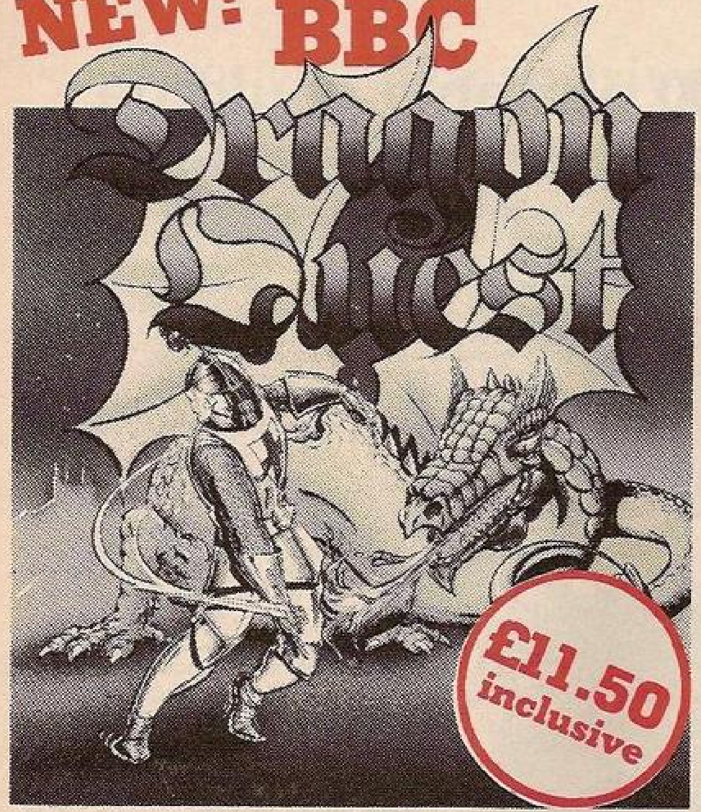
FOLLOWING THE SUCCESS of our Earls Court show in April *Your Computer* has organised the Northern Computer Fair to be held at Belle Vue, Manchester on November 25-27. Over 38,000 people, mainly from London and the Home Counties, visited Earls Court.

The Belle Vue show will give northern readers an opportunity to try out the products of more than 80 computer companies. The Sinclair Village is already fully booked and it will be even larger than at Earls Court. The latest in machines and software will be on show.

Like a camel the Memic-81 goes a long way without refuelling. It allows you to store a program for up to 10 years and access it almost instantly. It uses a CMOS memory chip and 10-year life Lithium batteries. Loading a program requires a couple of Pokes and a USR call. A 2K version is priced at £28.70, and the 4K version costs £34.45 from Cambridge Microelectronics, 1 Milton Road, Cambridge CB4 1UY.

ZX81... SPECTRUM... BBC MICRO... COLOUR GENIE... ATOM... VIC

NEW! BBC



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- Another VIC in the wall
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YC.11.82

ZX81... SPECTRUM... BBC MICRO... COLOUR GENIE... ATOM... VIC

Your Computer **Ace competition**

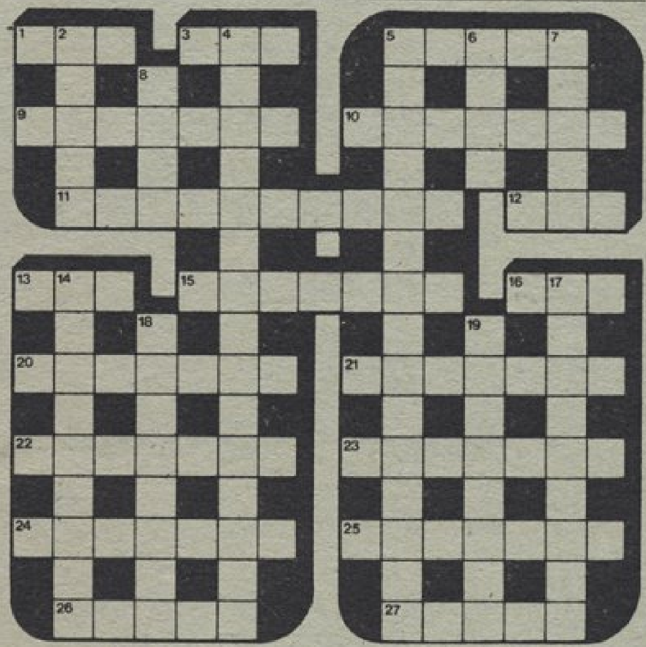
WIN A JUPITER ACE

An Ace will be awarded to the winner of the *Your Computer* Ace competition. To enter the competition, all you have to do is complete the crossword below and finish the sentence "The Ace would help me . . ." in less than 12 words. All entries must be sent to the *Your Computer* offices by the last working day in November 1982.

Name: ______________________________

Address: ______________________________

____



Complete this sentence in 12 words or fewer. "The Ace would help me . . . ______________________________

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Your Computer **Ace competition**

ACROSS

1, 3 & 5	Stop talking of A\$ (1 TO LEN(A\$)-1) (3, 3, 5)
9	Deal out 101,000 (A-INT(A)) (7)
10	Act for Gosub and return (7)
11	Sweeps round the not-so-new? (6, 4)
12	Domesticated micro (3)
13	Chip a point from cold material (3)
15	Strangely calm, tie up the atmosphere (7)
16	A record height (3)
21, 20	Holds power the way love, anger and guns do (7, 7)
22, 23	The biggest thrust leads to a peak (7, 7)
24	Rustle up a penny pastry (7)
25	Temporary termini exchange (7)
26	They hold the music for dancers (5)
27	The places the set is reflected (5)

DOWN

2	Operators from American vessel that carries the Queen (5)
4	Cricket gear for poor runner with flat soles (7, 8)
5	Raise row among the poles over Basic lines made under 6D (5, 10)
6	Promise of a hot stew (4)
7	It's nervous about the past, present or future (5)
8	Computer storage that confuses detectives (4)
14	Nature of CHR\$(n) (9)
17	Co-ordination — is it found in logics? (9)
18	Break taut diet for standpoint (8)
19	Disagreement with "A" as in FN(A) (8)

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YOUR COMPUTER NOVEMBER 1982

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RULES:

- The winner of the competition will be the person who enters a correct solution to the crossword and, in the view of the editor, completes the unfinished sentence in the most interesting way.
- The name of the winner will be printed in the January issue of *Your Computer.*
- All entries must arrive at the *Your Computer* offices by the last working day in November 1982.
- Each person may enter the competition only once.
- Entries to the competition cannot be acknowledged.
- No employees of IPC Business Press or their relatives may enter the competition.
- The decision of the editor is final.
- No correspondence on the result of the competition will be entered into.
- IPC Business Press assumes no responsibility or liability for any complaints arising from this competition.

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YOUR COMPUTER NOVEMBER 1982

Computer Club is here to encourage you to start your own local computer club or, if one already exists, to join it and become involved. We would like to hear of anything which has made your club a success, or of any projects or programs you are developing.

Southampton rings the changes

Each month in Southampton the Southern Gas Computer Club meets in the Corporation HQ. Many members are professional programmers but Paul Bond finds they share many of the obsessions of the home hobbyist — from Pac-man to computer art.

IT IS REWARDING to discover that we keep local user groups abreast of developments even on their own doorsteps. This month's lecture on new micros included — thanks to our October issue — the MPF-II, which is marketed by a Southampton company. Members hope that the machine will shortly be demonstrated to them.

Derek Cambray, who gave the talk, is systems programming controller for Southern Gas — so he is equally at home with an IBM-3032 mainframe or a ZX-81. This might lead one to conclude that the club has some very highly-qualified members, but it would be wrong to assume their activities are mind-bogglingly esoteric. Although the core of the club was formed about six months ago in Southern Gas's Data Processing Department, the members stress the club is very much for the enthusiastic amateur, as well as providing light relief for those accustomed to dealing in megabytes. Membership has grown steadily to include those outside the DP section, and younger users were much in evidence during our visit.

The club itself is smiled upon by the higher echelons of Southern Gas management, who are keen to encourage computer literacy. There is no stinting on facilities. Not only are excellent coffee and sandwiches provided free of charge as well as two rooms, but there is full access to all the audio-visual equipment belonging to the corporation's publicity and training departments. This means excellent quality monitors, guaranteed to turn the more impecunious computernik red, green and blue with envy, are available at every meeting.

Members are also allowed to use the company Pets — an 80-column machine with disc drive was running a script Adventure game with all the unexpected replies and jokes that around 96K can handle. Hardware was varied: two Pets, two BBC Model As, one Acorn Atom and a Spectrum, which produced impressive effects on a gargantuan Sony monitor. On the minus side, an unfortunate ZX-81 owner spent much of the evening failing to load his chess game.

One of the committee members, Andrew Craddock, had an unusual application for his Acorn Atom. A bell-ringing enthusiast, he has developed a program which, via a specially-built synthesiser peripheral, produces soothing xylophonic sounds. Since all bell-ringing is based on different permutations of eight numbers, the Acorn's job is to stand in for the seven other rope-pullers — the player provides the eighth note, according to which style one is playing in. The styles are named after counties like Yorkshire, Lincolnshire and Rutland. Computerised campanology, no less.

Ian Smith, another committee member, produces the club's newsletter — a daunting task well-executed, with the aid of John Trippick's impressive artwork. He took on the job because he was a member of two other micro clubs and, he says "I couldn't understand either of the newsletters".

Three issues have been produced already and are circulated among a membership of 60. For the future, the club's committee which, apart from Andrew Craddock, Ian Smith and Derek Cambray consists of Charles Dickens, Andy Harker and Dave Walker, plans to set up an extensive software library, and to continue their successful series of lectures on individual types of machine. If you want to find out more, contact Andrew Craddock on Southampton 824496. ■

Local society news

Computers in the Chilterns

THE RECENTLY-FORMED Chiltern Computer Club caters for enthusiasts from the Dunstable and Leighton Buzzard areas. Their meetings are held in the function room of the Five Bells pub in Eaton Bray at 7.30 on the second and fourth Mondays of each month. Telephone Stephen Betts on 0525-220922 for details.

BBCs in Preston

PRESTON AREA BBC Microcomputer User Group is starting a software library and a regular newsletter. The library will be run on a points system, with one point allocated per pound of purchase price. Members' programs will be evaluated by the club. Meetings take place at Preston Polytechnic in Room F2. For details, contact D Coulter, 8 Briar Grove, Ingol, Preston, Lancashire PR2 3UR.

Dublin micros

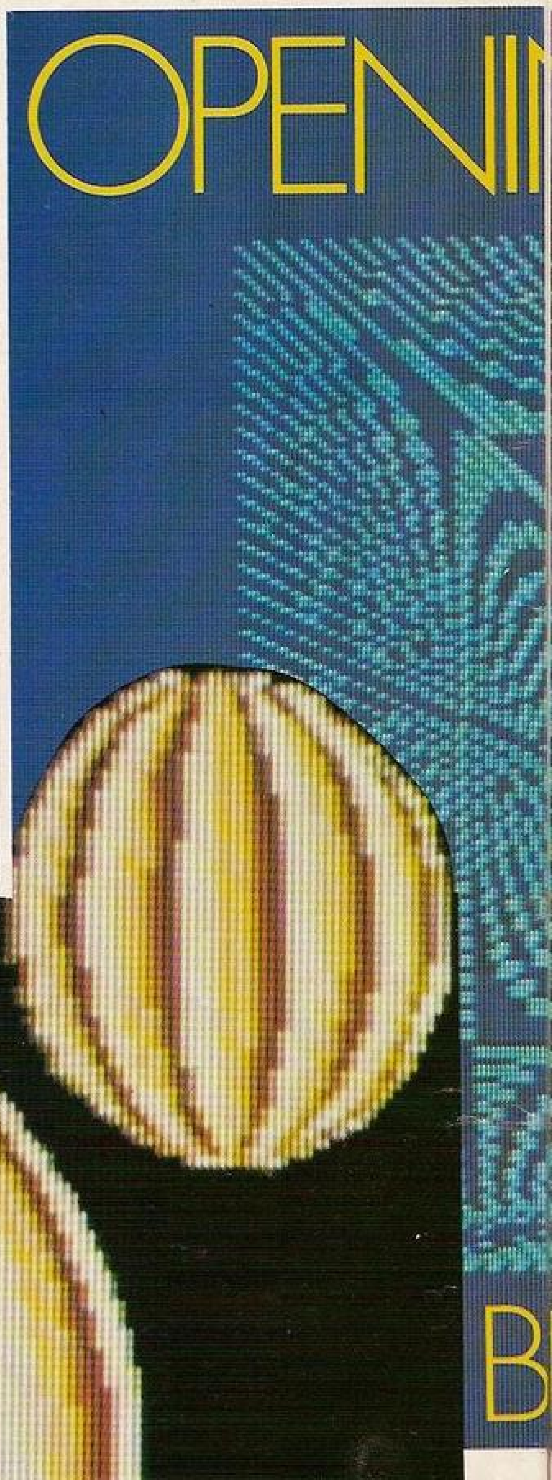
THE IRISH Amateur Computer Club, recently formed, wish to hear from anyone interested in personal computing in the Dublin area and other parts of Ireland. Contact Martin Stapleton, 48 Seacourt, Clontarf Dublin 3. Telephone 331304 or send stamped, addressed envelope to Brendan Haligan, 22 Gormore Avenue, Finglas South, Dublin 11.

Hampshire amateurs

THE FAREHAM and Portchester Amateur Computer Club have recently organised a referral service and users' group for the BBC Micro. The group meets at 7.00pm on the third Monday of each month at the Portchester Community Centre. Contact: Peter Smith, 23 Sandy Close, Petersfield, Hampshire. Telephone: 0730-4059, evenings.


ORIC-1
ORIC-1 TM
TIMELESS TECHNOLOGY FROM ORIC PRODUCTS INTERNATIONAL

Today's micros offer tremendous opportunities for colour graphics. You do not need to be Salvador Dali to conjure up surreal shapes in unnaturally bright colour any more. Tim Langdell illustrates graphics for the beginner, from simple shapes to 3D rotations.



HIGH-RESOLUTION Drawing and Plotting is a feature of the BBC Model B, the Dragon 32 and the ZX Spectrum. Although the BBC machine has finer definition both the Dragon and the Spectrum have such built-in facilities as circle drawing.

Simple plotting

The Spectrum is the easiest to use for simple Plotting to the screen. You simply envisage the screen as a matrix of dots 256 wide by 176 high and use a straightforward Plot X,Y statement to place a dot in the required position. Adding Over 1 to the statement removes the dot:

PLOT OVER 1; X,Y

On both the BBC and the Dragon you must first choose your mode of resolution. The BBC offers a choice between a 256 by 16 graphics screen, 256 by 320, or 256 by 640.

Once the level of resolution is set, you can use Move and Plot to place dots, or pixels, on the screen. Move has the form Move X,Y and moves the graphics cursor to the position X,Y on the screen without drawing anything. Plot draws using the following, very simple form:

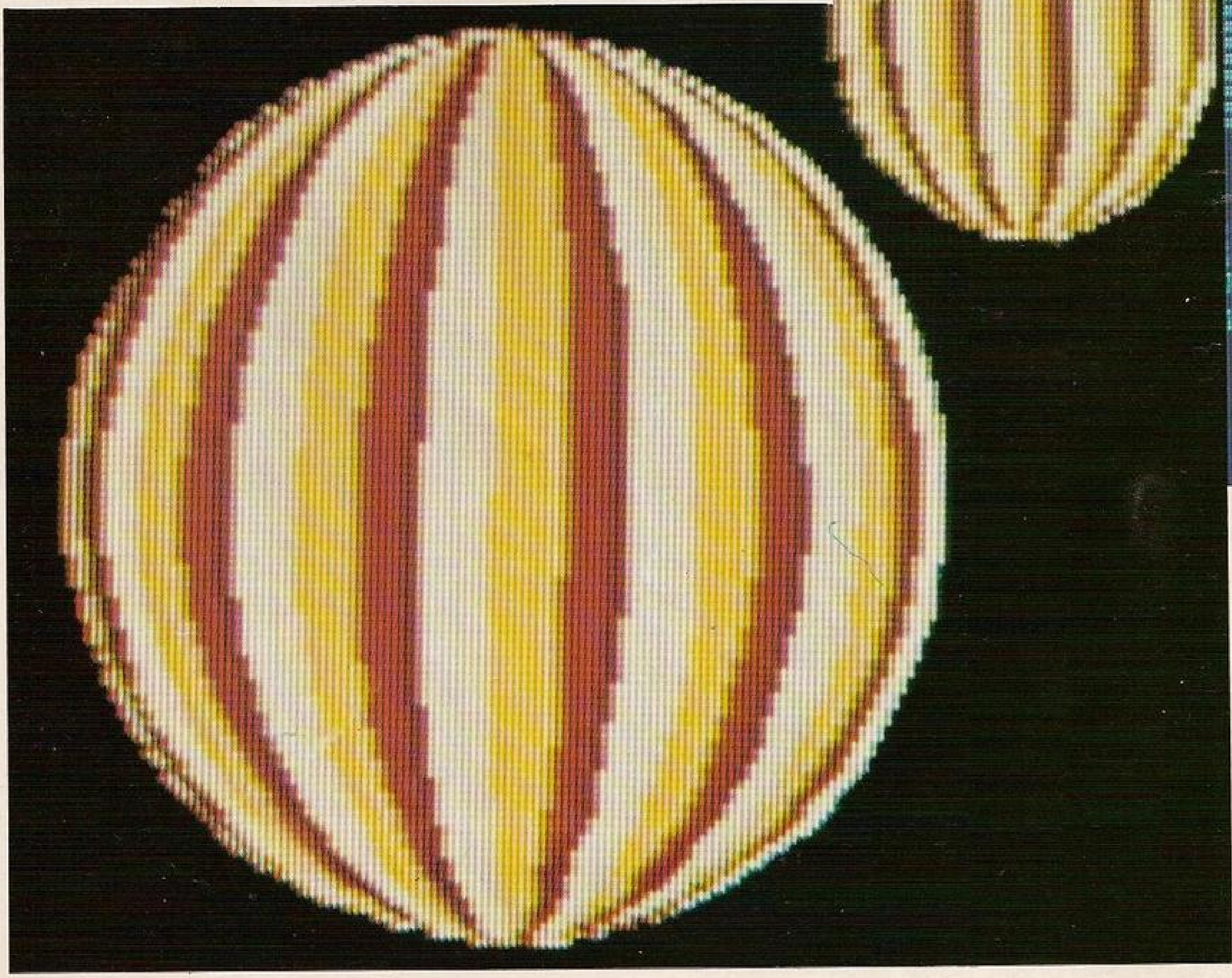
PLOT X,Y,K.

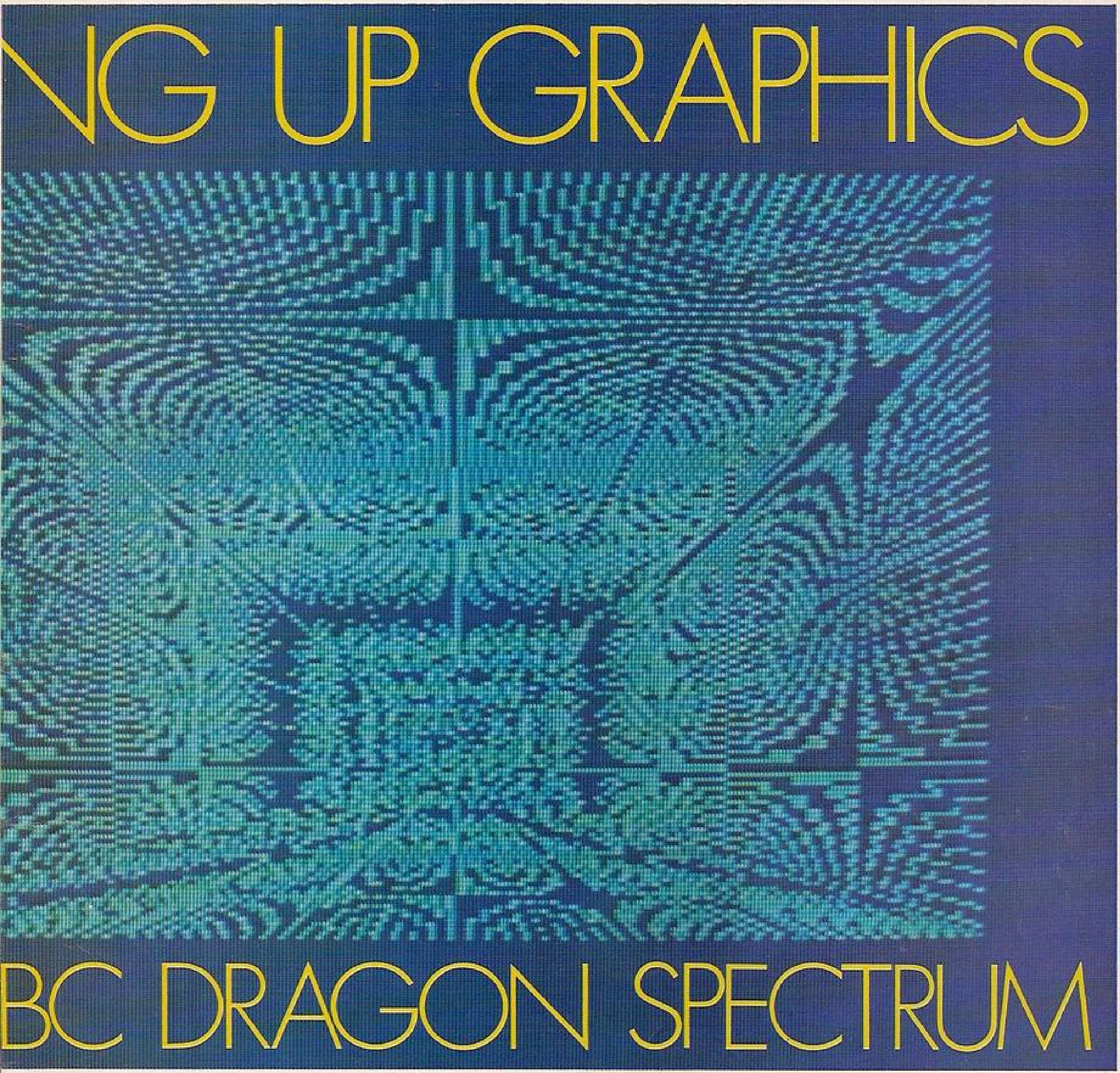
X and Y are the co-ordinates again, but K can take one of the following values:

0 Move relative to last point.
1 Draw line relative in current foreground — INK — colour.
2 Draw line relative in logical inverse colour.
3 Draw line relative in current background — PAPER — colour.
4 Move to absolute position — same as using Move.
5 Draw line absolute in current foreground colour
6 Draw line absolute in logical inverse colour.
7 Draw line absolute in current background colour.

Moreover K can have higher values: 16 to 23 draw the lines as dotted, and 80 to 87 draw filled triangles. The BBC has many more of these facilities than the Spectrum.

The Plot command is also used to draw lines on the BBC, whereas a separate Draw command is used on the Spectrum. This allows you to draw between two points defined by the last position Plotted and the co-





ordinates of another point given after the Draw keyword:

DRAW 128,88

The Dragon does not use Plot, but rather Set and Pset depending upon which mode of resolution you have chosen. In low resolution Set is used and in higher resolution Pset is used. Both Set and Pset have similar forms: Set (X,Y,C) and Pset (X,Y,C). The two co-ordinates of the point to be plotted are inside the brackets followed by a code number for the colour of the dot. In BBC Basic this colour is set with a GCol command just prior to the Plotting, whereas in Spectrum Basic one can either set the Ink colour globally or within the Plot statement itself, so that the colour is only that of the dot:

PLOT INK 2: 128,34

Drawing lines on the Dragon is done using Line, in the following form:

LINE (100,100) — (130,135),PSET

The co-ordinates of the line's starting point are put inside the first brackets. The ending point is put in the second brackets. The statement must then be terminated with PSet.

The Dragon can also draw a box with these co-ordinates by simply adding a B after the PSet. Adding BF, moreover, creates a filled box at those co-ordinates.

More complex statement

The Dragon also has Draw, but this refers to a more complex Basic statement. Using Draw on the Dragon you can create a whole series of dots and lines held within a string. The following aspects may be included in a Draw expression:

M = Move the draw position
U = Up
D = Down
L = Left
R = Right
E = 45° angle
F = 135° angle
G = 225° angle
H = 315° angle
X = Execute as substring and return
C = Colour
A = Angle
S = Scale
N = No update of Draw position
B = Blank — no Draw, just Move

In many ways this range of options is similar to the range of values of K on the BBC machine, plus the ability to define Drawing at angles to current positions, and scaling a graphic up or down. A Draw string might be:

10 DRAW "BM128,96; E25; F25; G25; H25"

This draws a square standing on one of its corners.

(continued on page 25)

(continued from page 23)

Both the Dragon and the Spectrum can draw circles with a single command; the BBC cannot. For the Spectrum, a simple Circle X,Y,R is needed, where X and Y are the co-ordinates of the circle's centre and R is its radius. The Dragon's statement is a little more complex because it makes allowance for drawing ovals and only parts of circles. It has the form

```
CIRCLE (X,Y),R,C,HW,S,E
```

where X and Y are the centre's co-ordinates again, R is the radius, C is the code of the colour to be used, HW specifies the height/width ratio, S specifies the starting point of the circle, and lastly E specifies the end point of the circle.

The Spectrum attains partial circles and arcs by using its Draw command in this manner:

```
DRAW X,Y,PI
```

This would draw a semi-circle. Spectrum owners might like to try this brief program by Andrew Glaister:

```
PLOT 55,27: DRAW OVER 1; 120,120,59↑ 3*PI
```

This single line actually produces quite amazing results which are peculiar to Spectrum Basic's Over and Circle drawing facilities. Over, on the Spectrum, operates exclusive Or printing to the screen, and this is also available on the BBC machine.

The Dragon 32 is the only machine of the three with a Paint command. This works by simply stating the starting point of the Painting process, the colour of the Paint and the colour of the line where the Painting should end.

For those with a Dragon, program D1 uses both the Paint and Get/Put features.

Get and Put are Dragon commands which can come in very useful for fast-moving games and animation. They Get an area of the screen within a box, defined by co-ordinates X and Y, and Store the points which make up that box in an array.

This array can then be put back anywhere else on the screen. The BBC machine has such fast Basic that it can attain similar results by simply Plotting or Printing user-defined characters on the screen.

The Spectrum however, has neither the Get/Put facility, nor the speed of the BBC machine. In trying to speed up graphics in games it is worth trying to put the characters into a string on the Spectrum, and then Printing the string at progressive positions on the screen.

The alternative on the Spectrum is the Poke to the screen, but this can be difficult due to the way the screen is mapped.

The first byte of each character position on the first eight rows is Poked first, followed by the second byte, and so on until the characters in the first eight rows are complete. Then the next eight rows are done in the same way, and finally the bottom eight rows.

The Dragon can perform fairly smooth graphics using its Get and Put instructions. Here, for instance, is a program which Gets a circle in the upper left-hand corner of the screen and Puts it at intervals across the screen, clearing the screen between each Put. The fairly smooth motion of the Dragon is illustrated in program D2.

The Spectrum is slower than the other machines, and short of machine code you will have to resort to tricks to portray moving graphics.

For instance, if you have two objects moving on the screen at the same time — a laser beam or bullet speeding toward a spacecraft for instance, then you would be advised to determine the speed of the spacecraft — when no firing is occurring — by the length of an overall delay loop. When the laser is fired, the delay loop slowing down the craft should be decreased and the travel of the laser arranged to take its place.

Craft and laser

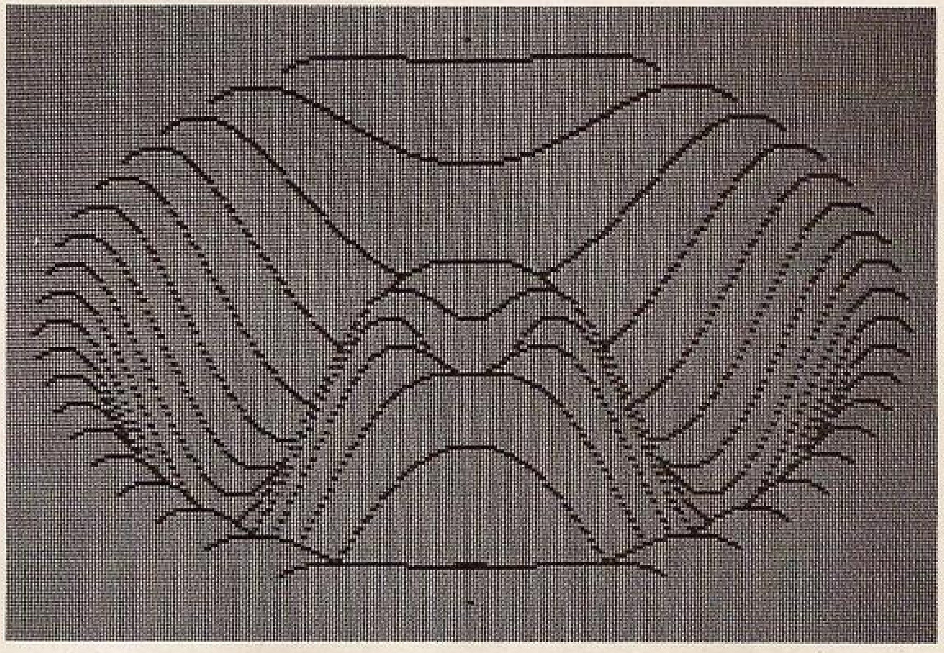
Thus the movements of the craft and laser would interchange rather than having the craft stop every time the laser fires. Even this method, though, cannot allow you to create very complex moving games on your Spectrum, although you can Poke to the screen.

First define the eight bytes which make up the character you are displaying, say, an alien created with user-definable graphics. Then Poke the first byte into the first location of the display file, 16384, followed by the next byte Poked to the location 32*8 bytes further on, and so on through all eight bytes. Then Poke these locations with zero to wipe the character off, and go on to Poke the same eight bytes into locations 16385, 16385+(32*8), and so on. You will find that this allows you to create faster-moving graphics, although your character will appear to scroll into and out of existence.

Holding the graphics information in arrays can also be recommended for the Spectrum. Using control characters in such strings allows creation of very complex figures which would otherwise take several lines of Basic.

The Dragon lets you add either S or R to a Draw statement in order to scale the drawing up or down, or Rotate it about a given angle. You can imagine how useful this is if you want

(continued on next page)



SPECTRUM

Program S1.

```
  5 DIM X(4) : DIM Y(4)
 10 PLOT 128,88
 20 FOR A=1 TO 4: READ X(A): NEXT A
 30 FOR A=1 TO 4: READ Y(A): NEXT A
 40 DATA 20,20,-20,-20
 50 DATA 20,0,-20,0
 60 FOR A=1 TO 4
 70 DRAW X(A),Y(A)
 80 NEXT A
 90 DIM H(4): DIM V(4)
100 FOR B=3 TO 50 STEP 5
110 PLOT 50 +B,88
120 FOR A=1 TO 4
130 LET H(A)=X(A)*COS (PI/B)-Y(A)
    *SIN(PI/B)
140 LET V(A)=Y(A)*SIN(PI/B)+X(A)
    *COS(PI/B)
150 NEXT A
160 FOR A=1 TO 4
170 DRAW H(A),V(A)
180 NEXT A
190 NEXT B
```

Program S2.

```
  5 OVER 1
 10 PAPER 5: INK1: BORDER1: CLS
 20 LET X1=RND*255
 30 LET Y1=RND*175
 40 FOR X=0 TO 255 STEP 0.8
 50 PLOT X1,Y1: DRAW X-X1,-Y1
 60 PLOT X1,Y1: DRAW X-X1, 175 -Y1
 70 NEXT X
 80 FOR Y=0 TO 175 STEP 0.8
 90 PLOT X1,Y1: DRAW -X1, Y-Y1
100 PLOT X1,Y1: DRAW 255-X1,Y-Y1
110 NEXT Y
```

(continued from previous page)

a plane to bank toward you and grow in size as it does so.

Neither the BBC nor the Spectrum has these facilities but simulating rotation is not too difficult. It involves the realisation that, given any set of co-ordinates, X and Y the new co-ordinates will be:

New X = Old X *COS a − Y(old) *SIN a
New Y = Old Y *SIN a + X(old) *COS a

where a is the angle you are turning the shape through. Program S1 is an example written in Spectrum Basic but easily translatable to the BBC machine.

Rotating shapes

This draws a parallelogram in the centre of the screen, then draws various rotations of the shape on the left-hand side. Unfortunately, in Basic, this routine is rather slow compared to the Dragon's built-in features, and not much use in games involving motion of any appreciable speed.

The simplest way to produce impressive graphics on the machines is to use some quirk of the way the machines does something. The one-line program for the Spectrum is a very good example of this. Another is the moiré kind of pattern that one can quite easily obtain on any of the three machines using their line-drawing facilities. Program S2 is a version for the Spectrum. A multi-coloured version of this can easily be created by adding Inks to the Draw statements.

Three-dimensional graphics are possible quite easily on each of the computers. An example for the Spectrum is shown in figure 1 but almost an identical program could be written for the other machines.

You can try Plotting different functions by changing line 60. In this example the function is:

FN A(T)=30*SIN T/12,
where T=SQR (X*X+Y*Y)

You can also vary the resolution of the Plot by changing the value of R in line 30. This can be anywhere between about 2 and 10. With R=10 the Plot will take about 15 minutes, but at resolution 2 it can take several hours.

Figure 1. Spectrum three-dimensional graphics.

```
  5 REM 3-D
 10 BORDER 1
 20 FOR X=-100 TO 100
 30 LET R=10: LET J=0: LET K=1
 40 LET V=R*INT (SQR ((10*4) -X*X)/R)
 50 FOR Y=V TO -V STEP -R
 60 LET Z=INT (80+30*SIN ((SQR
    (X*X+Y*Y))/12) -.7*Y)
 70 IF Z<J THEN GOTO 110
 80 LET J=Z
 90 PLOT X+110,Z-15
100 LET K=0
110 NEXT Y: NEXT X
```

Figure 2. Rotating ball for BBC.

```
ROTATING BALL:
 10 MODE 1
 20 PROCBALL (110,640,572,1)
 30 REM CHANGE ALL COLOURS TO
    BLUE
 40 FOR X= 1 TO 3
 50 VDU 19,X,4;0;
 60 NEXT
 70 A= INKEY (10)
 80 REM ROTATE BALL
 90 FOR X= 1 TO 3
100 VDU 19,X,7;0;
110 S=INKEY (10)
120 VDU 19,X,4;0;
130 NEXT
140 GOTO 90
150 DEFPROCBALL (S%,X%,Y%,C%)
160 VDU 29,X%;Y%;
170 MOVE 0,S%
180 FOR A=0 TO 20*PI STEP 0.2
190 SA=SIN(A)
200 Q%=1+(1+A/(PI*2))MOD 3
210 GCOL 0,Q%
220 IF SA<0 THEN GCOL 0,4-Q%
230 X%=S%*SA*COS(A/40)
240 PLOT 85,X%,S%*COS(A)
250 PLOT 85,X%,0
260 NEXT
270 ENDPROC
```

Figure 3. Fireworks for BBC.

```
FIREWORKS:
 10 MODE 2
 20 FOR G%=0 TO 20
 30 GCOL 0, RND(7)
 40 PROCelipse (0,500,120+RND(30),
    600+RND(200),
    SGN(RND)*(RND(100)),2)
 50 NEXTG%
 60 FOR G%=0 TO 20
 70 GCOL 0, RND(7)
 80 PROCelipse (0,750,120+RND(30),200+
    RND(50),SGN(RND)*(RND(150)),7)
 90 NEXTG%
100 GOTO160
110 DEF PROCelipse (X%,Y%,L%,
    XR%,YR%,S%)
120 FOR T%=0 TO L% STEP S%
130 PLOT 69,100+ SIN(RAD(T%))
    *XR%+X%,COS(RAD(T%))
    *YR%+(Y%-YR%)
140 NEXTT%
150 ENDPROC
160 FOR A%=900 TO 1000
170 GCOL 0,7
180 D=400+RND(1000)
190 PLOT 69,D,RND (1500)
200 NEXT
210 FOR A=1 TO 1000
220 GCOL 0,2
230 PLOT 69,100*SINA,A
240 NEXT
```

DRAGON

The Dragon Draws rather spiky-looking circles in one of its modes, but even this can be used to advantage. Program D3 makes a kind of lace pattern. A rather nice spiral cobweb is created by D4.

The BBC machine has a unique facility in that by drawing a series of curves or lines in a variety of colours and changing each of them, in turn, into one other colour, an impression of movement can be given.

BBC

Combining two ideas in the creative graphics package for the BBC by John Cownie it is possible to create a ball which appears to spin in mid-air. See figure 2.

In fact, the three colours involved have all been designated as blue, and then selected colours redesignated as white, and back to blue again, in sequence, to give the appearance of movement.

Finally, this month's cover was drawn on the BBC. Essentially several partial elipses were drawn turning left or right equally frequently, see figure 3.

Line 40 contains all the parameters which are passed to the procedure for the large spray and line 80 passes the necessary data for the smaller spray. Lines 30 and 70, by the way, create the random colours involved. ■

Program D1.

```
 10 PCLEAR 4
 20 DIM X (25,25)
 30 PMODE 3,1
 40 PCLS
 50 SCREEN 1,1
 60 CIRCLE (128,90),25
 70 PAINT (129,91),2,4
 80 PAINT (129,92),3,4
 90 GET (98,85)-(128,105),X,G
100 PCLS
110 FOR Y=1 TO 200 STEP -1
120 PUT (Y,85 -Y/5)-(Y+55,105 -Y/5),
    V,PSET
130 NEXT Y
140 GOTO 140
```

Program D2.

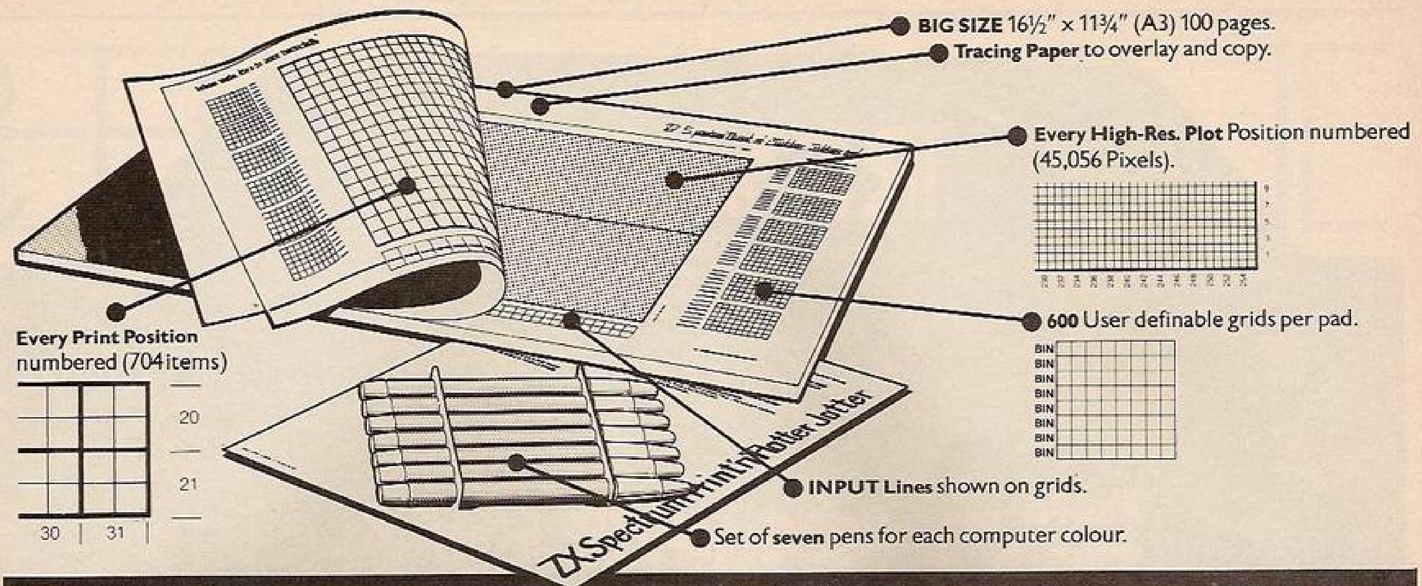
```
 10 PMODE 3,1
 20 PCLS: SCREEN1,1
 30 DIM X(20,20)
 40 CIRCLE (20,20),10
 50 GET (10,10)-(30,30),X
 60 PCLS
 70 FOR A=1 TO 500 : NEXT
 80 FOR Y=10 TO 100
 90 PUT (Y+10, Y+10)-(Y+30, Y+30),X
100 PCLS : NEXT
110 GOTO 110
```

Program D3.

```
 10 PMODE 3,1
 20 PCLS: SCREEN 1,1
 30 FOR X=1 TO 240 STEP 10
 40 FOR Y=1 TO 170 STEP 10
 50 CIRCLE (X,Y),10,,1,.3,.8
 60 NEXT X,Y
 70 GOTO 70
```

Program D4.

```
 10 PMODE4,1;PCLS: SCREEN1,1
 20 X=1.08: Y=50
 30 P=0: Q=10
 40 Q=X*Q: T=P*Y: P=P+2
 50 T=P*Y/60
 60 A=Q*COS(T)+130 : B=Q*SIN(T) +90
 70 LINE -(A,B),PSET
 80 IF A>190 OR A<0 THEN 100
 90 GOTO 40
100 GOTO 100
```



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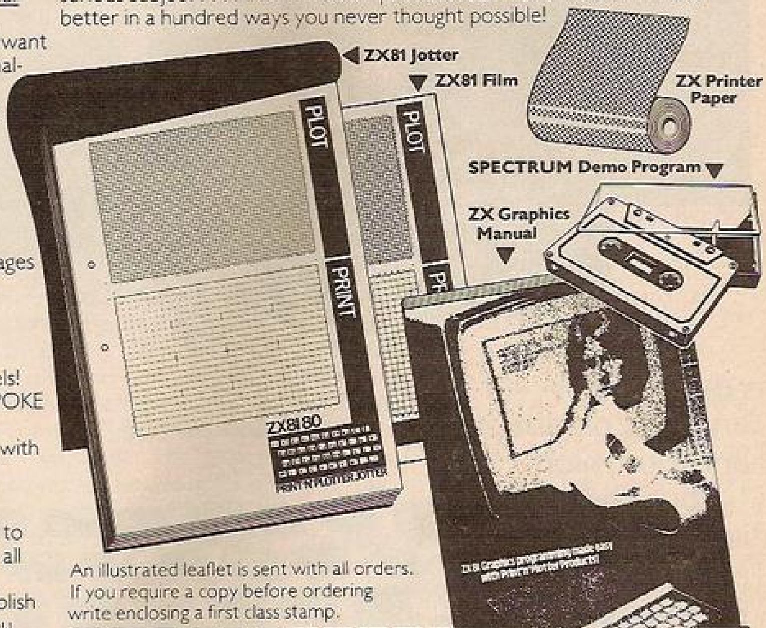

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REVIEW

Another day, another planet, another micro — but the Ace is so fast that even Bill Bennett had to switch into hyperdrive to review it.

THE JUPITER ACE is a radical departure from the mainstream of microcomputing, and could prove to be the start of a very important new trend. Rather than accepting the prevailing wisdom, Jupiter Cantab designed the machine around the Forth language. In a way, this makes the Ace a breakthrough — it is both the first mass-produced home computer not to use that tired old lady of micro languages, Basic, and is also one of the fastest micros ever made.

The speed element is vital; it is more or less the justification for using a hitherto arcane computer tongue. But speed is not the only advantage of Forth, or indeed of the Ace. It has that all-important feature; structure. Structured programming is definitely the "coming thing". It is preferred by both educationalists and professional programmers alike, and leads me to another fashionable computer buzz-word; portability.

Major differences

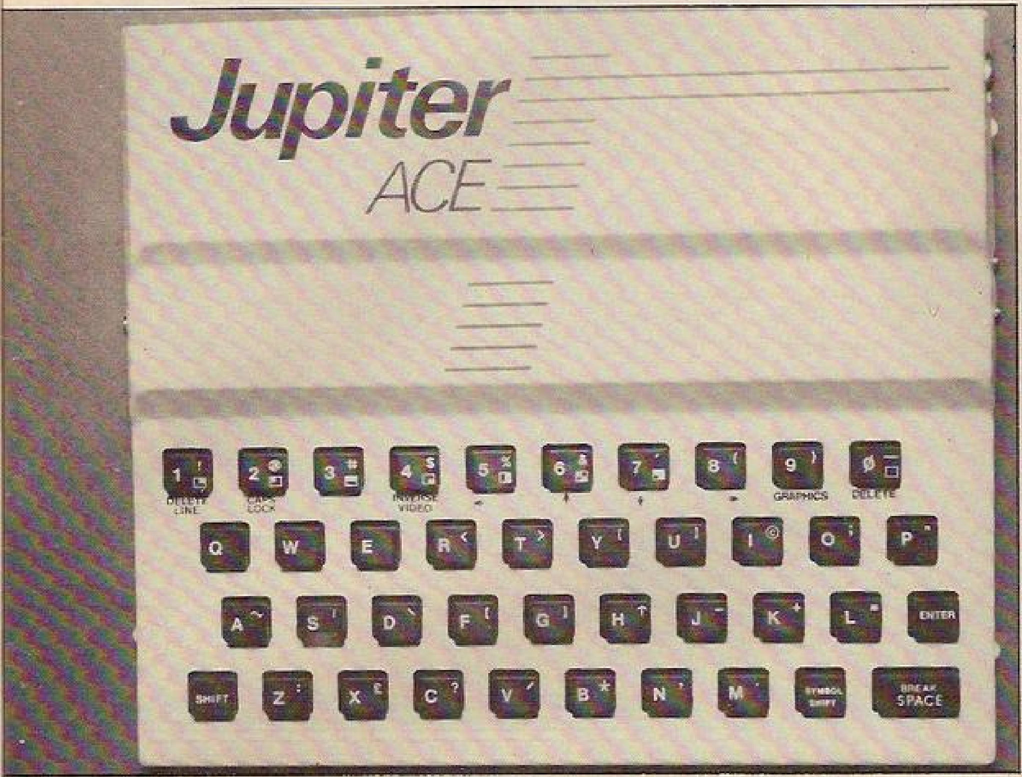
Portability is an important conception in microcomputing. Put simply it means the ability of one computer to run a program written for another, taking the hardware differences into account. Forth is highly portable. Providing the relevant hardware details, such as screen and memory size, are taken into account, any program written in Forth should run on any Forth system.

Programming in Forth is so fundamentally different to programming in Basic that some people prefer not to call Forth software "programs" at all. It is important to discard all your current ideas about programming before you start with the language Forth.

When writing a Basic program, it seems quite normal to think of the control passing through program lines. These lines are like rails along which the control runs, complete with loops and Goto jumps. The control path is often difficult to follow even in your own, short, well-documented programs. Imagine trying to sort out someone else's epic and rather badly-documented program, which they quickly wrote in the middle of the night. This just does not happen with Forth, because each little section of code is debugged as it is written, and the control path does not really exist as a concept.

A Forth system contains a set of words, called a kernel in some implementations. On the Jupiter Ace they are referred to as ROM-words, because they are in the machine's 8K of read-only memory. These words act on whatever number is on the top of the stack,

PEED MACHINE



which is the area of memory that the system plays with.

The best way to think of a stack is as a pile of plates. These plates are the numbers. Plates can be added to the top of the pile at any time, but only the one on the top can be worked on. This is a much more convenient way of managing the memory than using addresses, though with Forth it is still possible to define variables and constants.

Using Forth

Each word in the ROM-word set can be thought of as a call to a machine-code subroutine. Usually any value sent into a subroutine is called a "parameter". In Forth the relevant parameters are those numbers at present on the top of the stack. For example: plus is a Forth word — written + — which adds together the two numbers at the top of the system stack, and then puts the resulting number in their place. Thus, on the Jupiter, when you input

```
2 ENTER the screen shows 2 OK
3 ENTER the screen shows 3 OK
+ ENTER the screen shows + OK
. ENTER the screen shows 5 OK
```

The command "." prints out whatever is currently on the top of the stack. For convenience I will call this "dot". We can think of the numbers 2 and 3 as parameters sent to the plus routine, and the resultant value 5 as the parameter sent to the dot routine.

As soon as a Forth word is entered it is obeyed. A number of words can be entered at a time. For example, our example could have been input as:

```
2 3 + . ENTER
```

The result 5 is printed immediately at the cursor position. It is very important to remember to put a space between all Forth words or numbers as they are entered.

Forth really comes into its own when users start to define their own words. This is very simple to do. New words are formed by combining words already defined, and in some cases using numbers which are placed on the stack. For example, to write a word that will add two numbers together and then print out the result, we shall use the name Plus:

```
: PLUS + . ; ENTER
```

The colon at the beginning indicates that a new word is being defined. What follows it — Plus in this case — is the name of that word. We input the + and . to tell the computer that these are the Forth words which go to make up our word, Plus, and the semi-colon at the end closes the definition.

Once a new word is defined it appears on the top of the vocabulary list. The vocabulary initially contains the 140 ROM-words, and, the top word in the list is Forth. This merely indicates that the words below it constitute the main vocabulary. The Forth word VList makes the machine print out a list of all the words in the vocabulary, including all the new ones.

It is possible to define the same word twice. If, having typed in the word Plus as I described you decided that you wanted to change it so that the screen cleared first, you would have to use the editor. Enter the following:

```
EDIT PLUS,
```

and up comes the previous definition of that word, laid out thus;

```
: PLUS
  + .
;
```

The word CLS — clear screen — would need to be added before the word +. This is done by moving the cursor to the position where the extra word — or words — are to be inserted and typing that word in. The cursor-control keys are the 5,6,7 and 8, used in the same way as on the ZX-81.

Once the word has been changed to the corrected form, typing Enter now places that word in the vocabulary. If at this stage you type VList, you would find that there are two versions of the word Plus in the list. The computer would always execute the second version, leaving the first for dead. This makes debugging software incredibly easy because any incorrectly-defined words can be tested as they are entered and continually hacked about until they reach a correct form.

Because all previous attempts at the same word are kept in the dictionary, you can return to these at any time. When the definitive version of the word has been created, you can save memory space by deleting with Replace all the intermediate attempts.

Unlike most implementations of Forth, the Ace has a substantial level of error-checking. For example, the stack will not overflow. It is also made more powerful by the ability to redefine words without the system crashing.

However, should you require yet more speed than normally available, there is a Fast command. This does away with the error-checking, so it is wise to use it only when a program is totally debugged. It takes the computer's speed up to about 90 percent of a machine-coded program, but it does disable the break key.

At an end-user price of £89.95, the Jupiter Ace is an excellent way of learning an important new computer language. It will have a special appeal to those who feel that they have now grown out of their ZX-81s, especially as far as Basic programming is concerned. It will also be a Godsend to those who want the speed and economy of machine code but cannot grasp its principles.

Fast machine

The Jupiter Ace comes in a white plastic case, not all that dissimilar in style to the now-defunct ZX-80's horrible box. It is undoubtably the machine's worst feature, and the cost-cutting that has been done here could turn out to be that ha'porth of tar that spoilt the ship.

The printing on the case is in a matt-black, broken only by a series of red lines. These red lines are obviously the microcomputer world's equivalent of the "go-faster" stripes that

(continued on page 31)

(continued from page 28)
teenage car owners sport to make their old Ford Cortinas look a little sleeker.

The truth of the matter is that the Jupiter is very fast. The manufacturer claims that it is the fastest microcomputer in this quadrant of the galaxy. This has a lot to do with the rapidity of the Forth language, but some of the credit has to go to the Z-80A processor which nips along at a rate of knots — 3.25MHz to be precise.

Speed implies heat, but there is not much danger of the Jupiter overheating, or at least a sight less danger than some machines, because inside that flimsy plastic case is plenty of breathing room and what is more, the case is better ventilated than that of the ZX range of computers.

Internal design

Sinclair cognoscenti will smile when they peer inside the case and see the heatsink. I often wonder why they are such odd shapes — could it be they were designed by Picasso? Comparisons with the Sinclair machines will inevitably keep cropping up, because the designers of the Ace were, until recently, in the employ of Sinclair Research and so take some of the credit and blame for the ZX Spectrum.

Apart from the gross departure of choosing the Forth language, the design is fairly standard. Sinclair owners will find much inside the Ace's case that is familiar to them.

The keyboard closely resembles that on the ZX-81, both in the number of keys and their layout. But rather than having those horrid little squares that you have to struggle to push down as you program, the Ace uses a rubbery "moving-key" design. Personally I find it is a little like shaking a dead man's hand. The keys do at least have the advantage of being readable — that is, there are none of the Spectrum's red words which you can only track down using special spectacles.

Another small mercy that we can thank Jupiter for — or Zeus if you are Greek — is that there is no single-keyword entry to contend with. However, the designers probably did not abandon it for any good reason, but merely because the infinity of word names available to Forth makes it impracticable.

There are also some significant advances. For example, there are both upper and lower-case letters. It is also possible for the user to define his own character set — in fact by doing so, some reasonably high-resolution graphics are possible. In this way the graphics of the Ace remind me of a non-colour Spectrum. In normal mode there are 32 character positions across the display and 24 down.

In the Plot mode, there is a resolution of 64 by 48 points — not exactly high resolution. If you are prepared to play about with the character definition then this increases to a respectable 192 by 256.

The operation of the word Plot is like the other Forth words. The top three numbers on the stack are the parameters which are passed to a machine-code routine. At the top of the stack is a number which describes how the point is to be drawn, and the next two give its screen location.

Probably the biggest advantage of the Ace's picture quality over the ZX-81's is that the Ace has a rock-steady black screen on which any printing appears in white: the ZX-81 does the reverse which is not a natural way for a computer to behave.

The two machines certainly have a good deal in common, apart from the designer. The review machine did not have a power supply. That was no problem because I used the Sinclair Research one, which worked perfectly.

The user port on the rear of the Ace, closely resembles that on the Sinclair machines. It is not difficult to justify this as there are not really many ways of presenting the Z-80 lines at the edge of a board. Any device that connects to the rear of a Sinclair computer will snugly fit on the back of the Ace. All that is needed is a special cable that unshuffles the lines.

It will probably take a few months at least for a budding Forth programmer to need more than the 3K of user RAM that comes as standard with the Ace, but should you ever require more, the Sinclair 16K RAM pack will fit the bill.

Forth was originally designed as a control language, and the Jupiter Ace makes a fine control computer. In fact, this may become its eventual role. There are two words, In and Out for controlling the data lines. Put the Ace together with any of the available add-on hardware designed for the Sinclair, and you have a powerful control system.

The way forward

Other features available on the Ace include a speaker, which can operate right across the audio range. But, like the Spectum's, it is very quiet. It is controlled by the ROM-word Beep, and can be manipulated very easily by the language. Again, Forth is ideal for this kind of programming, and musical sequences are among the easiest things to write on the Ace.

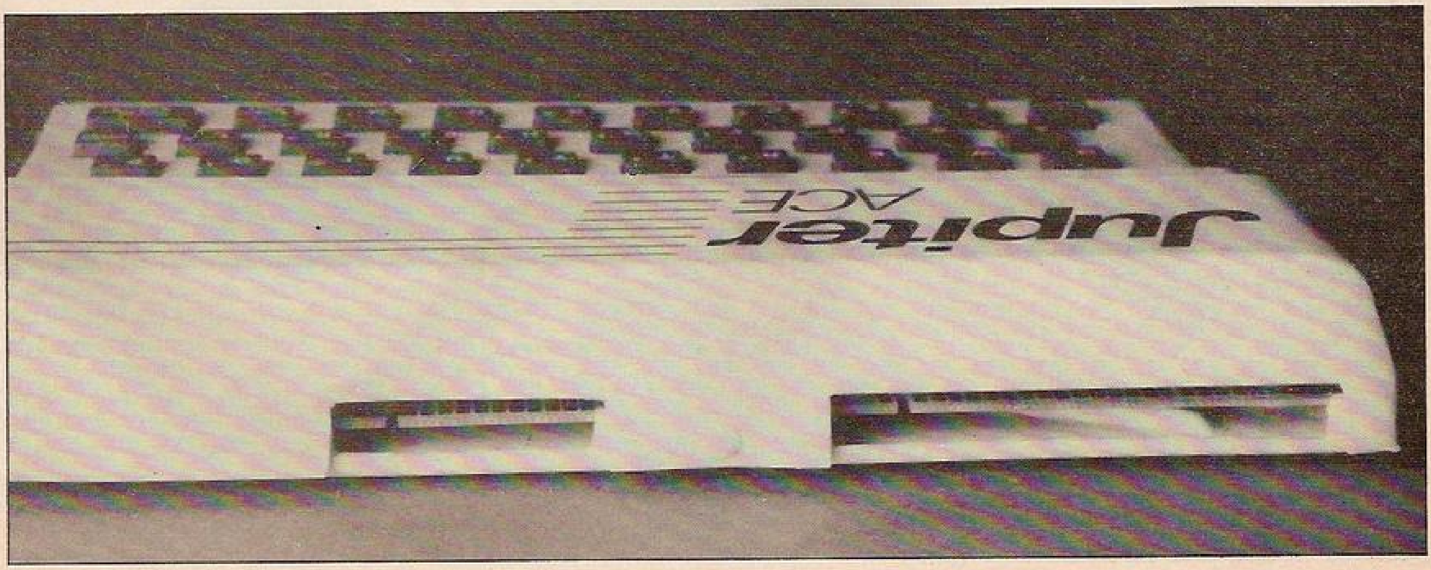
There is also a quartz timer, which doubles as the system clock. This can be accessed from Forth and has a number of possible applications. The timer sorts a number in four bytes,from 15403 to 15406. These can be extracted by use of the fetch word, written as @. I expect the most common use for such a facility will be in the timing of responses and in the generation of random numbers. Here is a very crude random-number generator:

```
: RAND 15403 @. ;
```

Perhaps the way forward for the Ace is best indicated by the other port at the back of the machine. It takes the video lines out from the main card. Eventually it will be used for a colour video generator. ■

CONCLUSIONS

- The success of the Jupiter Ace will depend on the machine-buying public's acceptance of another microcomputer language.
- The machine's development is certainly a brave gamble on behalf of its manufacturers.
- It will be of great interest to scientists, those with control applications, ZX-81 machine-code fans, educationalists and professional programmers who feel they cannot ignore the language.
- Home-computer users who have progressed beyond the beginner phase will like the language and the price but may balk at the lack of true high-resolution and colour graphics.



HARD COPY FOR M

Inexpensive printers for home computers were comparatively rare until recently. Simon Beesley takes a hard look at hard copy for the BBC Micro, Dragon and ZX machines.

UNTIL RECENTLY the Sinclair ZX Printer was unchallenged as the only low-cost printer available for micros. The Vic printer costs £230 and the cheapest printer for machines with RS-232 and Centronics ports is the Seikosha GP-100 for around £180. This prints an 80-column line and has full graphics capability but its price would probably be thought prohibitive by most home users.

The Amber 2400 costs £80.44 and can compete with the ZX printer on the same terms. It can be used on any machine with serial RS-232 or parallel Centronics ports. These are present on the Dragon, the Atom and the BBC. An RS-232 cable for the BBC Micro costs £6, parallel cables cost £11.44. Amber Controls also supplies an interface and cable for the ZX-81 and Spectrum at £21.85 and for the Vic-20 at £20.81.

The Amber 2400 is a dot-matrix printer which uses an inked ribbon on plain paper. It gives 24 characters a line in upper or lower case at a rate of 0.7 lines a second.

The cash-register-type roll is housed in a rugged and well-finished casing. While substantially heaver than the ZX printer it is small enough — 8cm. by 16cm. by 16cm. — to be portable. A line-feed button is the only hardware control.

The great merit of the Amber 2400 is its print quality. On the ZX Printer characters are often indistinct. Using a ribbon on plain paper, rather than Sinclair's aluminium-coated paper, means that the Amber's characters are remarkably clear.

Two of the six control codes which can be sent to the printer select double-width or double-height print. Four different character sizes can thus be obtained: normal — seven-by-five dot matrix; bold height — 14-by-five; bold width — seven-by-10; bold height and width — 14-by-10. The other control codes set the graphics mode, indented print format, carriage return and cancel previous codes.

In graphics mode the bit pattern of each byte sent from the computer is printed as a single line of eight dots. With 144 dots per line from a width of 18 bytes, detailed graphic printouts can be built. Amber's user manual gives two programs to print from the screen display on the Dragon and the BBC. These are rather slow but could probably be improved on.

The commands for listing or printing a string differ with the computer used. On the Dragon, for example, LList prints a listing, while on the BBC VDU 2 enables all output to the screen to be also sent to the printer.

Similarly variable is the extent to which control codes can be passed to the printer by control keys — rather than in a Print or VDU statement.

Since the code for ZX-81 characters is not standard and the Amber only accepts ASCII code there are problems in using this printer with the ZX-81. Amber's ZX-81 interface does not accept LList, LPrint or Copy, and the user must enter two software routines to send single bytes to the printer and convert to ASCII. This only allows you to print the contents of a string, not a listing.

Taking a listing from the Spectrum is possible but again you must first enter machine code and Basic programs. In view of this limitation the Amber cannot at present be considered a suitable alternative to the ZX printer for Sinclair machines. An adequate interface with the necessary software in ROM is what is needed.

But for other machines it fills the same role as the ZX Printer with the advantage of being considerably more versatile and more economical to run. Paper rolls are cheaper, costing £2.97 for five rolls as compared with £11.25 for five of the Sinclair rolls. The ribbons which cost £1.90 come in an easily-changed cartridge and last for around three 88 ft. rolls.

The facility for indenting carried-over lines by one space improves legibility but 24 columns are rather too few for a really satisfactory listing. However this drawback is compensated for by the clarity of the print and the choice of four different text sixes. Further

Below, left to right, an SP-42 printer, an Amber 2400 and a Model 81 with ZX-81 interface attached.

ICROS

details from Amber Controls Ltd, Central Way, Walworth Industrial Estate, Andover, Hampshire. Telephone: 0264-65951.

Dean Electronics supply two Alphacom thermal printers with 40-column lines. Like the Sinclair printer they use an electric pulse from a moving stylus to burn the characters from aluminium-coated paper. They take 4.2in. thermal paper rolls which are 130ft. long and cost £1.30 each. Print speed is two lines a second.

The Model 81 for £108, complete interface board and leads, runs on the ZX-81 but will also work on the Spectrum when Sinclair release the RS-232/Network board. The full Sinclair character set including inverse and graphic characters is available.

The print quality is not as fine as the Amber's but somewhat better than the Sinclair Printer's: the blue characters show up more distinctly against an off-white background.

A paper-release lever makes fitting the roll relatively simple. There is also a power switch and a paper-advance switch. The unit measures 10.5in. wide, 7.5in. deep and 4in. high. Compared to the ZX Printer it has a reassuringly solid feel to it.

The ZX-81's printer commands cannot be used. Instead it is necessary to make USR calls to machine-code routines provided on an EPROM which is plugged into the interface board. These provide three facilities in either regular or enhanced mode. You can list, print a string, and dump the contents of the screen to the printer. Enhanced mode prints double-size characters.

```
LET Z = USR 8204
```

for example, will print a listing in enhanced mode. Rather inconveniently, the ZX-81 needs to be in Fast mode before the printer can be used.

The ZX printer costs £59.95; at nearly twice the price, the Model 81 will only offer an alternative to those who value a far clearer printout and the option of enhanced mode.

The SP-42 is a slightly smaller version which can run on machines with RS-232 and Centronics ports. Dean Electronics also provide interface modules for most other machines like the Atari, the Pet and the TRS-80.

Like the Amber, commands to the printer are specific to the machine used.

```
PRINT #-2, A$
```

for example will print the string A$ from the Dragon.

Control codes provide features like vertical tab, line feed and carriage return. Sending the character-orientation code indicates which way up a character is to be printed — normal or upside down. Again, as on the Amber, the graphics mode can be set to plot a "bitmap". The printer recognises 95 ASCII characters as printable and prints in upper and lower case.

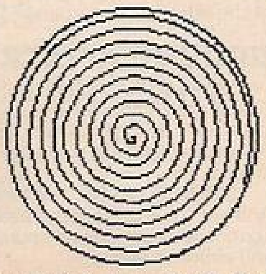
Dean Electronics are at Glendale Park, Fernbank Road, Ascot, Berkshire. Telephone: 0344-885661. ■

```
THIS IS AN EXAMPLE OF THE PRINT-OUT FROM
 THE DRAGON COMPATIBLE THERMAL PRINTER.T
HIS IS AVAILABLE FROM :
DEAN ELECTRONICS LTD.
GLENDALE PARK
FERNBANK ROAD
ASCOT,BERKS
THIS IS AN EXAMPLE OF THE PRINT-OUT FROM
 THE DRAGON COMPATIBLE THERMAL PRINTER.T
HIS IS AVAILABLE FROM :
DEAN ELECTRONICS LTD.
GLENDALE PARK
FERNBANK ROAD
```

Hard copy from the Dean Electronics' SP-42.

CONCLUSIONS

- The Amber 2400 costs only £20 more than the ZX printer but is considerably more versatile. It can interface with most popular micros at no extra cost other than the price of connecting leads.
- The use of economical plain paper and inked ribbon makes for a very clear printout from the 2400.
- The Amber benefits from the option of four different print sizes and a graphic mode; these facilities are easy to set through six control codes.
- The Amber's only drawback is that the width of the printout — 24 columns — is too narrow for satisfactory listings.
- The Dean Electronics Model 81 for the ZX-81 costs some £50 more than the ZX Printer but gives a better print quality.
- Sending commands to the Dean printer is less straightforward than on the ZX Printer but it offers enhanced mode as an extra.
- Like the Amber the SP-42 can interface with a wide range of micros but at £150 costs substantially more.
- Print quality is not quite as clear and it does not offer as many print sizes.
- In its favour are a 40 — as opposed to a 24 — column line and a faster printout. These make it more suitable than the Amber for serious applications.



DOUBLE WIDTH
Double Height
Double Width
and Height

```
LIST110,230
  110 REM PRINT GRAPHICS
  120 *FX5,1
  130 FOR Y=576 TO 0 STE
P -4
  140 A%=&11:VDU1:PRINT
CHR$(A%);
  150 FOR X = 0 TO 576 S
TEP 32
  160 A%=0:B%=128
  170 FOR X1 = X TO X+12
8 STEP 4
  180 IF POINT(X1,Y)=3 T
HEN A% = A%+B%
  190 B%=0.5*B%
  200 NEXT X1
  210 VDU1:PRINT CHR$(A%
);
  220 NEXT X:NEXT Y
  230 REM PRINT TEXT
```

Amber output.

```
THIS IS AN EXAMPLE OF THE ENHANCED TYPE
IN THIS ZX81 COMPATIBLE PRINTER

AND THIS IS THE REGULAR TYPE ON THIS
ZX81 COMPATIBLE PRINTER.
FULL DETAILS ARE ON THE ATTACHED DATA
SHEET.

THIS IS AN EXAMPLE OF THE ENHANCED TYPE
IN THIS ZX81 COMPATIBLE PRINTER
```

Dean Electronics' Model 81 — sample printout.

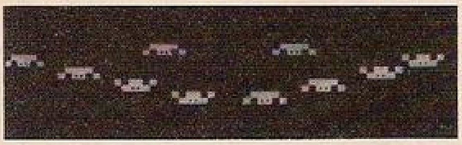
Eric Deeson has an entertaining time checking out the latest batch of ZX-81 games.

MANY GALAXIAN ADDICTS will be very happy with Artic's version, a short, but satisfying, machine-code product. It is not outstandingly fast, so that means high scores with the owner's name come thick and fast.

Abersoft's machine-code invaders follows the standard routine closely, is adequately designed and speedy; surprisingly, though, Break is not masked.

A new Breakout-type arcade game for the ZX programmer, Blastout, recently appeared on the Planet Software label. The control keys are Z and X — not a good choice, but the game is fast, with a reasonable attempt at making Sinclair graphics represent Breakout colours.

The first ZX Phoenix has appeared in the guise of Work Force's Winged Avenger. The copy reviewed was pre-production and it took a while to work out which keys to press, but this prototype has great promise — look out for the real thing. Asteroids is a popular arcade



game which ZX writers are strangely reticent in tackling. Silversoft is one of the few to attempt the game. The result, Meteor, is a trifle pricey at £5.95, but is a fully-fledged implementation.

Now for the Pac-Man-style batch. It is hard to do justice to them all — there are four close copies, plus the unusual Gulp from Campbell Systems. Its menu includes excellent instructions, and a choice of maze and speeds. There is only one gulper but one is quite enough. The four others include Zuckman by DJL Software, Zedman by Babtech, Mazeman by Abersoft, and Artic's Gobbleman.

The steady flow of Adventures for the ZX-81 all have the same basic skeleton: a quest for something, barriers to overcome, a track to find and fights to fight. Some scroll, as opposed to giving the rather dreary standard print and display. Non-graphic Adventures are now becoming thin on the ground. Even the collection of three from Phipps includes simple little map fragments. Although in a different league from the fully graphic games, I like this cassette — three classic adventure scenarios for £5 seems reasonable.

Well documented

Sorcery from Saxon Computing, is a well-documented Adventure set in Arthurian Britain. Although I liked it, I found it remarkably unpolished in a number of ways and there was one serious bug: on being confronted by a cliff-face, I moved east and was mysteriously transported into a totally different scenario.

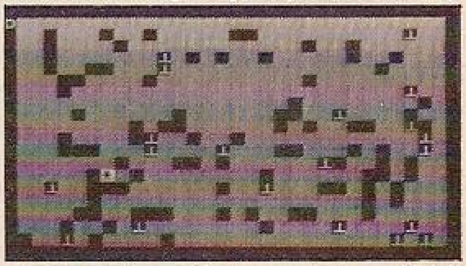
Moving on to look at adventures with pictures, I was particularly taken by Mazogs from Bug-Byte; the name is a compound of maze and trogs. The graphics are impressive, consisting of a two-dimensional maze in which you control a running figure, looking for a sparkling silver bar. The Mazogs are monsters patrolling the maze — wonderful black elves who have to be seen, with rubbed eyes, to be believed.

Assistance comes in the form of a sword with which to clear the way; the maze walls also enclose prisoners who can give you directions to the treasure. Of course when you do find the treasure, you have to escape from the maze — and with the treasure you cannot carry a sword.

That particular maze game is certainly a hard one to follow, but Doric Computer Services' Oracle's Cave is a well-executed, though somewhat slow, fully-graphic adventure game, for one or two players. There is a choice of quests and the status of each player is continuously displayed. Apart from some grammatical lapses and the lack of indication of your current position on map, this remains an extremely competent product.

Scout from Deltasoft, an impressive German ZX Software house, is an ingenious mixture of

Missile Command and Fighter. It comes with nine neat key overlays and an excellent booklet, whose English puts many U.K. suppliers to shame. During the game you must destroy



the 27 attackers without running out of fuel, oxygen, ammunition or shields. The three-dimensional graphics and other little tricks makes this a game which you will enjoy for a long time.

Several three-dimensional mazes have appeared lately. Apart from J K Greye's archetypal Monster Maze, Planet Software's version is perhaps the most impressive. Excellent graphics mixed with nice touches of humour and a turn of speed make a worthwhile combination.

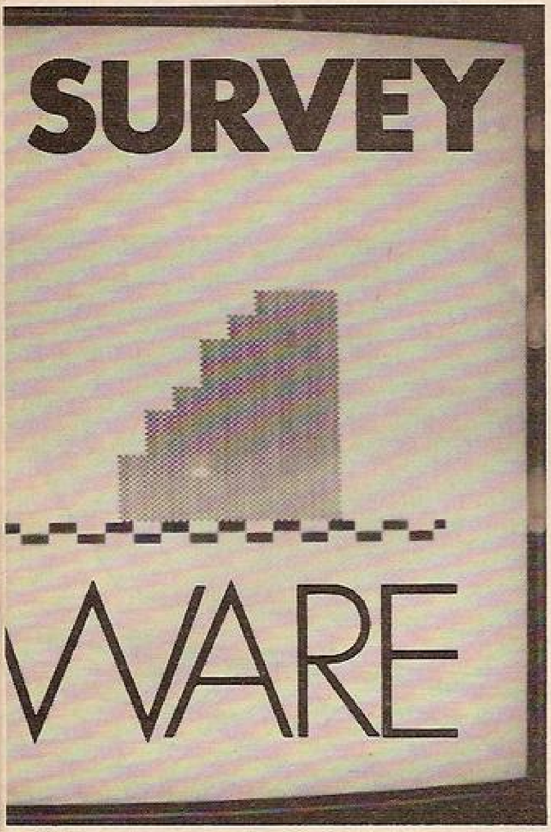
A standard type of graphic adventure is Damsel and the Beast from Bug-Byte. This is not one of the company's best — a purely Basic product with no written or internal instructions and no zip at all.

Quite the opposite is 3-D Defender from J K Greye. This is his fifth Gamestape and it is comparable to Monster Maze. This new product is just as innovative as standard Defender, but your view is from the cockpit rather than from the ground. A display of instruments is shown, together with the sky and approaching fliers. Key layout is good; there is a choice of keys for each function. 3-D Defender demands a lot of skill.

Perhaps most original of all the new graphics adventures is Newsoft's Time Bandits. The

Suppliers and addresses
Code

1 **Abersoft** 7 Maes Afallen, Bow Street, Dyfed.
2 **Addictive Games** 2676 Conniburrow Boulevard, Milton Keynes.
3 **Aquarius Software** 53 Towncourt Crescent, Petts Wood, Kent.
4 **Artic Software** 396 James Reckitt Avenue, Hull.
5 **Babtech** 3 Baberton Mains View, Edinburgh.
6 **Bobker** 29 Chadderton Drive, Unsworth, Bury, Lancashire.
7 **Bug-Byte** 98-100 The Albany, Old Hall Street, Liverpool 3.
8 **Campbell Systems** 15 Rous Road, Buckhurst Hill, Essex.
9 **Cases Computer Simulations** 14 Langton Way, London E3.
10 **Deltasoft** Osterfeldstrasse 79d, D2000 Hamburg 54.
11 **Digital Integration** 22 Ash Church Road, Ash, Aldershot, Hampshire.
12 **DJL Software** 9 Tweed Close, Swindon, Wiltshire.
13 **Doric Computer Services** 17 Claybrook Avenue, Leicester.
14 **J K Greye** 16 Park Street, Bath, Avon.
15 **Newsoft** 12 Whitebroom Road, Hemel Hempstead, Hertfordshire.
16 **Michael Orwin** 26 Brownlow Road, London NW10.
17 **Phipps Associates** 3 Downs Avenue, Epsom, Surrey.
18 **Planet Software** 10 Norton Drive, Eaton, Norwich.
19 **John Prince** 29 Brook Avenue, Manchester 19.
20 **Quicksilva** 92 Northern Road, Southampton 2, Hampshire.
21 **Saxon Computing** 3 St Catherine's Drive, Leconfield, Humberside.
22 **Richard Shepherd** 22 Green Leys, Maidenhead, Berkshire.
23 **Silversoft** 35 Bader Park, Bowerhill, Melksham, Wiltshire.
24 **Vortex Software** 16 Crawford Road, Hatfield, Hertfordshire.
25 **Workforce** 140 Wilsden Avenue, Luton, Bedfordshire.



source of the idea is obvious from the title; the real novelty is in the thoughtful implementation. On side A you have the chance to practise any of the five sub-games. When you graduate to side B, you experience the entire gamut in one game.

Aquarius Software has added another Star Trek to the several that already exist. Unoriginal and rather slow — being pure Basic — this program is cheap and does follow the well-defined rules. Much more interesting is Cosmos from Vortex Software. This is the pick of the company's batch, and a splendid machine-coded combat it is. You dart around space defending a convoy from alien spacecraft. Controls, once mastered, are good, and so are the score displays.

Remaining in orbit, Richard Shepherd's Space Mission provides great competition. The graphics for this space combat are spectacular, and the program shows great attention to detail. There are seven skill levels.

A simulation is a serious gaming product which tries to mirror some aspect of real life and perhaps even teach concepts or skills. One example of this is Football Manager from Addictive Games.

Management heavy

In this you play the role of a management heavy, buying and selling players, borrowing money, playing league games and generally enjoying the hurly-burly of screen life. A cunning tension-building device is the newsflash display which keeps you up to date on how your team is doing in a match.

Microcomputer flight simulations are becoming commonplace. A great one from a newcomer to the ZX scene, Digital Integration, is Fighter Pilot. Partly machine-coded and relatively fast, this game allows you to choose to practise landings or to attempt a full take-off, circuit, landing sequence. All this is pure instrument flying — 10 displays to watch and eight controls.

Night Gunner, another cassette from the same company, put you in the control seat of a rear gun, with targets weaving around in the night sky.

One company apparently going all out in the simulations direction is Cases' Computer Simulations. It has two products of the computerised board-game type, Autochef — in which you have to build up a fast food empire, and Airline — in which you emulate Freddie Laker.

Class of its own

In a class of its own is a new ZX chess, from Abersoft. This is extremely easy to use, plays very well and has seven levels giving black and white choice plus offering Copy. It is, in my opinion, the first piece of software to succeed in representing chess pieces with Sinclair graphics.

Michael Orwin's Cassettes 3 and 4 each have eight reasonably lengthy 16K games for £5. These contain a good blend: Adventure games, Invader-style material, serious games like Life and less serious ones like Oxo. Orwin's own name appears as author for only one of the 16 games — Fungaloids — but it is the pick of the bunch, a cross between Defender and Triffids.

Richard Shepherd's Bargain Bytes appeared in April, claiming to be first of a series, although further collections have been tardy in appearing. At £5 for eight 16K programs, each recorded once, this seems to be direct competition for Orwin. The games — fine as far as they go in stolid, uninspired Basic — are, however, hardly novel. There is a Hangman, a Mastermind, a Depthcharge, and two Adventures, one undersea, the other underground. The Adventures are Shepherd's main games on this cassette; they follow the usual format and tend to be rather slow, but this does not seriously detract from Adventure games.

John Prince has tried to go one better with his Astro-Invaders collection, but the Invaders itself is rather strange — it takes a while to figure out the controls, which turn out to be a trifle slow-acting. Some of the effects are quite nice, but there are many better implementations around. Prince's makeweights on the £3.65 cassette are better, even if not original — Grand Prix, Penalty, Golf and Swat.

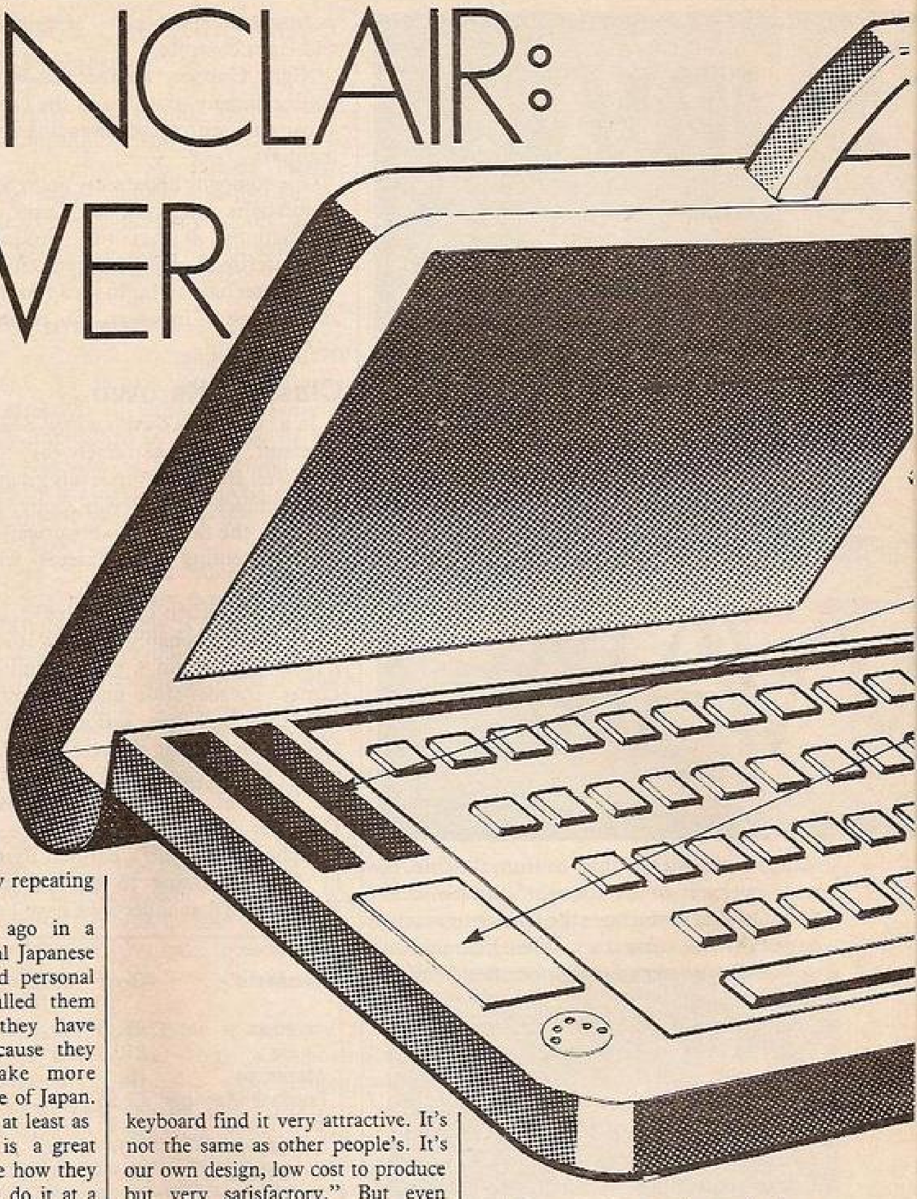
CONCLUSIONS

- The ZX-81 software market continues to be a very difficult one. Roughly 1,000 cassettes are available for this machine in Britain alone.
- There is a tendency for prices to fall and quality to rise, but slowly.
- Of course, there are some superb ZX games around now — but there is a whole load of rubbish riding on their backs, sometimes even from the same suppliers. Let the buyer beware.

Cassette	Cost	Code	Description	Assessment A	B	C	D	E	F	G	H
Invaders	£5	1	Arcade	—	5	4	3	4	3	4	1
Chess	£10	1	Full graphic	—	5	4	5	5	5	5	3
Mazeman	£5	1	Arcade	2	5	4	3	4	4	4	3
Football Manager	£7.95	2	Simulation	4	5	4	4	4	3	—	4
Star Trek	£3.95	3	Standard	4	5	3	3	3	2	2	2
Gobbleman	POA	4	Pac-Man-style	—	3	3	4	4	5	4	3
ZX Galaxians	£3.95	4	Arcade	—	5	4	5	5	4	4	4
Zedman	£5.95	5	Plus Invaders	—	5	4	3	4	4	4	4
Venture	£5	6	Seven in One	0	5	4	4	3	3	4	5
Mazogs	£10	7	Maze Adventure	4	5	5	4	5	5	5	5
Damsel & Beast	£6.50	7	Adventure	—	5	3	1	2	3	1	2
Gulp!	£4	8	Novel Pac-Man	2	5	5	4	5	5	5	5
Autochef	£4.75	9	Simulation	1	5	3	3	2	3	—	3
Airline	£4.75	9	Simulation	1	5	3	3	3	3	—	3
Scout 1	POA	10	Space fighter	5	5	5	2	4	4	5	4
Night Gunner	£3.45	11	Target	4	5	4	3	4	4	4	4
Fighter Pilot	£3.45	11	Simulation	3	5	4	3	4	4	—	4
Zackman	£5.95	12	Arcade	—	3	4	3	3	3	3	3
Oracle's Cave	POA	13	Graphic adventure	3	5	4	4	4	3	4	4
Defender	POA	14	Arcade-type	2	3	5	2	4	4	4	4
Time Bandits	£4.95	15	Complex adventure	1	5	3	3	4	4	4	5
Cassette 4	£5	16	Eight games	2	4	3	3	4	4	4	3
Cassette 3	£5	16	Eight games	3	4	3	4	4	3	3	4
Adventure	£5	17	Three of them	—	5	4	3	3	3	1	2
Blastout	POA	18	Arcade	1	5	4	3	5	3	4	3
3-D Maze	POA	18	As title	—	5	4	4	4	4	4	3
Astro-invaders	£3.65	19	Plus four small games	—	5	4	3	2	2	3	1
Scramble	£5.50	20	Defender plus	1	5	4	3	4	5	5	4
Sorcery	£4.95	21	Adventure	2	5	2	3	3	3	—	3
Space Mission	£6	22	Complex, arcade-type	—	5	5	5	4	5	5	4
Bargain Bytes	£5	22	Eight programs, four games	4	5	3	4	3	3	2	1
Asteroid	£5.95	23	Arcade	—	5	4	4	4	4	3	3
Cosmos	£5.99	24	Graphics, Space	—	5	4	4	4	5	4	5
Winged Avenger	£5.95	25	Phoenix	—	5	4	3	4	4	4	4

The assessments in this table range from 0-5 under the following heads: A, documentation; B, ease of loading; C, format/screen layout; D, ease of use; E, functional value; F, programming quality; G, graphics quality; H, novelty.

CLIVE SINCLAIR: WHATEVER NEXT?



One name is stamped indelibly on most British computers — Sinclair. Now Meirion Jones finds out what else Clive has in store.

CLIVE SINCLAIR epitomises all that is best in British industry — or at least people in high places think so. When Margaret Thatcher presented the Japanese Prime Minister with the latest Sinclair machine in front of a television audience of hundreds of millions, many must have been delighted at this demonstration of Britain outdoing the Japanese in high-technology consumer goods.

Others who, after four months, were still waiting for their Spectrums to be delivered or whose machines had proved unreliable on arrival may have viewed the spectacle with less enthusiasm. But love him or loathe him, no-one can deny Sinclair's pre-eminence in silicon Britain or his startling record of technological innovation. In the early 1970s he produced the world's first pocket calculator and followed it up with the Black Watch — the first to have all its electronics on one chip.

He opened this decade with the ZX-80, the first mass-produced home computer and soon followed it up with the ZX-81 and Spectrum, selling 500,000 computers in three years.

Now Clive Sinclair has become as synonymous with computers as Hoover is with vacuum cleaners. Yet unfortunately Sinclair's ventures have not always been as successful as expected. His calculator was soon overwhelmed by competition from the Far East and his digital watch had to be withdrawn because of unreliability and delivery delays, leaving the field clear for the Japanese.

Partly in response to these tribulations he has developed an unusual way of working. Despite a turnover of £30 million a year and rising, he employs just 50 people who concentrate on research, development and marketing while he farms out production of his proven inventions: "We're a nexus; we cause things to happen then stand back." With customers grumbling about delivery delays and a Japanese computer invasion on the cards can Clive Sinclair stop history repeating itself?

"That's a long time ago in a different business. Several Japanese companies have launched personal computers and then pulled them out. Time and again they have failed; they are out because they can't get in. We make more computers than the whole of Japan. As long as our volume is at least as high as theirs — and it is a great deal higher — I don't see how they can compete. They can't do it at a low price".

If the Japanese cannot do it, how about Binatone's computer with 16K colour and sound for £50 to be launched in January? — "I'll believe it when I see it. Binatone wouldn't know how to design the thing and we don't know of anyone in the Far East who could do it for them."

'We make more computers than Japan'

Sinclair's £125 Spectrum has become the standard by which other micros are judged: — "We started with the ZX-81, where people wanted something extra — a moving-key keyboard, colour and sound and a larger internal memory. The Spectrum was a solution to that." While the 16K of RAM and quality of colour were an instant success, the keyboard was criticised for its lack of a full-size space bar and for what one rival called the "dead-flesh" feel of the keys.

"People who've actually used the keyboard find it very attractive. It's not the same as other people's. It's our own design, low cost to produce but very satisfactory." But even Sinclair has to concede that it does not make word processing easy: "The keyboard may be a limitation but you could put another keyboard on it if you were really that desperate."

The success of the Spectrum has brought its own problems. Hundreds of Sinclair customers have written to or telephoned *Your Computer* to complain about delivery delays. "They're entitled to complain and we don't take it lightly. We did get things wrong but we've moved heaven and earth to correct it — the criticisms are justified and we'll make damn sure it doesn't happen again."

What angered customers most was Sinclair's failure to give realistic delivery dates and the lack of information about problems with the Spectrum's printed circuit board and power pack which have since been solved.

Sinclair prefers to interpret the delays as a back-handed compliment to the Spectrum. "Yet again, we've been amazed by the demand. It's not that we don't learn, it's just that this time we deliberately didn't advertise in the national press to start with in order to restrain demand.

"Nonetheless sales of the Spectrum have been just as high as with the ZX-81 which we advertised nationally despite the fact that it is more expensive. In addition we've been behind schedule but we're on schedule now and catching up rapidly."

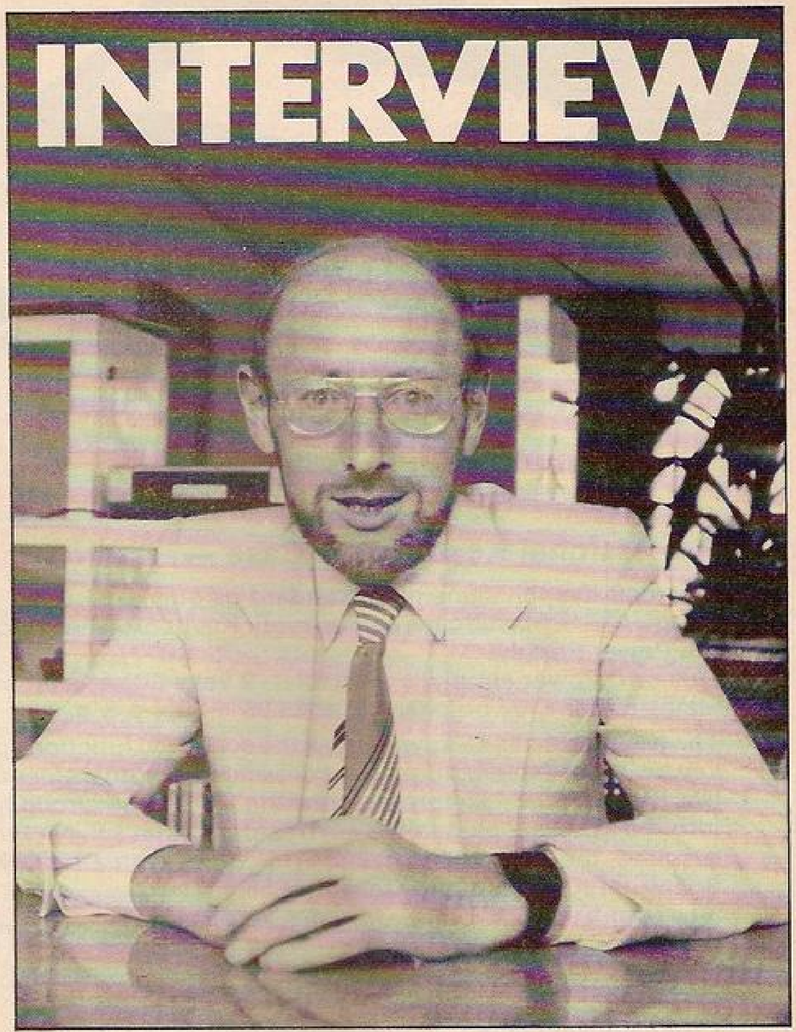
Clive has little time to read micro magazines: "There are so many that I only have time to glance at them" but he had read September's *Your Computer* interview with Hermann Hauser of Acorn with more than passing interest.

'They're entitled to complain and we don't take it lightly'

Ever since the BBC chose Acorn rather than Sinclair to produce the BBC Micro, the Cambridge air has been suitably blue with allegations and counter-allegations between the rival firms. Sinclair is particularly scathing about Hauser's claims for the Electron, Acorn's Spectrum challenger due to be launched next

Your Computer artist's impression of Sinclair's 1983 briefcase computer. The machine will feature one or two Microdrives and a flat screen. Other likely features include telephone Modem, improved keyboard and battery operation.

INTERVIEW



month: "The Electron isn't here for a start — not expected by them until the end of the year — and not by anybody wise until next year. It will come out a year later than the Spectrum and will be way behind it in technology.

"It will have — as Hauser says — more RAM, more ROM, more ULA, for the simple reason that in my view they don't know how to produce a machine half as well as we do. Ours isn't complex if you mean it has fewer chips — but that of course is the clever bit about it. It takes them 32K of ROM to do the interpreter and so on, which we do in 16K: they need 32K RAM minimum because their display takes 20K to do exactly the same as our display does in 8K. It's going to be much more expensive to make than the Spectrum and it only does the same job — in some ways not as well.

"They were announcing it at the same time as we were announcing the Spectrum — by the time it does appear I'm afraid the competition will be so fierce in that sector of the market that I think it will be too late. Hauser says that if he does have a problem, he just picks up the telephone. Well, we don't — we do it all in-house."

Sinclair is no less damming about the BBC machine. "If it wasn't for the fact that the BBC for their strange reasons allow Acorn to stick a BBC logo on their machines I don't think they would sell many computers. Hauser says it's an Apple and Pet competitor. Those machines were designed a long time ago and the Spectrum far exceeds their specification — and so it should, it's up to date."

Hauser's claim that BBC Basic is becoming the standard particularly offends Sinclair's sensibilities: "Sinclair Basic is the most widely used in the world today — by the end of this year half the computers produced in the world will have our Basic on them — if that's not a standard what the hell is?" Sinclair freely admits that his Basic may not be suitable for all applications but r[illegible] than restructuring his Basic [illegible]lieves in "Horses for courses. We will offer a whole range of languages for the Spectrum."

Sinclair damns his other competitors with faint praise. "Commodore is a very effective company but technically way behind. Then again, Commodore makes many machines we don't have anything to compete with." He does not see Commodore's forthcoming Max as a threat either: "It's a games machine, that's all." As for the Dragon and purpose-built Spectrum-bashers like the Oric he will only say "Wait and see".

Next month Clive Sinclair takes the wraps off his most closely guarded secret, the Microdrive. If it is half as good a storage system as he claims, his competitors have much to fear. Until now if you wanted to use your machine to handle information you could either store the data on cassette and wait for hours when you needed it, while the computer found the right pieces of tape, or spend a small fortune on a 5.25in. disc-drive system and do the job properly.

> **'We have the flat screen, we have the Microdrive'**

Now the manufacturers are miniaturising the drives to take 3in. and 3.5in. discs and bringing prices down to size as well. Sony, Hitachi and BATS have all produced small drives which could be on sale for less than £200 by early next year, but once again Sinclair upstaged his rivals by announcing — last St George's Day — that he would release a 100K rapid-access storage system, the Microdrive, for £50.

Sinclair's reluctance to release any further details since April, together with the low price, has fuelled speculation that his micro-floppy might not be a real disc drive. Sinclair will only say "it will do exactly the same job as the other drives" and he is particularly indignant at Hermann Hauser's claim that the Microdrive will be obsolete before its launch.

"The micro-floppy is the most important thing we're doing and contrary to what Hermann Hauser supposes it is actually well in advance of the 3in. and 3.5in. machines that the Japanese are doing and less expensive." As for access times: "They're all a sight faster than any customer is ever going to need, it'll do anything you want it to do. "The Japanese ones even for large volumes will retail at twice our price. I was talking with Adam Osborne about this and he wants to buy ours even though he can buy anywhere in the world".

Like Sinclair, Osborne was once an electronics writer before he started building the briefcase computers which now carry his name and which Sinclair admires. "That portability thing makes it very sexy but the true virtue of his machine is that it's all in one package. You don't have all those cords trailing about to plug together."

It comes as no surprise that Osborne is working on a less cumbersome successor to his present machine incorporating Microdrives. Could Sinclair be working on a lightweight briefcase machine himself?

He has spent 10 years perfecting

(continued on page 41)

(continued from page 39)

the flat-screen television and now has the Microdrive. Both are likely to find a place in next year's new Sinclair, which will not be called the ZX-83.

"That's a likely product. We have the flat-screen technology, we have the Microdrive technology. Late next year we'll have a machine which is not a replacement for anything we have now, and which will have the display and the drives. It is for that reason that I don't think our opposition stands a heck of a chance — because we can do that and nobody else can. Obviously it is going to cost a lot more than the Spectrum."

Next year's model should also step straight into the era of electronic mail. It will incorporate Sinclair's telephone Modem which will become available as a Spectrum add-on early next year for about £50. "When you're linked to the telephone you can send a message from one computer to another, so you've got electronic mail."

The Modem will also allow Sinclair owners to access databases like Prestel and viewdata. Sinclair plans to use Prestel to sell programs. Sinclair owners will be able to download games programs from the telephone line. "It's a good way to sell software, the sort of thing we're doing will probably be a great boost for Prestel."

Sinclair seems confident that Prestel will at last make the long-predicted breakthrough, if only because he expects hundreds of thousands to buy Spectrums and Modems. "We won't get our fingers burnt at all because we're simply offering a facility." Sinclair believes that the size of this market may encourage others to set up their own databases: "Other companies will set them up — we're talking to them about it now."

Electronic mail may also extend the useful life of the ZX Printer, "From time to time you need hard copy either for electronic mail or for the data you're taking from the Post Office viewdata system. That's where our printer becomes so important."

He rejects criticisms that the print-out on narrow aluminised paper is unsatisfactory: "We're not replacing it at all because that printer has the unique ability to do graphics very rapidly, to print out a complete screen of data in 12 seconds. No other machine can do that at anything remotely like the price."

Those who want typewriter quality print-outs will have to wait another year for a solution from Sinclair but, in the meantime, next month's release of the Sinclair RS-232 interface will make it easier to find a compatible printer.

"We are developing a plain-paper printer — not before the end of next year — but that's a full-size printer for letters, stationery, invoices, and things like that."

Sinclair is also working on a desk-top executive machine for ICL which will incorporate many of the same ideas. "A couple of Microdrives, 7in. or 9 in. flat screen, an enhanced version of our Basic, and a telephone which links in." Inside the ICL will be an expanded Spectrum and the machines could be networked together or communicate over the telephone.

"It will replace the paper that moves around at the moment An executive can send data to anyone

'That's what a telephone is going to look like'

else in the net, receive messages on it, and his mail will come through there. It will be arranged so that somebody who doesn't know anything about computers can use it — just get a menu up on screen and select. The price will be pretty modest because we have the best technology — otherwise ICL wouldn't be coming to us."

Tony Baden of Bug-Byte believes that every home will have a home computer by the end of next year — Sinclair is slightly more cautious: "We can't make them that fast, but there will be millions, because" he points to an artist's impression of the ICL machine "that's what a telephone is going to look like one of these days. Very few will sit down to program them but people will need the facilities, like electronic mail, that it offers."

Among the other facilities Sinclair expects to offer by 1984 are expert systems giving individual tuition to children and medical advice to the family. Could the Spectrum be adapted to do this? "Perhaps the Spectrum — certainly son of Spectrum. I think the home doctor is the application we'll tackle first — that's the vital one. We'll get to the point where we have expert systems linked into teaching, offering infinite patience and infinite attention."

Cynics might suspect that a government might use this as an excuse to do away with the health and education services but Sinclair prefers to believe that "It will enable us to make better use of a scarce resource."

Sinclair is optimistic about our electronic future although he acknowledges that millions more will be thrown out of work by the new technology. "Computers are not going to suddenly and radically change our lives — they'll gradually improve them. The only way in which there can be new jobs is by hundreds of thousands of people starting different sorts of businesses — in the service industries, in new technology and in the life sciences."

Sinclair believes that the writing is on the wall for the big corporations. Small businesses "will replace the megalithic companies — the vast employers of people." Ironically his own computers are made by Timex, an American-owned multi-national.

He believes that the information revolution could lead us into a new Golden Age of civilisation rivalling Augustinian Rome, Louis XIV's France or Elizabethan England. Hopefully life for the majority of people would not be as miserable in Clive's Golden Age as it was in the societies he admires.

Renaissance prince he may be, but Sinclair resisted the temptation to be photographed next to an imitation

'Enable us to make better use of a scarce resource'

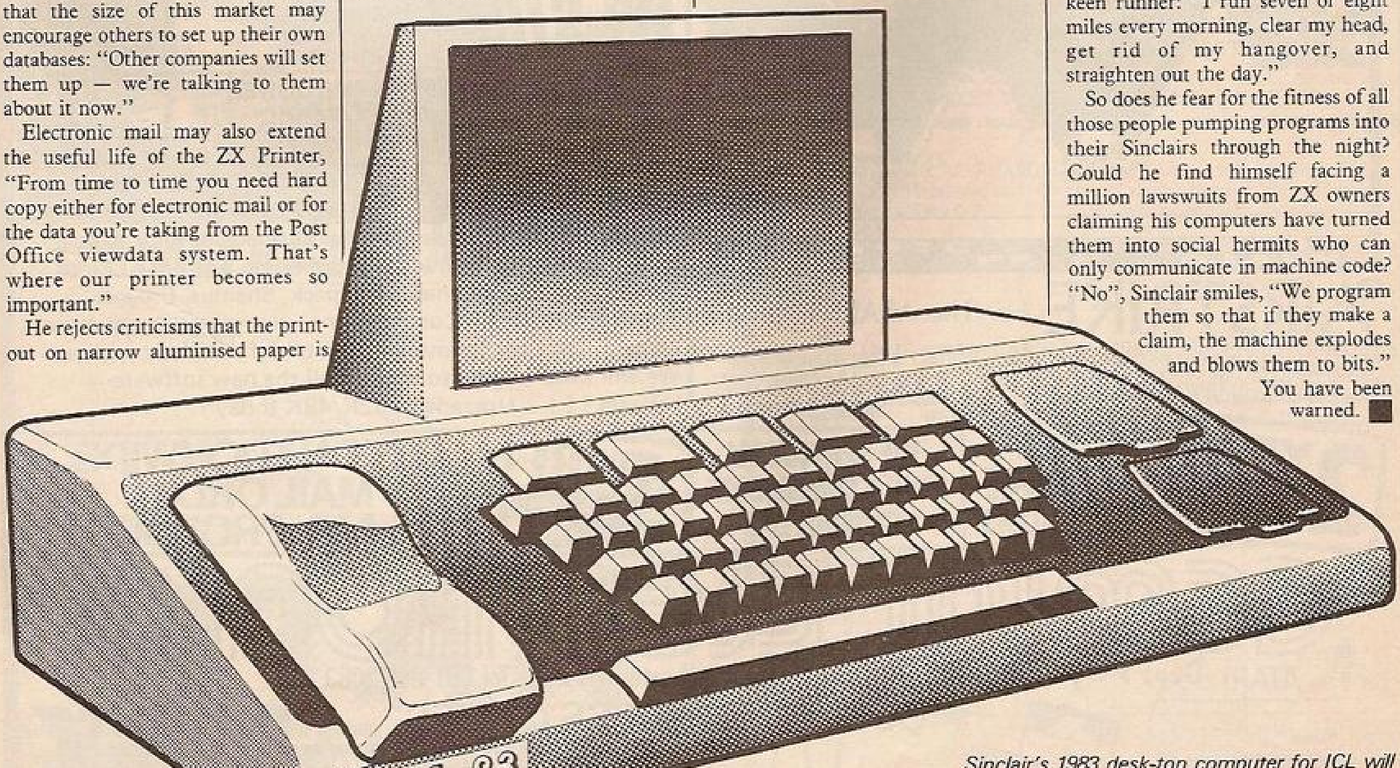
Greek statue on the balcony of his Chelsea service flat. "No, it's a horrible thing".

In such spare time as he has Sinclair is chairman of British Mensa, an organisation for people with high IQs. He laughs at the idea that there is anything sinister about the head of the world's largest home-computer firm also being head of Mensa.

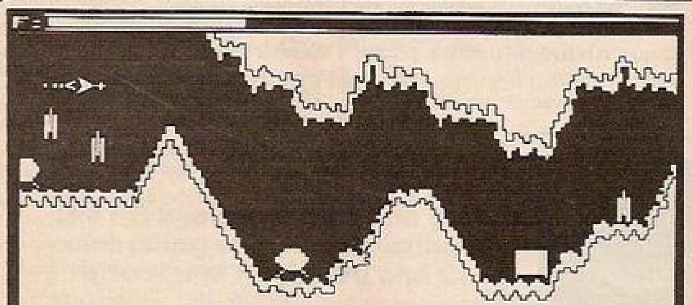
Contrary to popular belief Clive Sinclair does not have square eyes with little white squares in the bottom left-hand corners. He is a keen runner: "I run seven or eight miles every morning, clear my head, get rid of my hangover, and straighten out the day."

So does he fear for the fitness of all those people pumping programs into their Sinclairs through the night? Could he find himself facing a million lawswuits from ZX owners claiming his computers have turned them into social hermits who can only communicate in machine code? "No", Sinclair smiles, "We program them so that if they make a claim, the machine explodes and blows them to bits."

You have been warned. ■



Sinclair's 1983 desk-top computer for ICL will include 7in. or 9in. flat screen, two Microdrives, a telephone and Modem, professional keyboard, user-definable keys and Son of Spectrum insides. Your Computer *artist's impression.*



Can you stay on the road? Dirk Lampe's Vic-20 program tests your skills to the limit.

THIS PROGRAM is similar to the popular arcade game Nightdriver. The aim is to steer a racing car along an intricately winding road in the dark. But this program also tries to increase the competition by allowing more than one driver to compete in the race. Each driver races after the previous one has completed the course, the winner eventually being the one to finish in the fastest time.

This program was written on a Vic-20 expanded by 3K, and occupies about 4,300 bytes, but it can be squeezed into an unexpanded Vic with some rearrangement. Machine-code subroutines are Poked into memory locations near the top of the Vic's RAM at locations 6000, 6100, 6200 and 6300 in lines 10 to 190. The first subroutine draws the left side of the road, and the second the right side. The third and fourth erase the left and right sides of the road respectively.

These machine-code programs are accessed in lines 1000 to 1030 using the Vic Basic SYS command which is similar to USR on many other versions. The data is stored in locations zero and one of memory and calculated in lines 1040 to 1250.

The rest of the program — all written in Basic — starts at line 190. Lines 190 to 193 ask whether instructions are needed, and wait for the operator to press either Y or N. If Y is pressed, it then jumps to the subroutine from 2200 to 2280 which displays the instructions on the screen. As can be seen from the instructions, either a joystick or the keyboard can be used to control your car and the routine to read the joystick is situated at line numbers 2000 to 2040. In order to read the joystick the keyboard must be temporarily disabled by Poke 37154,127. It is important that you re-enable the keyboard with a Poke 37154,255 in line 2040.

Lines 200 to 301 deal with the preparations for the program and set up certain parameters like screen colour, auto-repeat on all keys, keyboard-buffer length as well as disabling the character-set switching ability, setting the position of the character set in memory and also turning off any superfluous sound.

Location 36867 controls the number of rows on the Vic screen and line 210 sets this to 46 over 2, that is 23.

Lines 220 to 260 draw a colourful title on the screen. Lines 270 to 301 then ask for the required skill level: the lower this is, the harder it is to negotiate corners; the higher, the easier. Desired course length and number of players are also requested at the same time.

The race then starts at line 305, a loop in which eight plus-signs are Poked on to the screen at line 380, representing the car bonnet. Lines 390 to 440 then move the road according to the car's movement. The keyboard buffer is scanned and the joystick read while line 450 halts the program for a time dependent on the speed of the car — top speed 255 km/h. Lines 460 to 470 produce the sound of the car engine and 480 increases the distance travelled. If you drive for one hour at 60 km/h you will, unsurprisingly, cover a total distance of 60km.

Line 530 checks if you are driving off the road. If you are, it jumps to the subroutine making you move further off the road for a random number of times. If you are not driving off the road, line 540 decides whether the road ahead should be left-curved, right-curved or straight. Line 550 checks to see if you have crashed by looking to see whether the plus-signs have been erased by the road. If they have, it makes an explosion. From there to line 600 the program returns back to line 375 unless the finishing line has been crossed or the car crashed more than five times.

In this case, the program moves to lines 3000 to the End. In this, the driver's time is displayed. If there are still more contenders, it then returns to the start of the race track for the next driver. If the driver was the last contender, the competitors' results are once again displayed.

To fit the program into an unexpanded Vic's memory, first write lines 10 to 100 leaving out all the Rem statements. Then change the Poke addresses as shown.

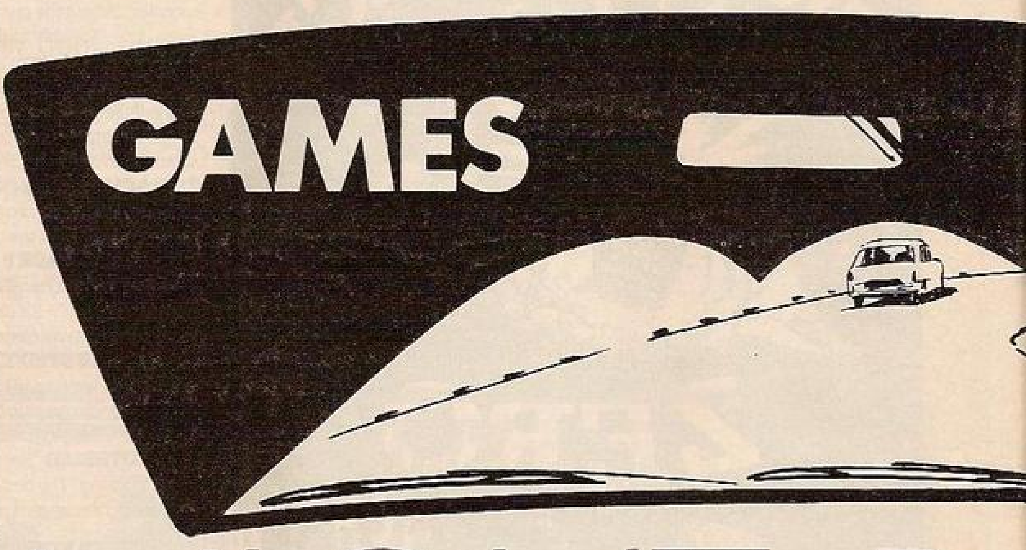
Line	New address
10	6800 + S
40	6830 + S
60	6860 + S
90	6890 + S

Change the last few items in the Data statements of the following lines to the new numbers given — in each case, the numbers to be changed are those following the number 76.

Line	Old	New
30	112,23,£	144,26,£
50	212,23,£	174,26,£
80	56,24,£	204,26,£
100	156,24,£	234,26,£

Next, Save the program on tape, then write the rest of the program as listed, leaving out the following sections and any Rem statements that might turn up: lines 101-260 inclusive, and lines 1999-2280.

In line 390 delete the Gosub 2000; in lines 1000-1030 change the SYS addresses to 6800, 6830, 6860, 6890 respectively, from what they



NIGHT RA

```
7 REM MACHINE CODE TO
8 REM DRAW ROAD.
9 REM
10 READA$:IFA$<>"#"THENPOKE6000+S,VAL(A$):S=S+1:GOTO10
11 M=RND(-TI)
20 DATA24,165,0,233,22,176,1,96,24
30 DATA169,78,160,0,145,0,165,0,233,20,133,0,76,112,23,#
35 S=0
40 READA$:IFA$<>"#"THENPOKE6100+S,VAL(A$):S=S+1:GOTO40
50 DATA24,165,0,233,22,176,1,96,24,169,77,160,0,145,0,165,0,233,22,133,0,76,212
,23,#
55 S=0
56 REM ************
57 REM MACHINE CODE
58 REM ERASE ROAD.
60 READA$:IFA$<>"#"THENPOKE6200+S,VAL(A$):S=S+1:GOTO60
70 DATA24,165,0,233,22,176,1,96,24
80 DATA169,32,160,0,145,0,165,0,233,20,133,0,76,56,24,#
85 S=0
90 READA$:IFA$<>"#"THENPOKE6300+S,VAL(A$):S=S+1:GOTO90
100 DATA24,165,0,233,22,176,1,96,24,169,32,160,0,145,0,165,0,233,22,133,0,76,15
6,24,#
110 REM
120 REM ADDRESSES :
130 REM DRW LEFT 6000
140 REM DRW RIGHT 6100
150 REM ERS LEFT 6200
160 REM ERS RIGHT 6300
170 REM
180 REM
190 REM THE BASIC
191 PRINT"❏INSTRUCTIONS?"
```

were previously — 6000, 6100, 6200, 6300 — and in line 260 type Poke 650,128. Now, Save the program after the first part.

The loading procedure for the unexpanded Vic program is as follows: wind the tape to wherever the first program is stored and then type Load, and when the program has loaded, Run followed by New and Load again. The game is then loaded.

This an an assembled version of the machine-language subroutine starting at 6000 (or 6800):

```
CLC         LDY#0
LDA 0       STA (0),Y
SBC#22      SBC#22
BCS 1       STA 0
RTS         JMP 6000 or 6800
CLC         on the unexpanded Vic.
LDA#78
```

A joystick cannot be used on an unexpanded Vic.

The other machine-code subroutines are almost identical. All are written in 6502 machine code. ■

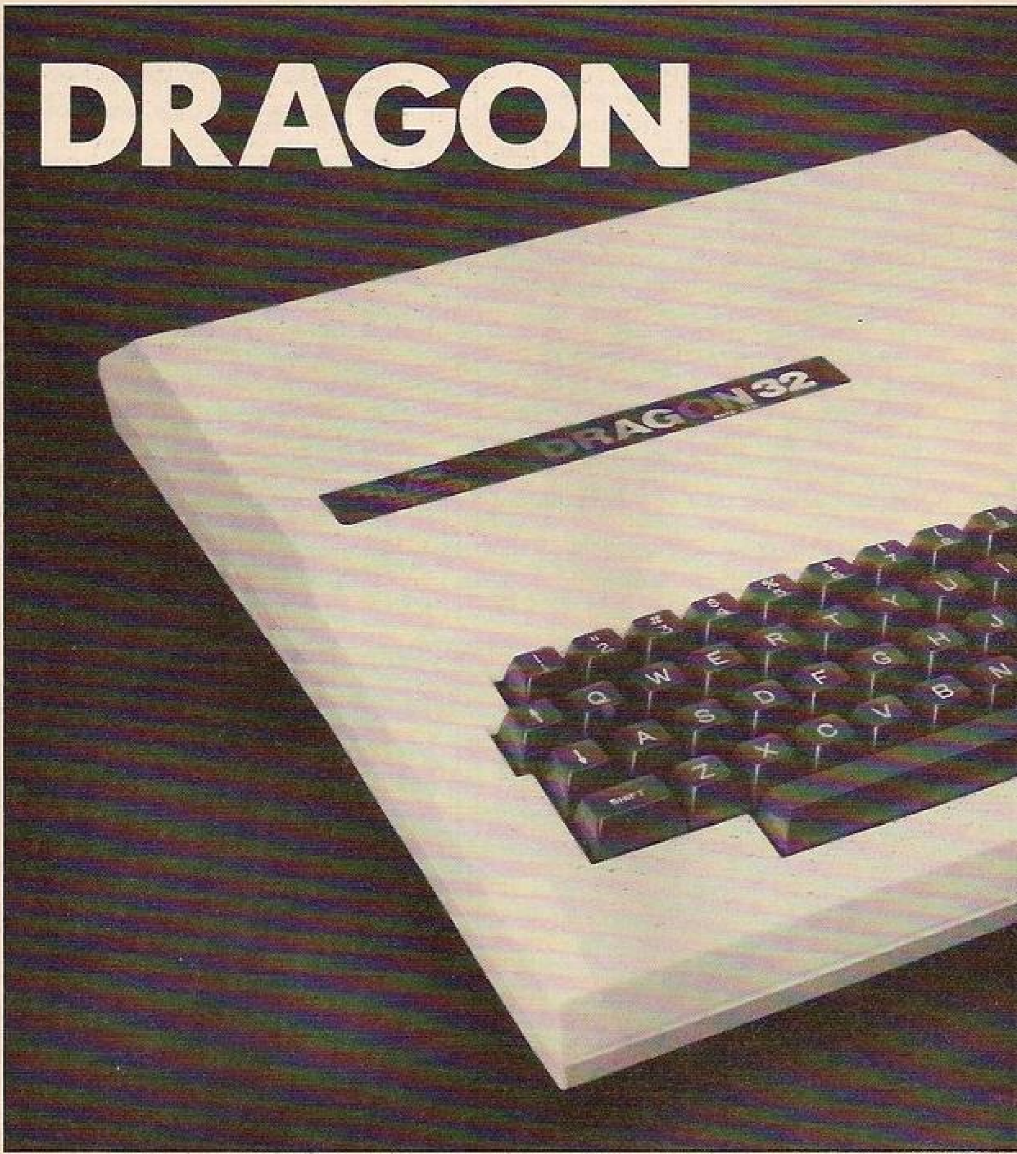
Vic-20 addresses.

- 1024-7679 RAM, for programs, on expanded Vic
- 4096-7679 on unexpanded
- 7680-8185 screen memory
- 36879 screen/border colours
- 36878 volume of sound
- 36874-36877 sound speaker channels, value >128 and sound emits from appropriate speaker.
- 650 key repeat (>128 and all keys repeat)
- 649 length of keyboard buffer
- 657 disable switching keys
- 36869 location of character generator in memory, if 240 then in ROM 32768
- 0,1 zero page RAM — usually not used by Vic's OS
- 36867 rows on Vic screen (×2)
- 37152, 37137, 37154 Vic user port for joystick

The above addresses in the Vic would need to be changed for conversion to other systems.

```
192 GETA$:IFA$<>"N"ANDA$<>"Y"THEN192
193 IFA$="Y"THENGOSUB2200
200 POKE36879,31:POKE650,128:POKE657,128:POKE649,1:POKE36869,240:POKE36874,0:PO
KE36875,0
210 POKE36867,PEEK(36867)AND129OR(46):POKE36876,0:POKE36877,0:POKE36878,0
220 PRINT"                              NIGHTDRIVER
"
230 FORI=7680TO7701:POKEI,160:POKEI+30720,IAND7:NEXT
240 FORI=7789TO7768STEP-1:POKEI,160:POKEI+30720,IAND7:NEXT
250 FORI=8164TO8185:POKEI,160:POKEI+30720,(I-1)AND7:NEXT
260 PRINT:PRINT"WRITTEN BY DIRK LAMPE.":PRINT
270 INPUT"LEVEL OF PLAY";LE:IFLE<>INT(LE)ORLE<>ABS(LE)ORLE<1THEN270
280 LE=LE+1
290 INPUT"COURSE LENGTH";CL:IFCL<>INT(CL)ORCL<>ABS(CL)THEN290
300 INPUT"NO OF PLAYERS";PL:IFPL<>INT(PL)ORPL<>ABS(PL)ORPL<1THEN300
301 DIMTT(PL),TT$(PL)
305 FORQ=1TOPL
310 FORI=1TO1000:NEXT
320 PRINT"*****NIGHT DRIVER*****":PRINT"                              ";
330 PRINT"SPEED   :             DISTANCE:            CAR NO  :          ";
340 PRINT"PLAYER   :"Q"              ":POKE36879,11:POKE36867,PEEK(36867)AND129OR(
32)
350 L=0:SP=10:CN=1:DS=0:R=0:RR=7921:RL=7900:TS=0
360 GOSUB1000
370 GOSUB1010:X=TI:Y=TI
375 PRINT""SP"":PRINT""INT(DS)"
"
376 PRINT""CN""
380 FORI=7907TO7914:POKEI,43:NEXT
390 FORI=1TOLE:GETA$:GOSUB2000:IFA$="G"ORA$="T"THENI=LE:GOTO420
400 IFA$="F"THENGOSUB1040
410 IFA$="H"THENGOSUB1200
420 NEXT:IFA$<>"G"ANDA$<>"T"THEN445
430 IFA$="G"ANDSP<255THENSP=SP+1
440 IFA$="T"ANDSP>0THENSP=SP-1:PRINT"        ";:PRINT"
"SP"
445 IFSP=0THEN375
450 FORI=1TO64*4-1-SP:NEXT
460 SS=(SPAND63)+128+INT((SP+64)/64)*10
470 POKE36874,SS:POKE36875,SS:POKE36876,SS:POKE36877,SS:POKE36878,15
480 DS=DS+((TI-X)/216)*SP
490 IFR<>0ANDR<>1THEN530
500 T=RND(1):IFT<.1THENGOSUB1040:GOTO550
510 IFT<.2THENGOSUB1200
520 GOTO550
530 IFR>0ANDRND(1)<.95THENGOSUB1200:IFRND(1)>.8THEN530
535 IFR>0THEN550
540 IFRND(1)<.95THENGOSUB1040:IFRND(1)>.8THEN540
550 A=0:FORI=7907TO7914:IFPEEK(I)<>43ANDPEEK(I)<>32THENA=9:I=7914
560 NEXT:IFA<>9THEN590
570 POKE36874,0:POKE36875,0:POKE36876,0:POKE36877,128:FORI=15TO0STEP-1:POKE3687
8,I
580 FORJ=1TO500:NEXT:NEXT:CN=CN+1:IFCN>5THENTT$(Q)="C":GOTO3000
590 IFDS>=CLTHEN3000
595 IFSP>TSTHENTS=SP
600 X=TI:GOTO375
999 GOTO999
1000 POKE0,RL-INT(RL/256)*256:POKE1,INT(RL/256):SYS6000:RETURN
1010 POKE0,RR-INT(RR/256)*256:POKE1,INT(RR/256):SYS6100:RETURN
1020 POKE0,RL-INT(RL/256)*256:POKE1,INT(RL/256):SYS6200:RETURN
1030 POKE0,RR-INT(RR/256)*256:POKE1,INT(RR/256):SYS6300:RETURN
1040 GOSUB1020:GOSUB1030
1050 IFL>=0THENL=L+1:RL=RL+1:GOTO1070
1060 IFL<0THENL=L+1:RL=RL+22
1070 IFR>0THENR=R-1:RR=RR+1:GOTO1090
1080 IFR<=0THENR=R-1:RR=RR-22
1090 GOSUB1000:GOSUB1010:RETURN
1200 GOSUB1020:GOSUB1030
1210 IFR>=0THENR=R+1:RR=RR-1:GOTO1230
1220 IFR<0THENR=R+1:RR=RR+22
1230 IFL>0THENL=L-1:RL=RL-1:GOTO1250
1240 IFL<=0THENL=L-1:RL=RL-22
1250 GOSUB1000:GOSUB1010:RETURN
1999 REM JOYSTICK
2000 IF((PEEK(37137))AND4)=0THENA$="G":RETURN
2010 IF((PEEK(37137))AND8)=0THENA$="T":RETURN
2020 IF((PEEK(37137))AND16)=0THENA$="F":RETURN
2030 POKE37154,127:IF-((PEEK(37152)AND128)=0)=1THENA$="H"
2040 POKE37154,255:RETURN
2200 PRINT"INSTRUCTIONS"
2210 PRINT:PRINT"F=LEFT"
2220 PRINT"H=RIGHT"
2230 PRINT"T=DECELERATE"
2240 PRINT"G=ACCELERATE"
2250 PRINT:PRINT"OR USE JOYSTICK"
2260 PRINT:PRINT"HIT A KEY"
2270 GETA$:IFA$=""THEN2270
2280 RETURN
3000 POKE36874,0:POKE36875,0:POKE36876,0:POKE36877,0:POKE36867,PEEK(36867)AND12
9OR(46)
3010 POKE36879,25:Y=TI-Y:TT(Q)=Y
3020 PRINT"PLAYER"Q":":IFTT$(Q)="C"THENPRINT"CRASHED......":GOTO3050
3030 PRINT"CROSSED THE FINISH":PRINT"LINE IN A TIME OF":PRINT""INT(Y/60)"SECS"
:PRINT
3040 PRINT"TOP SPEED:"TS"KM/H"
3050 FORI=1TO4000:NEXT:NEXT
3060 PRINT"THE RESULTS :":PRINT
3070 FORI=1TOPL:PRINT"PLAYER"I":";
3080 IFTT$(I)="C"THENPRINT" CRASHED":GOTO3100
3090 PRINTINT(TT(I)/60)"SECS"
3100 NEXT:PRINT:PRINT
3110 IFPL=1THEN3160
3120 PRINT"THE WINNER :":PRINT:A=0
3125 FORI=1TOPL
3126 IFTT$(I)<>"C"THENA=I:I=PL
3127 NEXT:IFA=0THENA=PL
3130 FORI=1TOPL:IFTT$(I)="C"THEN3150
3140 IFTT(I)<TT(A)THENA=I
3150 NEXT:IFTT$(A)<>"C"THENPRINT"PLAYER"A
3155 IFTT$(A)="C"THENPRINT"NOBODY."
3160 PRINT:PRINT"HIT A KEY.":FORI=1TO10:GETA$:NEXT
3170 GETA$:IFA$=""THEN3170
3180 CLR:GOTO200
```

DRAGON



The high-resolution graphics capabilities of the Dragon 32 are excellent, but the manual suggests that the best way to produce a picture on the screen is to resort to a pencil and a high-resolution grid. The standard graphics commands and the manual give you a high degree of control over drawing high-resolution pictures but need to be planned carefully. Keith and Steven Brain's drawing program allows you to take advantage of the Dragon's best graphics features while giving you the freedom of a true artist of the electronic screen. With the program you can paint and fill in areas of the screen as your creative drive demands.

PURISTS WILL ALWAYS insist that programs should be written away from the keyboard. The more spontaneous among us find direct drawing on to the screen preferable. This article deals with some of the difficulties which have to be tackled to enable this on the Dragon.

Curves and colour

The first problem encountered is the inability to Print on the high-resolution screen or to make inputs in high-resolution mode, but fortunately these problems can be overcome via the Inkey$ function. Although the Line and Circle commands require specification of start and end co-ordinates, the Draw command is much more lenient and is easily accessed via Inkey$.

The default value for any of the standard draw commands, Up, Down, Right, Left, E, F, G, and H Diagonal is one scale unit. Therefore these can be called by a single Inkey$ character, to give a single scale to be achieved by the following simple subroutine:

```
20 A$ = INKEY$
30 IF INKEY$ = "" THEN 20
100 DRAW A$
```

Curves can be constructed by judicious use of these keys at the minimum Scale setting.

The fundamental Scale unit must be defined at the start of the program, together with the PMode and Screen type, but Scale can also be varied during execution by means of the S key and evaluation of A$. Depression of this key can be made to increase the value of the Scale unit thus:

```
10 PMODE = 3,1: SCREEN = 1,0: S = 4
40 IF INKEY$ = "S" THEN S = S + 2
50 DRAW "S" + STR$(S)
```

Another key can be used to reduce or reset the Scale to the original value and thus one key gives a wide range of Scale factors.

Colour can be reached similarly by checking if the Inkey$ function is a numeral whose Val can be used to set the subsequent Draw colour, by examining the ASCII value in the new line 100.

```
60 A = ASC(A$)
100 IF A>47 AND A<57 THEN C$ = A$
    ELSE DRAW A$
```

Blank moves can be made by Drawing in the background colour, and these moves can also be used to erase unwanted parts of the picture. Any permitted Colour for the selected PMode can be called.

To aid composition, a flashing cursor can be provided to indicate the current Draw position. It does this by rapidly Drawing in a visible Colour and then Drawing in the reverse direction in the background Colour.

```
30 IF A$ = "" THEN DRAW
    "S1C1R1COL1": GOTO 30
```

Further assistance can be provided via the Sound function. An audible feedback can be provided for each type of key depression: different tones can be constructed around middle C — 89 — from the ASC value of the Inkey$ string.

```
110 SOUND (89 + ASC(A$)), 2: GOTO 30
```

For the final touch, more colour can be added to the screen via Paint. This is reached through P, returning the screen to low-resolution and requesting the co-ordinates and colour information to be added. As the high-resolution screen is not cleared, return from this subroutine to high-resolution reveals Painting in progress, and further Drawing can also take place.

```
70 IF A$ = "P" THEN GOTO 200
```

Figure 2.

```
10 CLS0
20 X=RND(7):Y=X*16:Z=143
+Y
30 N=RND(510):PRINT@(N),
CHR$(Z);
40 A=255-INT(N/2):IFA=0T
HENA=1
50 SOUNDA,1:GOTO20
```


```
200 CLS: PRINT "PAINT COORDINATES";:
    INPUT P1, P2: PRINT "PAINT COLOUR";:
    INPUTPC:PRINT"BORDER COLOUR";:
    INPUT BC
210 PMODE 3,1: SCREEN 1,0: PAINT (P1,
    P2), PC, BC: GOTO 70
```

Having composed a masterpiece worthy of Rembrandt or Picasso, one obviously would like to retain this for posterity.

Although the Get command allows storage of screen information in an array, it cannot be used to store the entire screen due to memory limitations. Each screen would require the setting up of an array of 256 * 192 units — more than 48K. A more conservative alternative was suggested by examination of the Dragon memory map which revealed that the first four Pages of high-resolution RAM lie between 1536 and 7679. A subroutine which Peeks the values in these locations and Loads them into an array can therefore store the same information in much more compact form, about 6K.

Cut access time

For more permanent storage, this array can be put on to a cassette as a data file. Whilst this approach does work it is rather slow as a 6K-long data file takes over five minutes to load.

This problem can be easily circumvented by use of the CSaveM and CLoadM commands to Save and Load the contents of high-resolution graphics pages as a machine-code file. This reduces the access time to only 20 percent of that required for a data file and makes storage of detailed freehand pictures easy.

A complete program for real-time on-screen drawing based on these principles is given in figure 1. This is rather more complex and incorporates a number of devices to make it more user-friendly.

Program devices

Line 20 includes B$ which contains a list of all permitted keys, and X$ which lists the number of high-resolution pages for each mode. Line 30 requests the PMode and Screen parameters to be used, and sets the default Scale value to four. Line 40 uses string-slicing to set PG to the appropriate value for the number of pages required.

Line 50 sets up the high-resolution display, and moves the cursor to the top left-hand corner. Line 60 checks for instructions and, if there are none, flashes the cursor.

Line 70 uses the Instr function to check whether an incorrect key has been depressed, and if so sounds a raspberry.

Line 80 sets the Scale and Colour parameters for each movement. Line 90 checks whether an increase in Scale is required, and line 100 resets Scale to the default value.

Line 110 checks for "C" for clearing the screen. After a few accidental disasters this requires confirmation of action via the subroutine at 260 which requires an Input.

Line 120 checks for "P" and leads to the Paint subroutine at 240, which allows blocks of colour to be added. Warning: watch out for pinholes in your pictures — the paint can spill through them with disastrous results.

Line 130 leads via î to the Save routine, and 140 via @ to the load routine. Both of these subroutines request a file name, and ask if the recorder is ready.

To avoid recognition of taped machine-code files when making a directory, an M is added to the selected file name. The Save routine displays that Saving is in progress, and that Saving has been completed. As the high-resolution screen is set up before activation of the CLoadM, the result is an impressive build-up of the complete picture from the top of the screen as loading progressess.

Line 150 is the default which checks if Inkey$ is a number and, if so, alters the Colour value, or Else draws U, D, L, R, E, F, G or H — all one-scale units. If background Colour is selected then obviously a blank move is achieved.

Line 160 makes a sound related to the ASCII value of Inkey$ to confirm the selected move, and returns to the keyboard-scanning mode.

Figure 2 is a simple program which builds up a display of blocks of colour on the screen. As each randomly-chosen block of colour appears in a random position on the screen, a note sounds. The notes are high if the block appears towards the top of the screen and low towards the bottom. The program is not particularly sophisticated but it does indicate how easy it can be to create a background display or conversation piece perhaps for a party. ■

Figure 1.

```
10 REMDRAGARTCOPYRIGHTK&
SBRAIN1982
20 B$="CUDLREFGHSXP01234
5678@↑":X$="12244"
30 CLS0:PRINT"MODE";:INP
UTZ:PRINT"SCREEN";:INPUT
Y:S=4
40 PG$=MID$(X$,Z+1,1):PG
=VAL(PG$)
50 PMODEZ,1:SCREEN1,Y:DR
AW"BM0,0"
60 A$=INKEY$:IFA$=""THEN
DRAW"S1C1R1C0L1":GOTO60
70 IFINSTR(1,B$,A$)=0THE
NSOUND2,5:GOTO60
80 DRAW"S"+STR$(S):DRAW"
C"+C$
90 A=ASC(A$):IFA=83THENS
=S+2:GOTO160
100 IFA=88THENS=4:GOTO16
0
110 IFA=67THEN260
120 IFA=80THEN240
130 IFA=94THEN170
140 IFA=64THEN210
150 IFA>47ANDA<57THENC$=
A$ELSEDRAWA$
155 DRAW"S"+STR$(S):DRAW
"C"+C$
160 SOUND(89+ASC(A$)),2:
GOTO60
170 CLS4:PRINT"SCREENSAV
E":GOSUB220:CLS3:PRINT@1
92,"SAVING SCREEN"
180 CSAVEMF$,1536,(1536+
(1535*PG)),(1535*PG)
190 PRINT@384,"SCREEN SA
VE":PRINT@480,"PRESS SPA
CEBAR TO CONTINUE"
200 IFINKEY$=""THEN200EL
SEGOTO20
210 CLS2:PRINT@0,"SCREEN
LOAD":GOSUB220:PMODEZ,1:
SCREEN1,Y:CLOADMF$:GOTO6
0
220 PRINT@160,"FILENAME"
;:INPUTF$:F$="M"+F$:PRIN
T@224,"WHEN TAPE READY P
RESS SPACEBAR"
230 IFINKEY$=""THEN230EL
SERETURN
240 CLS0:PRINT"PAINT CO-
ORDINATES";:INPUTP1,P2:P
RINT"PAINT COLOUR";:INPU
TPC:PRINT"BORDER COLOUR"
;:INPUTBC
250 PMODEZ,1:SCREEN1,Y:P
AINT(P1,P2),PC,BC:GOTO60
260 CLS4:PRINT"CLEAR SCR
EEN (Y/N);:INPUTD$:IFD$<
>"Y"THENGOTO50ELSEPCLS:G
OTO50
```

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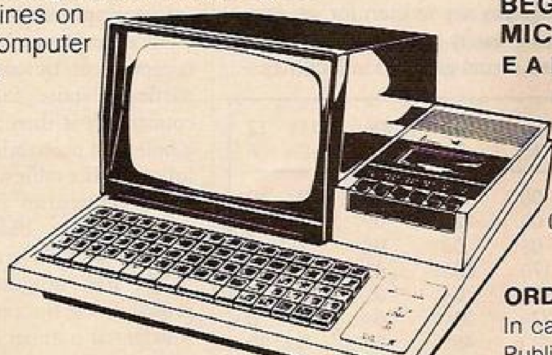

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MUSIC

THE SOUND OF

The hills could be alive with the sound of your Atom if you take David Morton's advice.

MOST MICROCOMPUTERS can make noises, though sometimes their range is limited. Apart from sound effects for games this capacity has an obvious application in music production. However, if you, like me, are completely unmusical you will not have been able to make the best use of the variety of programs allowing you to compose, play and store music. Why not use the computer to compose and play short melodies?

A computer can compose tunes by basing its composition on a pattern of established music. This is done by taking a piece of music, splitting it into bars and storing them in memory. Bars can then be selected at random and joined together to form flowing music.

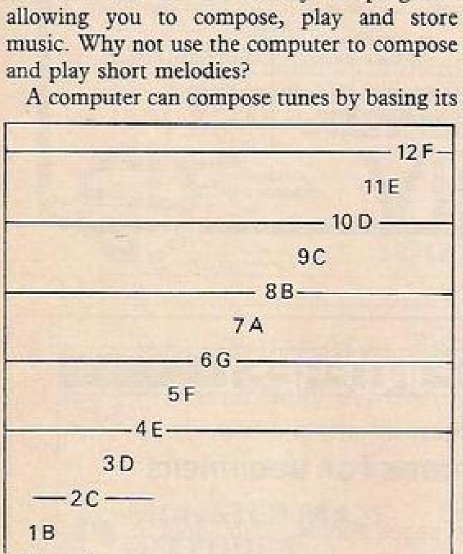


Figure 1.

The disadvantage of this method is the large amount of storage needed. Another approach is to analyse examples of a composer's work statistically, and this is the approach covered here. The programs are written for an Acorn Atom, but are easily modified for other computers with sound-generation facilities.

		1 B	2 C	3 D	4 E	5 F	6 G	7 A	8 B	9 C	10 D	11 E	12 F
1	B	29	141	56	0	0	29	0	0	0	0	0	0
2	C	13	48	36	109	24	13	0	0	12	0	0	0
3	D	35	57	46	57	12	12	24	0	0	0	12	0
4	E	0	9	59	18	51	51	25	17	25	0	0	0
5	F	0	0	0	80	16	95	24	8	0	0	0	32
6	G	11	0	16	0	37	31	69	37	26	6	22	0
7	A	0	10	10	0	33	48	25	43	48	5	5	28
8	B	10	0	5	10	23	10	75	23	75	10	14	0
9	C	0	8	0	8	8	22	16	76	45	34	12	26
10	D	0	0	0	0	0	25	34	9	93	68	9	17
11	E	0	10	0	0	0	0	0	39	49	88	49	20
12	F	0	9	0	0	0	0	26	34	42	0	68	76

Table 1. The Strauss probabilities.

It is simple to count how many times a particular note occurs, but this is not much use for composition unless the number of times a particular note follows any other note is counted. It is then possible to calculate, given a note, the probability that any other note will follow it. If a table of such probabilities is built up, a fingerprint is provided on which the computer can base its composition. This fingerprint is different for each composer.

The first program produces this table of probabilities, but requires some time to enter a substantial number of notes at the keyboard. I have therefore given the results from two runs of the program on different composers. For simplicity, and because of the limit on storage space, I have confined the analysis to 12 notes and ignored the duration of each note. The notes are entered as the numbers 1-12 representing the notes as indicated in figure 1.

Each analysis should ideally be confined to the music of one composer; a variation in style confuses the results. The program is simple. It counts the number of times any note follows any other note, building up an array of 144 elements.

		1 B	2 C	3 D	4 E	5 F	6 G	7 A	8 B	9 C	10 D	11 E	12 F
1	B	0	0	255	0	0	0	0	0	0	0	0	0
2	C	0	0	255	0	0	0	0	0	0	0	0	0
3	D	16	16	32	80	48	16	10	16	0	15	16	0
4	E	0	15	96	48	64	0	0	16	0	0	16	0
5	F	0	0	32	64	80	32	0	32	15	0	0	0
6	G	0	0	0	0	64	47	0	96	47	0	0	0
7	A	0	0	0	0	0	0	0	255	0	0	0	0
8	B	0	0	16	0	80	15	16	64	48	0	16	0
9	C	0	0	16	0	16	16	0	143	32	0	32	0
10	D	0	0	0	0	0	0	0	0	127	128	0	0
11	E	0	0	0	0	0	0	0	64	111	48	16	16
12	F	0	0	0	0	0	0	0	95	0	160	0	0

Table 2. The U.S. composer's probabilities.

On completion of the data entry, indicated by entering an 0, this array is converted to an array of probabilities in which 255 represents certainty and 0 impossibility. The two tables of probabilities below were produced from about ten melodies each, the first by Strauss and the second by an American composer.

Each table can be stored in memory as an array — although I used the Atom's byte-vectors to save space. In each table the last note to be played is represented in the extreme left column, and the probability of any note following it is represented by the members of that row. Thus, in the first example, the probability that the note C2 follows B1 is 141/255 and it is impossible for the note C9 to follow B1.

The second program uses the second table of probabilities to decide on a series of notes, playing and drawing them as it does so.

A range of notes

In this program, the subroutine between lines 330 and 350 decides on the next note to be played by choosing a random number between 1 and 255, and then looking along the appropriate row of the table. The members of that row are added together until the sum is greater than the random number. The note whose probability was last added to the sum is chosen as the new note, which is played and drawn on the screen.

The Atom's speaker is connected to Bit 2 of an output port and a tone is produced by Exclusive-Oring the port with 4. The speed at which this is done determines the frequency of the tone produced. The assembler routine at line 80 does this; it is an exact copy of the one from the Atom's manual.

The frequency is determined by the contents of the accumulator and the duration of the note by the Y-register. These are calculated by Basic before entering the machine-code routine at line 310.

The numbers representing the frequency of each note are stored in another array, and are calculated from the fact that the time between successive blips of the speaker is $5*x+17$ cycles, which at 1 MHz is $(5*x+17)*10^{-6}$ seconds. The value of x can therefore be easily found. The frequencies I used are listed below and are based on a middle C of 262 Hz.

Note	Frequency Hz	x
B	988	199
C	1047	188
D	1174	167
E	1319	148
F	1397	140
G	1568	124
A	1760	110
B	1976	98
C	2093	92
D	2344	82
E	2637	72
F	2794	68

The music produced by this program, although far from random, tends to lose structure over a long period of time. There is some scope for improvement. For example, it is possible to analyse three or more note sequences instead of two, or to take account of the length of notes. Much better results are obtained when a programmable sound generator, like the AY 38910, is used.

(continued on next page)

(continued from previous page)

```
   10 P.$12'"   *****music analy
ser*****"'''
   20 P." THIS PROGRAM WILL CREA
TE A      TABLE IN WHICH "
   30 P."THE PROB. OF ANY NOTE F
OLLOWING ANY OTHER NOTE ISGIVEN.
"
   40 P.''" PLEASE ENTER NOTES A
S THE        NUMBERS 1-12."''''
   50 P."press a key";LI.#FFE3
   60 P.$12
   70 W=#2800;F.N=0TO144;W?N=0;N

   80 REM INPUT NOTES
   90 O=8;DO
  100 IN.N;IF N<0OR N>12;G.100
  110 P=(O-1)*12+N-1
  120 W?P=W?P+1
  130 O=N
  140 U.N=0
  150 REM CREATE PROBS.
  160 F.X=0TO144S.12;S=0
  170 F.Y=X TO(X+11)
  180 S=S+W?Y;N.
  190 IF S=0;S=1
  200 F.Y=X TO(X+11)
  210 W?Y=W?Y*255/S
  220 N.;N.
  230 P.'"TABLE OF PROBS IS STOR
ED IN W?0 TO W?143."'
  240 END
   10 P.$12'"         *******COMPOS
ER*******"
   20 P.'"  THIS PROGRAMME COMPO
SES TUNES."
   30 P."THE ATOM IS GIVEN THE"'
"PROBABILITY"
   40 P." THAT ANY NOTE WILL  FO
LLOW ANY OTHER NOTE."
   50 !#71=#85FFE320;!#75=#6070
   60 DIM F12,WW4,W144,P-1
   70 P.$21
   80[:WW0 STA #80;LDA@0
   90:WW2 LDX#80
  100:WW1 DEX;BNE WW1
  110 EOR@4;STA#B002
  120 DEY;BNE WW2;RTS;]
  130 P.$6
  140 F?0=199;F?1=188;F?2=167;F?
3=148;F?4=140;F?5=124
  150 F?6=110;F?7=98;F?8=92;F?9=
82;F?10=72;F?11=68
  160 F.X=0TO144;W?X=0;N.
  170 W?2=255;W?14=255;W?24=16;W
?25=16;W?26=32;W?27=80;W?28=48
  180 W?29=16;W?31=15;W?33=16;W?
34=16;W?37=15;W?38=96;W?39=48
  190 W?40=64;W?43=16;W?46=16;W?
50=32;W?51=64;W?52=80;W?53=32
  200 W?55=32;W?56=15;W?64=64;W?
65=47;W?67=96;W?68=47;W?79=255
  210 W?86=16;W?88=80;W?89=15;W?
90=16;W?91=64;W?92=48;W?94=16
  220 W?98=16;W?100=16;W?101=16;
W?103=143;W?104=32;W?106=32
  230 W?116=127;W?118=128;W?127=
64;W?128=111;W?129=48;W?130=16
  240 W?131=16;W?139=95;W?141=16
0
  250 N=A.R.%12
  260 P.''" NOTE LENGTH ?";LI.#7
1;A=(?#70-47)*2
  270 GOS.b
  280 DO
  290 D=(50+A.R.%A)*256
  300 A=F?N;Y=D/A
  310 LI.WW0
  320 GOS.a;GOS.c;U.?#B001<>#FF;
P.$12;G.260
  330aREM NEXT NOTE
  340 Y=A.R.%254+1;G=0;M=N*12
  350 DO;G=G+(W?M);M=M+1;U.G>=Y;
N=M-(N*12)-1;R.
  360bREM DRAW NOTE
  370 CLEAR4;F.K=163TO85.-30;F.J
=1TO20S.4
  380 MOVE2,(K+J);PLOT1,250,0;N.
;N.;U=0;V=157;R.
  390cU=U+8;Q=N
  400 MOVE U,(V+Q*2);PLOT1,-2,0;
PLOT1,0,2;PLOT1,2,0;PLOT1,0,-2
  410 PLOT1,-1,1;PLOT1,1,1
  420 IF Q>6PLOT0,-2,-2;PLOT1,0,
-7;G.d
  430 PLOT1,0,7
  440dIF U%248=0U=0;V=V-30;IF V<
0GOS.b
  450 R.
```

STAR OF STA
SCREEN AN
LIVING-ROO

Whether your musical tastes are heavy metal or Trapp family singers the BBC Micro has something to offer. This month and next month Chris Melville shows you how to turn your BBC into a musical instrument.

THE BBC MICRO is one of the most impressive machines on the market, and its capabilities for music generation are much-praised.

That does not mean, however, that every BBC owner can immediately plug in and start emulating Gary Numan, though this article will show you how to take full advantage of the features that are present in the BBC's music box.

We will now define the initial problems you may encounter, and see what can be done to overcome them, so that our micros can start making pleasant noises.

There are two main hardware grumbles — both easy to solve. Most BBC Micros emit an annoying buzz from the loudspeaker during normal use. This is caused by signals from the data bus being amplified. A 10Kohm resistor across pins 16 and 15 of the 1MHz bus should cure it — you can either fit a plug, or solder it to the corresponding tracks on the PCB. Acorn will be doing this themselves soon.

Secondly, if the tinniness inherent in the small internal speaker is restrictive, you can connect an external amplifier of 50Kohms impedance to pin PL16 on the PCB. These modifications might affect your warranty, so check with your local Acorn Service Centre.

Statement syntax

Moving on to documentation, I presume that the Envelope and Sound statements are now understood, thanks to the new user guide and to previous articles such as that in July *Your Computer,* but briefly, the Envelope statement has the following syntax:

	Pitch envelope	Amplitude envelope
Envelope	n,1,p1,p2,p3, n1,n2,n3	a1,a2,a3,a4,t1,t2

where n is the envelope number — usually 1-4, or 1-16 if not using tape filing in Basic: and l is the length of a time step — usually 1-127 for pitch envelope repeat. Add 127 if the pitch envelope is not for repeat. The change of pitch per step in the corresponding pitch parts is given by p1,p2,p3 from −128 to 127. The number of steps in each part of the pitch envelope is designated by n1,n2,n3 from 0 to 255. The a1,a2 give the change of amplitude in attack, and change of step in decay parts, using values from −127 to 127. The a3,a4 give the change of amplitude in sustain and the change of step in release, using values from −127 to 0. The t1,t2 are the target levels for amplitude at the end of the attack, decay parts; 0 to 126. And here, briefly, is the syntax for the Sound statement:

- d = dummy flag, 0 or 1
- s = sync flag, 0 or 3
- f = flush queue flag, 0 or 1
- c = channel number, 0 to 3
- a = amplitude, 0 to −15 for envelope 1 to 16
- p = pitch, 0 to 255 for a music channel, or 0 to 7 for a noise channel
- d = duration of sound 10 to 2550ms.

In BBC Basic sound qualities are programmed using the Envelope statement as shown above. However, a statement followed by 14 parameters does not give much idea of the sound it will produce.

The EnvPlot program, for 32K, allows you to draw an envelope directly on the VDU by moving a cursor around. Then you edit it, sampling the sound produced. You define the pitch and amplitude parts separately on separate axes.

EnvPlot enables the user to start from scratch and define both pitch and amplitude envelopes on the screen. The program is either in Pitch Mode; blue background, pitch envelope/axes displayed, pitch envelope information displayed at top of screen: or Amplitude Mode, red background, amplitude envelope/axes, and amplitude envelope information at top of screen when the user is entering or manipulating the amplitude envelope.

The two modes are interchangeable at any stage, and if you re-enter either, you will be returned to where you left off. There is a cursor on the screen which is moved about by using the arrowed keys. You cannot move the cursor anywhere that would produce out-of-range parameters.

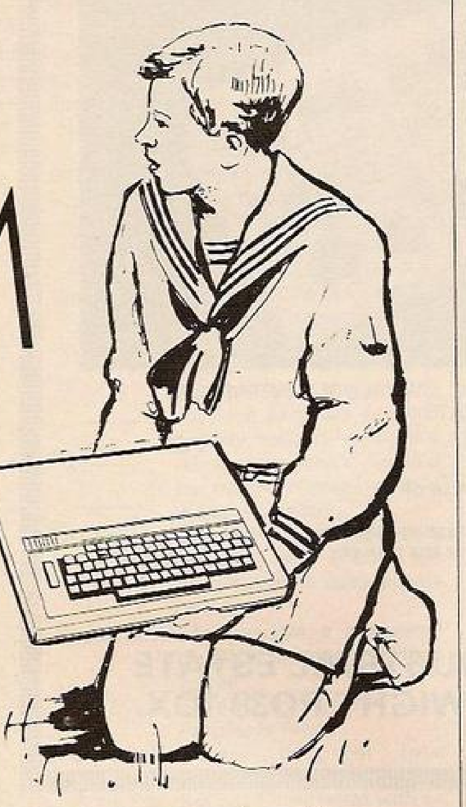
Presssing any function key will rub out the cursor and, when the function has been executed, the cursor will reappear on the last-entered point. All of the functions are foolproof. For example, you cannot Sound the envelope unless you have completed both

BBC MUSIC

```
>>L.IST
   10REM     C.MELVILLE  1982
   11ON ERROR RUN
   12*TV255
   13MODE4:PROCINITIALISE:PRINT"YOU ARE NOW RUNNING THE ENVELOPE-DEFINE PROGRAM,
SEE SEPERATE SHEET FOR INFO."''"HIT KEY TO START....":X=GET
   14PROCAXES      .
   15VDU29,182;420;
   16REPEAT
   17PROCCURSOR:PROCWIPE
   18ON O% GOSUB 30,38,24,43,56,60,74,36,32
   19UNTIL N%=3
   20PROCFUNCTION:PROCWIPE
   21ON O% GOSUB 30,38,24,43,56,60,74,36,32
   22IF O%=2 GOTO 16 ELSE GOTO 20
   23END
   24IF NOT AF% OR NOT PF% GOTO60
   25SOUND1,-15,100,4:VDU4,12:PRINT"PARAMETER PRINT :-You can list the ENVE-LOPE
 parameters  that are  formed from  your graphs.This is a good way to store any
good sounds you discover for later  use.     Hit a key..."::X=GET
   26CLS:PRINT"The statement would be:-"'"ENV.1,";STP;",";F%(1);",";F%(2);",";F%
(3);",";S%(1);",";S%(2);",";S%(3);",";F%(5);",";F%(6);",";F%(7);",";F%(8);",";S%
(5);",";S%(6);'"And the SOUND statement would have its  duration parameter=";
   27PRINTSTR$(INT(X%(7)*XMAX%/900*((STP-1)MOD126+1)/5))::X=GET
   28RETURN
   29REM **** ENTER PORTION ROUTINE ***
   30SOUND 1,-15,1,4:IF N%=2 PF%=-1 ELSE IFN%=7 AF%=-1
   31MOVEX%(N%),Y%(N%):DRAWX%,Y%:N%=N%+1:X%(N%)=X%:Y%(N%)=Y%:S%(N%)=DSTEPS%:F%(N
%)=FSTEPS%:RETURN
   32SOUND 1,-15,1,4:VDU4,12:PRINT"INFINITE SUSTAIN OPTION"'"You may choose infi
nite sustain for the"'"note sounded with F5 (hit I) or allow"'"it to decay norma
lly,as given by RELEASEpart of the amplitude envelope (hit N)";
   33REPEAT:INF$=GET$:UNTIL INF$="N" OR INF$="I":VDU12,5:RETURN
   34
   35 REM ** SELECT PITCH **
   36VDU4,12 :PRINT'"You are already in PITCH mode,numbskull'":SOUND1,-15,10,4:P
ROCWAIT(150):VDU12,5:RETURN
   37REM * DEL. LAST PORTION ROUTINE *
   38IFN%<4 PF%=0 ELSE AF%=0
   39IF N%=0 OR N%=4 VDU4,12: PRINT"No last-portion to delete":SOUND 1,-15,120,5
:PROCWAIT(100):VDU12,5:RETURN
```

GE

M



pitch and amplitude sections. All parameters entered are checked before they are accepted.

In Pitch Mode the Y-axis is labelled relative to f — which is the pitch used in the Sound statement concerned.

When moving the cursor about, remember that the dotted line can have a gradient — given as P/STP at the top — of zero even when it is not horizontal, since integer arithmetic and integer parameters cannot give totally accurate results. If the gradient of any section is zero, then, when the computer Sounds that part, there will be no pitch change.

Relative pitch

The Y-axis is the relative pitch, the X-axis is the number of steps. The actual duration of a step depends on what you have set it as.

The pitch envelope has three sections, for each section the computer needs to find the gradient, that is pitch/step; and its length in steps to use in the Envelope statement.

Whether the pitch envelope keeps cycling over is, of course, determined by the value chosen for the step length. In Amplitude Mode the Y-axis represents amplitude, the X-axis represents steps.

The parameters taken for the amplitude part of an envelope statement are somewhat odd, and the system used by the computer can cause amplitude envelopes to differ from the one you have drawn.

For this reason it is usually best to have a horizontal sustain section otherwise the note will fade quickly due to inaccuracies caused by the computer's Sound software dealing only in integers. *(continued on page 57)*

```
40SOUND1,-15,150,3:MOVEX%(N%),Y%(N%):N%=N%-1:PLOT7,X%(N%),Y%(N%):RETURN
41
42REM **** RESCALE ROUTINE ****
43SOUND1,-15,100,3:VDU4,12:PRINT"RESCALE AXIS-To pick axis type one of:-"''"X
,Y - To rescale the graph correctly."''"x,y - To scale axis but not the graph."'"
F   - To 'Forget' this operation.";
44REPEAT:*FX15,0
45Q$=GET$:UNTIL Q$="X" OR Q$="Y" OR Q$="x" OR Q$="y" OR Q$="F"
46IF Q$="F"VDU12,5:RETURN
47IFQ$="Y"ORQ$="y"REPEATCLS:INPUT"MAXIMUM Y-VALUE (5-83585) ",M:UNTILM>=5ANDM
<83586:PX%=XMAX%:PY%=INTM ELSEREPEATCLS:INPUT"MAXIMUM X-VALUE (3-765)",M:UNTILM>
=3ANDM<766:PX%=INTM:PY%=YMAX%
48IFN%=0GOTO54
49BAD=0:FORQ=1TON%:IFQ$="x"ORQ$="y" PS%(Q)=INT(S%(Q)/XMAX%*PX%+.5):PF%(Q)=FNR
OUND(F%(Q)/PX%*XMAX%/YMAX%*PY%):PX%(Q)=X%(Q):PY%(Q)=Y%(Q):GOTO51
50PF%(Q)=F%(Q):PS%(Q)=S%(Q):PX%(Q)=INT(X%(Q)/PX%*XMAX%+.5):PY%(Q)=INT(Y%(Q)/P
Y%*YMAX%+.5)
51IFPX%(Q)>900 ORABS(PY%(Q))>400 ORABS(PF%(Q))>126 ORPS%(Q)>255 BAD=-1
52NEXT:IFBAD CLS:PRINT"NO RESCALE-Bad graph":SOUND 1,-15,50,5:PROCWAIT(100):G
OTO43
53FORQ=1TON%:X%(Q)=PX%(Q):Y%(Q)=PY%(Q):F%(Q)=PF%(Q):S%(Q)=PS%(Q):NEXT
54 XMAX%=PX%:YMAX%=PY%:VDU5:PROCSCREEN:VDU29,182;420;:RETURN
55REM *** DEFINE STEP DURATION ***
56SOUND1,-15,100,4:REPEATVDU4,12:INPUT" Enter step duration (1-127 centisecs.
)",TAB(10,2),STP:UNTILSTP>=1ANDSTP<128:STP=INTSTP
57IF AF% AND INT(X%(7)*XMAX%/900*((STP-1)MOD126+1)/5)>254 SOUND1,-15,20,4:VDU
12:PRINT''"REJECTED-this value causes the amplitudeenvelope to be longer than the
 DURATION parameter in a SOUND statement can take.";:PROCWAIT(400):GOTO56
58CLS:PRINT"Do you want the pitch envelope to play  ONCE,or to keep REPEATING
 (enter O,R) ?":REPEAT:Q$=GET$:UNTILQ$="O"ORQ$="R"ORQ$="r"ORQ$="o":IFQ$="O"ORQ$=
"o"STP=STP+127:RETURN:ELSERETURN
59REM ****** BEEP ROUTINE ******
60VDU4,12:IF AF% AND PF% GOTO 63 ELSEIF NOTPF% PRINT"PITCH";:IF NOTAF% PRINT"
 and ";
61IF NOT AF% PRINT"AMPLITUDE";
62PRINT" envelope incomplete":SOUND1,-15,10,5:PROCWAIT(100):RETURN
63PRINT" DEPRESS  one of M,N,B to produce sound M   - produces MUSIC"'"N,B -
NOISE or BUZZ respectivly"'"E   - to END this operation";:*FX15,1
64*FX15,1
65REPEAT:Q$=GET$:UNTIL Q$="M" ORQ$="N" ORQ$="B" OR Q$="E":*FX15,0
66IF Q$="E" RETURN
67IF INF$="N" DUR%=INT(X%(7)*XMAX%/900*((STP-1)MOD126+1)/5) ELSE DUR%=255
68IF Q$="M" ENVELOPE1,STP,F%(1),F%(2),F%(3),S%(1),S%(2),S%(3),F%(5),F%(6),F%(
7),F%(8),S%(5),S%(6):SOUND&11,1,PITCH%,DUR%:GOTO64
69IF Q$="N" Z%=7 ELSE Z%=3
70ENVELOPE1,STP,F%(1),F%(2),F%(3),S%(1),S%(2),S%(3),0,0,0,F%(8),0,0:SOUND&11,
1,PITCH%,DUR%:SOUND&10,-15,Z%,DUR%:GOTO64
71GOTO65
72
73REM ** AMPLITUDE ENVELOPE **
74G%=2:N1%=N%:N%=M%:X1MAX%=XMAX%:Y1MAX%=YMAX%:XMAX%=AXMAX%:YMAX%=AYMAX%
75VDU19,1,1,0;0;19,0,1,0;0;:SOUND1,-15,20,4:CLG:PROCSCREEN:VDU19,1,3,0;0;19,0
,1,0;0;4,12,29,182;100;
76IFN%<>4 GOTO80
77PRINT"        AMPLITUDE MODE"'"You may now define an amplitude envelopein th
e same way.You can use the functionkeys.F7 returns you to pitch-define mode
 (SPACE BAR TO CONTINUE)";:X=GET
78PRINT'"Note that the first 3 stages must have atotal length of less than 25
5 (20'ths ofa second)  or the  corresponding   SOUNDstatement will have  DURATIO
N parameter out of range.        (SPACE BAR...)";:X=GET
79 CLS:PRINT"You have got the option of never-ending SUSTAIN by using F8 at a
ny stage."'"Note that 'never - ending SUSTAIN' means that the RELEASE section is
 never reached.   (SPACE BAR...)";:X=GET
80    VDU4:CLS:PRINT"Part one is   ATTACK"'"Part two is   DECAY"'"Part three
is SUSTAIN"'"Part four is  RELEASE"'"         PRESENT PART: ";
81ON N%-3 GOTO 82,83,84,85,86
82PRINT" ATTACK";:GOTO87
83PRINT" DECAY";:GOTO87
84PRINT" SUSTAIN";:GOTO87
85PRINT" RELEASE";:GOTO87
86PRINT" ALL DONE";
87 SOUND1,-15,10,2:*FX15,1
88X=INKEY(300):IF N%=8 GOTO 91 ELSEREPEAT:PROCCURSOR:PROCWIPE
89ONO% GOSUB30,38,24,98,56,60,94,96,32
90UNTIL N%=8 OR O%=8:IF O%=8 RETURN
91PROCFUNCTION:ONO% GOSUB30,38,24,98,56,60,94,96,32:IF O%=8 RETURN
92 IF O%=2 GOTO 88 ELSEGOTO91
93REM***AMPLITUDE MODE FUNCTION***
94VDU4,12:PRINT"You are already in AMPLITUDE mode-DOZY!!":SOUND1,-15,50,5:PRO
CWAIT(100):RETURN
95 REM ** RETURN TO PITCH MODE **
96    M%=N%:N%=N1%:G%=1:AXMAX%=XMAX%:AYMAX%=YMAX%:XMAX%=X1MAX%:YMAX%=Y1MAX%:V
DU19,1,4,0;0;19,0,4,0;0;5,12:PROCSCREEN:VDU29,182;420;19,1,6,0;0;:RETURN
97REM ** AMP. RESCALE ROUTINE **
98SOUND1,-15,100,3:VDU4,12:PRINT"RESCALE AXIS : type one of:-"''" X,Y - Re-pl
ots graph accordingly"'" x,y - Scales axis but leaves graph"'" F - To FINISH thi
s operation.";
99REPEAT:*FX15,0
100Q$=GET$:UNTILQ$="X" OR Q$="x" OR Q$="F" OR Q$="y" OR Q$="Y":IF Q$="F" VDU12
,5:RETURN ELSE IF Q$="Y" OR Q$="y" GOTO112
101 REPEAT CLS:INPUT"Maximum X-value (3 to 1400) "M:UNTILM>=3 AND M<1401:BAD=0
:PX%=INTM:IF N%=4 GOTO 111
102 FORQ=5 TON%
103IFQ$="x" PX%(Q)=X%(Q):PF%(Q)=FNROUND(F%(Q)*XMAX%/PX%) ELSE PF%(Q)=F%(Q):PX%
(Q)=INT(X%(Q)*XMAX%/PX%+.5)
104NEXT:ON 9-N% GOTO 105,106,107,108
105IF PF%(8)>0 ORPF%(8)<-126 BAD=-1 ELSE IF PF%(8)=0 AND S%(8)<>S%(7) PF%(8)=-
1
106 IF PF%(7)>0 ORPF%(7)<-126 OR PX%(7)*PX%/900*((STP-1)MOD127+1)>1270 BAD=-1
ELSE IFPF%(7)=0 AND S%(7)<>S%(6) PF%(7)=-1
107IF PF%(6)>126 ORPF%(6)<-126 OR PX%(6)*PX%/900*((STP-1)MOD127+1)>1270 BAD=-1
 ELSE IFPF%(6)=0 AND S%(6)<>S%(5) PF%(6)=SGN(S%(6)-S%(5))
108IF PF%(5)>126 ORPF%(5)<0 OR PX%(5)*PX%/900*((STP-1)MOD127+1)>1270 BAD=-1 EL
SE IFPF%(5)=0 AND S%(5)<>0 PF%(5)=1
109IF BAD CLS:PRINT"NO RESCALE - bad graph.":SOUND1,-15,50,5:PROCWAIT(100):GOT
O98
110FORQ=5 TO N%:F%(Q)=PF%(Q):X%(Q)=PX%(Q):NEXT
111XMAX%=PX%:VDU5:PROCSCREEN:RETURN
112REPEAT:CLS:INPUT"Enter max. y-value (9-126) "M:UNTIL M<127 AND M>=9:PY%=INT
M:BAD=0:IFN%=4 GOTO121
113FORQ=4 TON%
114IFQ$="y"PY%(Q)=Y%(Q):PF%(Q)=FNROUND(F%(Q)*PY%/YMAX%):PS%(Q)=INT(S%(Q)*PY%/Y
MAX%+.5) ELSE PY%(Q)=INT(Y%(Q)*YMAX%/PY%+.5):PF%(Q)=F%(Q):PS%(Q)=S%(Q)
115NEXT:ON 9-N% GOTO116,117,118,119
```

(listing continued on page 57)

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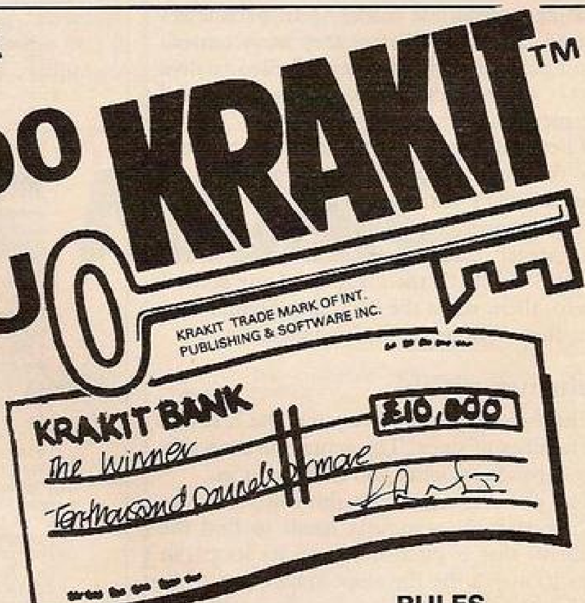

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(continued from page 55)

The end of the sustain section determines how long the note is Sounded for, although the amplitude can reach 0 before this thus effectively ending the note.

The release section does not have to end on the X-axis, it is only its gradient that is needed for the Envelope statement. Now for a complete description of all the functions assigned to the soft keys:

F0 EnterPoint	Enters position of cursor as next point on current envelope.
F1 DeletePoint	Deletes last point entered.
F2 Parameters	Gives completed envelope as the Envelope and Sound parameters needed to produce it.
F3 RescaleAxes	Used to rescale the x and/or y axes. There are two options: first, normal rescale—in which the axis is rescaled and any of the envelope parts are adjusted suitably; second, alternative rescale—the axis is rescaled but the graph shape is left in the same position.
F4 Set Step	Used to set the length of a step, and also whether the pitch envelope auto-repeats or not.
F5 Sound Env	Demonstrates a completed envelope in one of three voices
F6 Amp Mode	Enters program into Amplitude Mode
F7 Pitch Mode	Enters program into Amplitude Mode
F8 Infinite Stn	Set any future notes with an infinite sustain part — also cancels it
F9 Unused	

Note also that Escape starts the program all over again and so Break should be used to exit the program.

I would like to offer two simple yet useful tips for saving programs (especially long ones) on cassette.

Because of the bugs present in the BBC cassette-filing system, it is a neccessary precaution to Save programs several times in order to ensure at least one will Load back. It can be very boring sitting around waiting for long programs to save so that they can be saved over again, especially at 300 baud, so a good idea is to type:

*KEY 0 SAVE "programname"
|M|MTIME=0:REPEAT:UNTIL TIME =500|M

Then set your cassette recording and press soft key F0 say four times, one for each copy. You can then go away and have a cup of tea — the program will be saved four times with an inter-program gap of five seconds for those recorders with no motor control.

A much-criticised oversight on the BBC is the lack of a Verify command, since *CAT is not really the same thing. However if you try:

*LOAD "" 8000

then the computer will load the target program from hexadecimal 8000 onwards, which is, of course, read-only memory in the BBC Micro. However, although nothing is actually loaded into RAM, the machine still thinks it is loading a proper program. It will thus report any errors that occur, including the corrupting of block 00 — the most common of the cassette-filing system bugs. ■

(listing continued from page 55)

```
116IF PF%(8)>0 OR PF%(8)<-126 OR PS%(8)>126 BAD=-1 ELSE IF PF%(8)=0 AND PS%(8)
<>PS%(7) PF%(8)=-1
117IF PF%(7)>0 OR PF%(7)<-126 OR PS%(7)>126 BAD=-1 ELSE IF PF%(7)=0 AND PS%(7)
<>PS%(6) PF%(7)=-1
118IF PF%(6)>126 OR PF%(6)<-126 OR PS%(6)>126 BAD=-1 ELSE IF PF%(6)=0 AND PS%(
6)<>PS%(5) PF%(6)=SGN(PS%(6)-PS%(5))
119IF PF%(5)>126 OR PF%(5)<0 OR PS%(5)>126 BAD=-1 ELSE IF PF%(5)=0 AND PS%(5)<
>0 PF%(5)=1
120IF BAD GOTO109 ELSE FOR Q=5 TO N%:F%(Q)=PF%(Q):S%(Q)=PS%(Q):Y%(Q)=PY%(Q):NE
XT
121YMAX%=PY%:VDU5:PROCSCREEN:RETURN
122DEF PROCINITIALISE:XMAX%=765:YMAX%=126:AXMAX%=400:AYMAX%=126:*FX4,1
123 VDU 28,0,4,39,0,23;8202;0;0;0,12
124 *FX11,30
125 *FX12,1
126*KEY0 1
127*KEY1 2
128*KEY2 3
129*KEY3 4
130*KEY4 5
131*KEY5 6
132*KEY6 7
133*KEY7 8
134*KEY8 9
135*KEY9 :
136  *KEY10 OLD|MMODE6|MVDU19,1,5,0;0;|M|NL.|M
137DIM X%(8),Y%(8),F%(8),S%(8),PX%(8),PY%(8),PF%(8),PS%(8):FOR I%=0TO8:X%(I%)=
0:Y%(I%)=0:F%(I%)=0:S%(I%)=0:NEXT
138N%=0:X%=0:Y%=0:DSTEPS%=0:FSTEPS%=0:STP=1:G%=1:M%=4:AF%=0:PF%=0:INF$="N":PIT
CH%=126
139 VDU23,224,224,224,224,0,0;0;19,1,6,0;0;19,0,4,0;0;
140ENDPROC
141 DEF PROCCURSOR
142 VDU5 :X%=X%(N%)+INT(900/XMAX%+1):DSTEPS%=1:FSTEPS%=0:Y%=Y%(N%):PROCINFO
143XN%=X%:YN%=Y%
144 *FX15,1
145MOVE0,0:DRAW400,0:MOVE0,-100:DRAW0,100:Q%=GET
146IF Q%=137THENXN%=XN%+6:GOTO151
147IF Q%=136THENXN%=XN%-6:GOTO151
148IF Q%=139THENYN%=YN%+16:GOTO151
149IF Q%=138THENYN%=YN%-16:GOTO151
150IF (Q%-48)>0 AND (Q%-48)<10 Q%=Q%-48:GOTO 157 ELSE GOTO144
151IF FNBAD PROCREJECT:PROCINFO:GOTO143
152SOUND0,-10,1,1:PROCINFO2:PROCWIPE
153PLOT29,XN%,YN%
154MOVE XN%-4,YN%+4:PRINTCHR$224
155X%=XN%:Y%=YN%
156GOTO144
157ENDPROC
158DEF PROCAXES:VDU5,29,0;0;:MOVE182,20:DRAW182,820:IFG%=1THENQ=420:A%=32:B%=4
00 ELSEQ=100:A%=112:B%=720
159MOVE1082,Q:DRAW100,Q
160FORI%=170TO1070STEP100:MOVEI%,Q+16:PRINT":":NEXT
161FORI%=170TO1070STEP300:MOVEI%,Q-6:PRINTSTR$(INT((I%-170)/900*XMAX%+.5)):NEX
T
162FORI%=A%TO832STEP80:MOVE0,I%:IFQ=100 Q$="  " ELSEQ$="F":IFI%>Q Q$="F+"
163PRINTQ$;STR$(INT((I%-Q-12)/B%*YMAX%)):MOVE164,I%:PRINT"-":NEXT
164VDU29,182;Q;:ENDPROC
165
166DEF PROCREJECT:SOUND1,-15,100,5:VDU4,12:PRINT"Not allowed-outside parameter
 range":PROCWAIT(100):VDU5:ENDPROC
167DEF PROCWAIT(T%):TIME=0:REPEAT UNTIL TIME>T%:ENDPROC
168DEF PROCINFO:IF N%<4 A$="Pitch/step=":B$="Steps":C$="P/Stp":D$="PITCH " ELS
E A$="Amp./step =":B$="Amp. ":C$="A/Stp":D$="AMPLITUDE"
169VDU4,12:PRINT"CURSOR:";TAB(19,0);D$;" envelope";TAB(0,1);"Part      =";A$;
'B$;"     ="'"Step time = ";(STP-1)MOD127+1;" cs.";TAB(19);"Pitch repeat : ";:IF
 STP>127 PRINT"OFF"; ELSE PRINT"ON";
170 IFN%=0 OR N%=4 GOTO173 ELSEPRINTTAB(19,1);"Point";TAB(19,2);C$;TAB(19,3);B
$;
171 IF N%<4 THEN Q=0 ELSE Q=4
172 REPEAT Q=Q+1:W%=20+(Q MOD4)*5:PRINTTAB(W%,1);"*";Q MOD4;"*";TAB(W%,2);F%(Q
);TAB(W%,3);S%(Q);:UNTIL Q=N% OR Q=7
173PROCINFO2:ENDPROC
174 DEF PROCWIPE:MOVEX%-4,Y%+4:GCOL0,0:PRINTCHR$224:GCOL0,1:MOVE X%,Y%:PLOT7,X
%(N%),Y%(N%):ENDPROC
175 DEF PROCINFO2:VDU4:PRINTTAB(12,1);N%MOD4+1;TAB(12,2);FSTEPS%;"   ";TAB(12,
3);DSTEPS%;"  ";:VDU5:ENDPROC
176DEF PROCSCREEN:CLS:PROCAXES:MOVE0,0:IFN%=8 THEN Q=5 ELSE Q=N%DIV4*4
177FORQ=Q TO N%:DRAWX%(Q),Y%(Q):NEXT:ENDPROC
178 DEF FNROUND(X)=INT(ABS(X)+.5)*SGNX
179  DEF FNBAD:ON N%+1 GOTO 180,180,180,180,182,185,188,191
180 PDSTEPS%=INT((XN%-X%(N%))/900*XMAX%):IF PDSTEPS%<=0 OR PDSTEPS%>255 THEN =
-1
181 PFSTEPS%=FNROUND((YN%-Y%(N%))/400*YMAX%/PDSTEPS%):IF ABS(PFSTEPS%)>126 THE
N =-1 ELSE FSTEPS%=PFSTEPS%:DSTEPS%=PDSTEPS%:=0
182 V%=INT(XN%/900*XMAX%):IFV%<=0 OR V%*((STP-1)MOD127+1)>1270 =-1
183IF YN%<0 OR YN%>720 =-1 ELSE PDSTEPS%=INT(YN%/720*YMAX%+.5):PFSTEPS%=INT(PD
STEPS%/V%+.5):IF PDSTEPS%<>0 AND PFSTEPS%=0 PFSTEPS%=1
184IF ABSPFSTEPS%>126 =-1 ELSE FSTEPS%=PFSTEPS%:DSTEPS%=PDSTEPS%:=0
185 W%=INT((XN%-X%(N%))/900*XMAX%):IFW%<=0 OR (V%+W%)*((STP-1)MOD127+1)>1270 =
-1
186IF YN%<0 OR YN%>720 =-1 ELSE PDSTEPS%=INT(YN%/720*YMAX%+.5):PFSTEPS%=INT((Y
N%-Y%(N%))/720*YMAX%/W%+.5)
187 IF PFSTEPS%=0 AND PDSTEPS%<>S%(5) PFSTEPS%=SGN(PDSTEPS%-S%(5)): GOTO 184 E
LSE GOTO 184
188 U%=INT((XN%-X%(N%))/900*XMAX%):IFU%<=0 OR (V%+W%+U%)*((STP-1)MOD127+1)>127
0 =-1
189IF YN%<0 OR YN%>Y%(N%) =-1 ELSE PDSTEPS%=INT(YN%/720*YMAX%+.5):PFSTEPS%=INT
((YN%-Y%(N%))/720*YMAX%/U%+.5):IF PFSTEPS%=0 AND PDSTEPS%<>S%(6) PFSTEPS%=-1
190IF PFSTEPS%<-126 OR PFSTEPS%>0 =-1 ELSE FSTEPS%=PFSTEPS%:DSTEPS%=PDSTEPS%:=
0
191 IF XN%<=X%(N%) OR YN%>Y%(N%) OR YN%<0 =-1 ELSE PDSTEPS%=INT(YN%/720*YMAX%+
.5):PFSTEPS%=INT((YN%-Y%(N%))/720*YMAX%/((XN%-X%(N%))/900*XMAX%)+.5)
192IF PFSTEPS%<-126 =-1 ELSE FSTEPS%=PFSTEPS%:DSTEPS%=PDSTEPS%:=0
193DEF PROCFUNCTION:PROCINFO:VDU4,30:PRINT"You may now use    "'" any of F0-F9
  "'"   WAITING......"'"                 ";:VDU5
194*FX15,1
195 Q%=GET-48:IF Q%<2 OR Q%>10 GOTO194 ELSE ENDPROC
```

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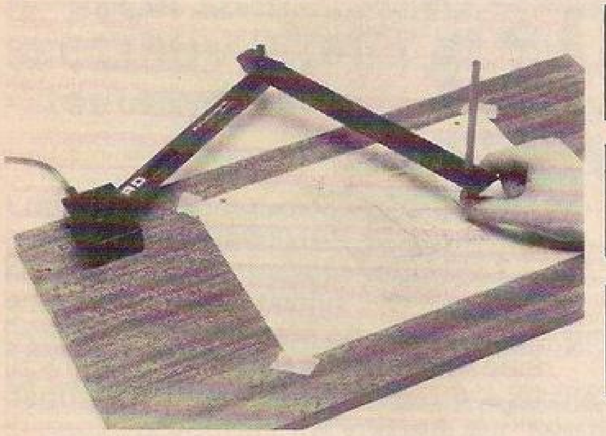

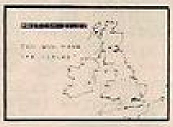

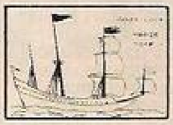

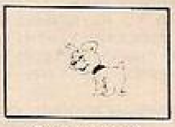

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If snowdrops and Spectrums are among your favourite things, these valuable machine-code routines by Jeremy Hall will help improve your micro's sound-producing ability. Impressive noises can be produced to rival the machine-code routines used by software houses.

SOUND OUT YOUR SPECTRUM

WITH A LITTLE knowledge of machine code and of how the Spectrum produces sound, some quite impressive noises can be produced, despite its limited sound facility.

The Spectrum produces sound by sending a series of clicks to its internal loudspeaker. The time interval between each click, and hence the pitch of the note, is dependent on the value held in the HL register pair of the Z-80. The higher the value stored in HL, the longer the interval between clicks, hence the lower the pitch of the note produced, and vice versa. The length of the note produced, that is, the number of clicks, is controlled by the value stored in the DE register pair; the larger the number, the longer the note.

Having set these registers to the required values, it is then simply a matter of calling the sound-producing routine in the Basic ROM. This starts at address 03 B5 hex, 949 decimal. Program 1 demonstrates this idea very simply, and figure 1 shows the machine-code mnemonics of this program. Try changing some of the values of HL and DE in this program by altering the Data statements, but before you do this, save the program on cassette in case you crash the system.

It probably will not take you very long to tire of program 1 and you will want to move on to some more interesting sounds. This is where program 2 comes into it; figure 2 shows the machine-code mnemonics for this program. Register B is loaded with the number of times that the whole sound is to be repeated. Try loading it with 1, that is change the second number in the data statement from 10 to 1.

HL and DE are set to the required value and the sound routine called. On returning from the routine, DE is loaded with 16, which is then added to HL to increase its value, and lower the pitch of the next note. The sound routine is then called again, and this process repeated 255 times. Register B is then decremented and if it is zero the program will end and return to Basic, otherwise the whole process will be repeated. Note that registers HL and BC must be saved by it.

In the final program, program 3, the machine code held in each data statement is based on the previous program, but with different values of HL and DE in each case. Enter the program exactly as shown, with the correct number of zeros after each Data statement. These zeros are used as padding to make each routine 30 bytes long and thus make each USR address easier to remember — 32400 to 32430 and so on. Try experimenting with the values of HL and DE again; you might be surprised at the results. ■

Program 1.

```
10 CLEAR 32499
20 FOR a = 32500 TO 32509
30 READ n : POKE a , n
40 NEXT a
50 DATA 17 , 128 , 0
55 DATA 33 , 0 , 3
60 DATA 205 , 181 , 3
65 DATA 201
100 RANDOMISE USR 32500
```

```
10 CLEAR 32499
20 FOR a = 32500 TO 32529
30 READ n : POKE a , n
40 NEXT a
50 DATA 6, 10, 197, 33, 15, 0, 17, 20, 0, 229,
   205, 181, 3, 225, 17, 16, 0, 167, 237, 90,
   125,254, 255, 32, 237, 193, 16, 230, 201, 0
60 RANDOMISE
   USR 32500
```

Program 2.

```
10 CLEAR 32399
20 FOR a = 32400 TO 32549
30 READ n : POKE a , n
40 NEXT a
50 DATA 6, 3, 197, 33, 15, 0, 17, 40, 0, 229,
   205, 181, 3, 225, 17, 4, 0, 167, 237, 90,
   125, 254, 255, 32, 237, 193, 16, 230,
   201, 0
60 DATA 6, 20, 197, 33, 0, 3, 17, 1, 0, 229,
   205, 181, 3, 225, 17, 16, 0, 167, 237, 82,
   32, 240, 193, 16, 233, 201, 0, 0, 0, 0
70 DATA 6, 5, 197, 33, 15, 0, 17, 40, 0, 229,
   205, 181, 3, 225, 17, 16, 0, 167, 237, 90,
   125, 254, 255, 32, 237, 193, 16, 230,
   201, 0
80 DATA 6, 2, 197, 33, 0, 6, 17, 5, 0, 229,
   205, 181, 3, 225, 17, 8, 0, 167, 237, 82,
   32, 240, 193, 16, 233, 201, 0, 0, 0, 0,
90 DATA 6, 50, 197, 33, 0, 1, 17, 1, 0, 229,
   205, 181, 3, 225, 17, 16, 0, 167, 237, 82,
   32, 240, 193, 16, 233, 201, 0, 0, 0, 0
100 RANDOMISE USR 32400
110 RANDOMISE USR 32430
120 RANDOMISE USR 32460
130 RANDOMISE USR 32490
140 RANDOMISE USR 32520
150 GO TO 100
```

Program 3.

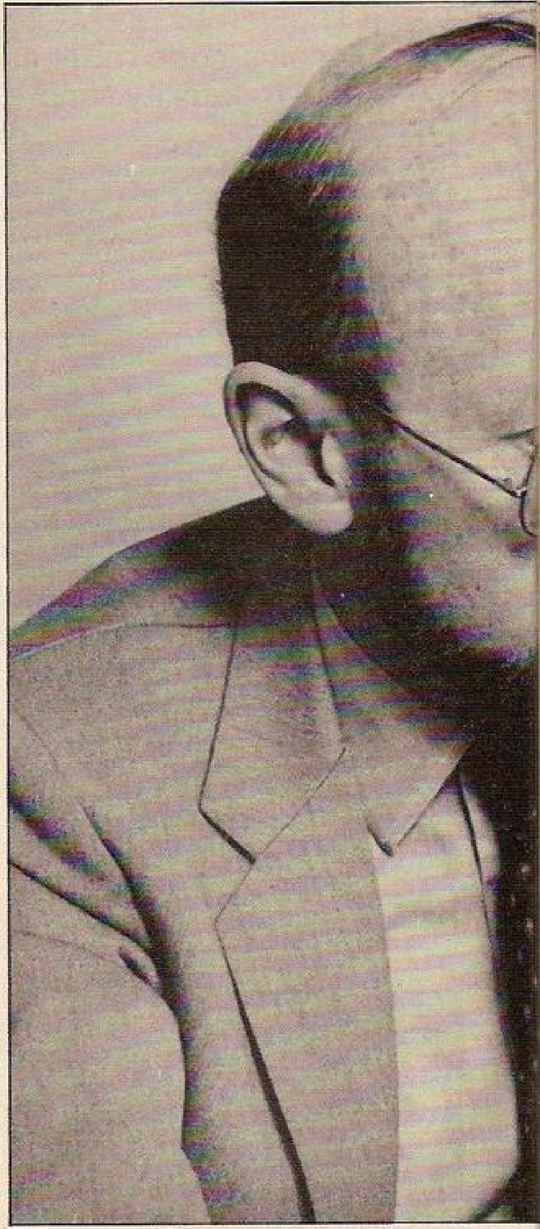
Mnemonic	Hex	Decimal	Comment
LD DE, 128	11 7F 00	17 128 0	Note length
LD HL, 768	21 00 03	33 0 3	Pitch
CALL 949	CD B5 03	205 181 3	Call sound
RET	C9	201	Return to Basic

Figure 1.

Mnemonic	Hex	Decimal	Comment
LD B , 10	06 0A	6 10	Repeat sound 10 times
PUSH BC	C5	197	
LD HL ,15	21 0F 00	33 15 0	Initial pitch
LD DE ,20	11 14 00	17 20 0	Note duration
PUSH HL	E5	229	
CALL 949	CD B5 03	205 181 3	Sound routine
POP HL	E1	225	
LD DE , 16	11 10 00	17 16 0	Decrease
AND A	A7	167	the
ADC HL , DE	ED 5A	237 90	pitch
LD A , L	7D	125	Repeat
CP 255	FE FF	254 255	255 times
JRNZ -18	20 ED	32 237	
POP BC	C1	193	
DJNZ -25	10 E6	16 230	Dec B, repeat if not zero
RET	C9	201	Return to Basic

Figure 2.

```
   5 REM sound analysis
         © J.D.M.Edwards
  10 INPUT "Number of words ";no
  20 DIM a(no,175)
  25 DIM a$(no,20)
  30 DIM b(175)
  35 DIM c(no)
  36 FOR n=1 TO no: LET c(n)=0:
NEXT n
  40 INPUT "Which sound (1-";(no
);") ";q
  50 GO SUB 1000
  60 FOR n=1 TO 175
  70 IF c(q)=0 THEN LET a(q,n)=b
(n)
  80 IF c(q)=1 THEN LET a(q,n)=(
a(q,n)+b(n))/2
  90 NEXT n
  95 IF c(q)=0 THEN INPUT "Word
";a$(q)
 100 LET c(q)=1
 110 GC SUB 2000: GO SUB 3000
 120 PRINT AT 0,0; OVER 1;"Press
 'c' to cont,'r' to learn"
 123 BEEP 1,30
 125 PRINT AT 0,0; OVER 1;"Press
 'c' to cont,'r' to learn"
 130 IF INKEY$="" THEN GO TO 130
 140 IF INKEY$<>"c" AND INKEY$<>
"r" THEN GO TO 130
 150 IF INKEY$="r" THEN GO TO 40
 160 GO SUB 1000
 165 GO SUB 2000
 166 GO SUB 3000
 170 DIM d(no)
 180 FOR m=1 TO no
 190 FOR n=1 TO 175
 200 IF ABS (a(m,n)-b(n))>10 THE
N LET d(m)=d(m)+1
 210 NEXT n
 220 NEXT m
 230 LET low=9999
 235 LET wor=0
 240 FOR n=1 TO no
 250 IF d(n)<low THEN LET wor=n:
 LET low=d(n)
 260 NEXT n
 270 PRINT AT 10,10;a$(wor)
 280 GO TO 120
 999 STOP
1000 REM enter sound
1010 PRINT AT 0,0; OVER 1;"Speak
 After Tone"
1020 BEEP 1,30
1030 PRINT AT 0,0; OVER 1;"Speak
 After Tone"
1035 GO SUB 4000
1040 FOR n=1 TO 175
1050 LET l=USR USR "r"
1060 LET b(n)=PEEK 23608
1070 NEXT n
1080 RETURN
2000 REM draw graph (b)
2005 FOR n=0 TO 21: PRINT AT n,0
;"                   ": NEXT n
2010 FOR n=1 TO 175
2020 PLOT 0,n
2030 DRAW b(n)/2,0
2040 NEXT n
2050 RETURN
3000 REM draw graph (a)
3005 FOR n=0 TO 21: PRINT AT n,1
5;"                  ": NEXT n
3010 FOR n=1 TO 175
3020 PLOT 127,n
3030 DRAW a(q,n)/2,0
3040 NEXT n
3050 RETURN
4000 REM wait
4010 LET l=USR USR "r"
4020 IF PEEK 23608=0 THEN GO TO
4010
4030 RETURN
```



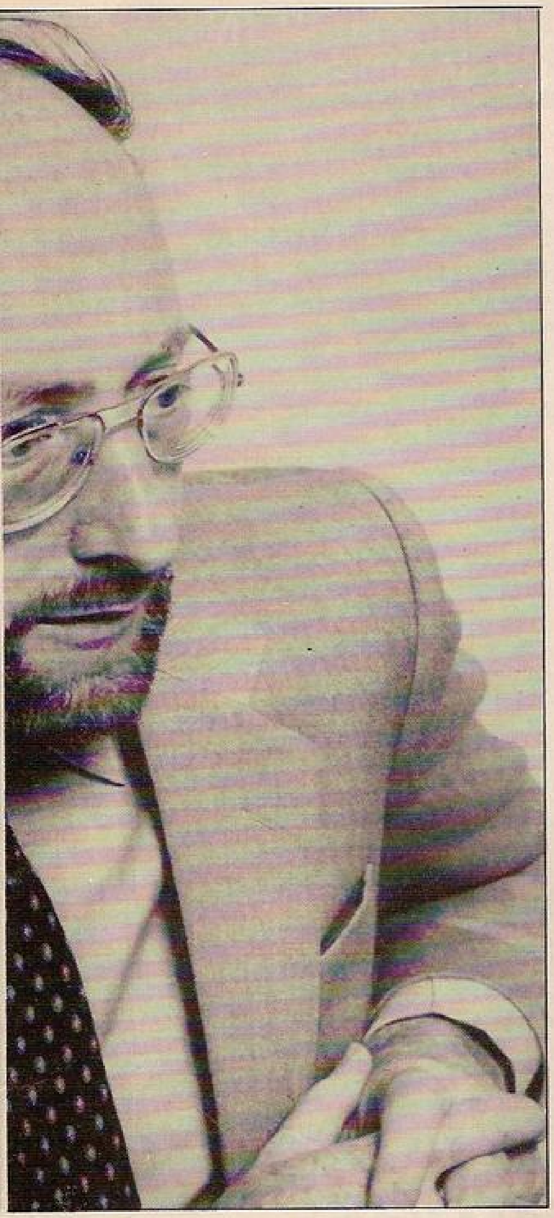
BEFORE ENTERING the main Basic program the machine-code routine should be entered using the following Basic program.

```
10 FOR n = USR "r" TO USR "u"
20 INPUT a
30 POKE n,a
40 NEXT n
```

After entering the program, type Run and press Enter, then enter the numbers in the left-hand column taking / as Enter. The mnemonics are included for machine-code enthusiasts.

33/56/92/	LD HL,(5C38)
62/0/	LD A,00
119/	LD (HL),A
6/255/	LD B,FF
219/250/	IN A,(FA)
254/255/	CP FF
40/1/	JR Z 01
52/	INC (HL)
16/247/	DJNZ -9
201/	RET
0/0/0/0/0/0/0/	NOP (*7)

The machine code acts as a crude frequency counter by looping round 255 times and adding 1 to the location 23608 each time it hears a noise through the ear socket. We are therefore left with a number between 0 and 255 at location 23608 each time we call the routine. This number will correspond to the frequency and, to some extent, the amplitude



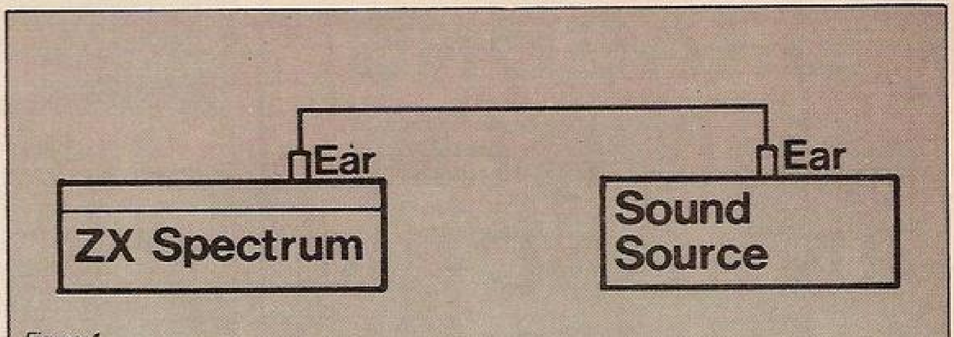


Figure 1.

TALK TO YOUR SPECTRUM

If the strain of pushing keys is telling, J D M Edwards' program lets you sit back and relax.

of the sound entering the ear socket when the routine was running.

To use the program you will need some kind of input to the ear socket; you could use a radio or a cassette recorder. To use the main Basic program you will need some way of connecting a microphone to the ear-socket, via an amplifier so that the computer can analyse your voice dynamically — as you speak.

Sound source

To use the program, plug the ear lead on the Spectrum into the ear lead of your sound source as shown in the diagram, figure 1.

If you want to see the program working but cannot connect a microphone to your Spectrum, then Enter the following short Basic program.

```
10 FOR n=1 TO 175
20 LET a=USR USR "r"
30 PLOT 0,n
40 DRAW PEEK 23608,0
50 NEXT n
60 CLS
70 GOTO 10
```

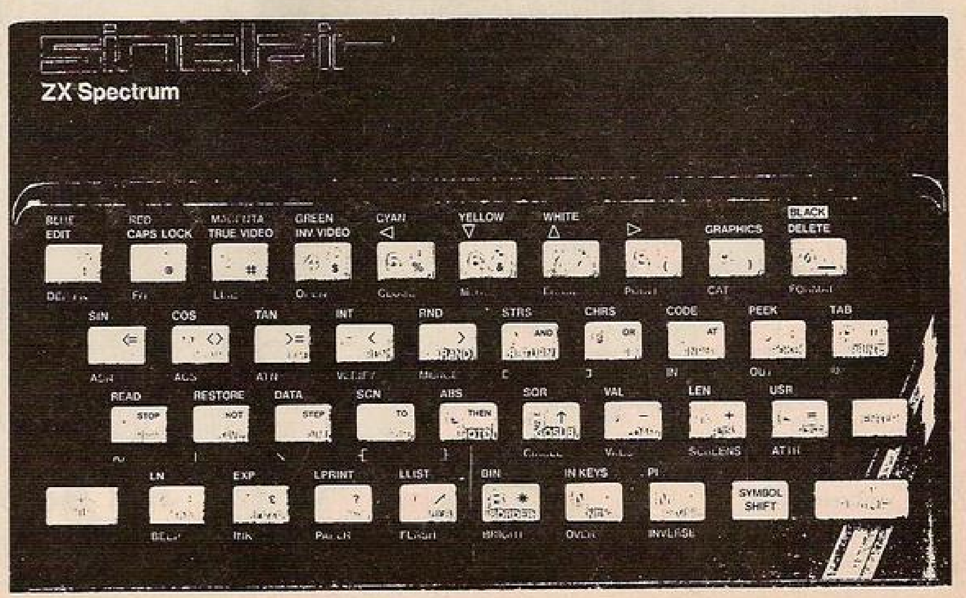
Type Run and Enter and gradually turn the volumn of your sound source up until you see a fine bar graph across about one quarter of the screen; your computer is now displaying the sound that is going into the ear socket.

If you can connect a microphone to your computer then try this Basic speech-analysis program. After entering it, type Run and switch on your microphone. Enter how many words you want — I suggest two for your first try — then enter which word you want to enter first. You shold see the words "Speak after tone" appear, accompanied by a beep.

The machine will then wait for a sound in the mike before it starts inputting information, so you can take your time before saying your word after the tone has stopped. When you have said your word, sit back and wait until the machine asks for the name of the word. After entering this you will be given two graphs at the moment identical and will be asked if you want to learn or continue. Select learn and you will again be faced with the prompt "Which sound?". This time enter 2 and repeat the process. For better results repeat each word several times — not on the same analysis, but respond with each number several times to the prompt. This will be averaged out to provide a more accurate result.

Word matching

Having repeated each word several times, respond with Continue to the prompt and say one of your words after the tone. The Spectrum will sort through its files and print the word nearest to yours. Although slow, this method has a good success rate and could be rewritten in machine code to save time.



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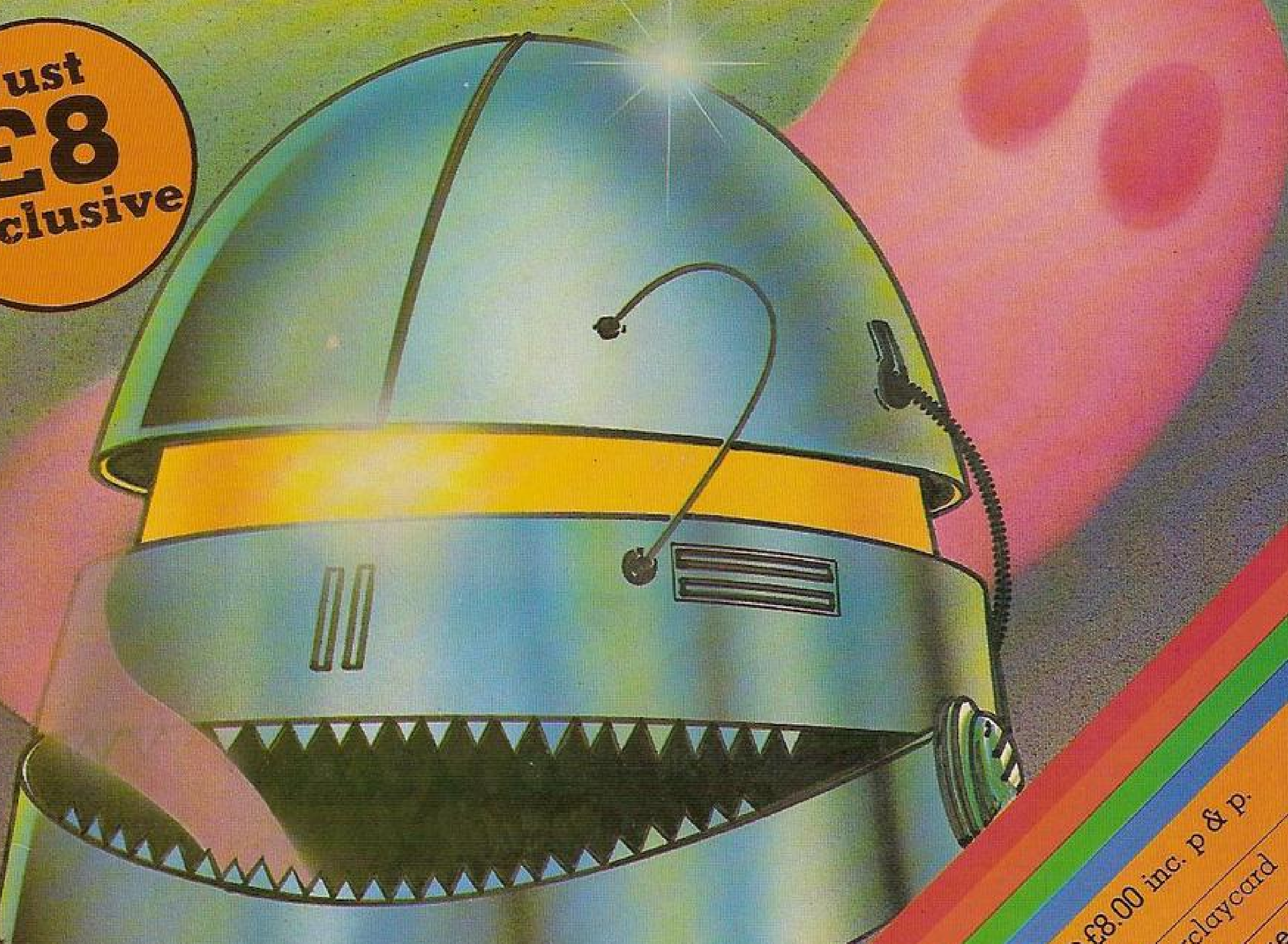

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ALL THE PROGRAMS in this series of articles will run on a 1K ZX-81. In fact if you have a RAM pack you will need to remove it, or reset RAMtop to less than 3.25K.

The first essential when producing a games program is to set up the background display. With the 1K ZX-81 the display file is collapsed, so it is impossible to Poke the characters into the display. Therefore one must first set up a display file of the size required.

In machine language there is an instruction RST 10 — D7 hex. This is a very important instruction on the ZX-81: it is only one byte long and instructs the computer to print a character, held in the A register, in the first free space on the screen. If you look at program 1 you will see how this is done.

```
16514   3E 1C   LD A, 1C   CHR$ 0
        D7      RST 10     Print it
        C9      RET        RET TO BASIC

1  REM Y0 NOT TAN
2  RAND USR 16514
```
Program 1.

With the demonstration programs 1 to 5 there is no need for a hex loader, since they all can be keyed in. Keywords are emboldened; Some keywords such as Copy are entered by typing Then Copy and erasing the word Then.

The 0 in program 1 can be replaced by any character available from the keyboard. The character will be printed in the first available print position, that is 0,0.

Program 2 demonstrates how to print up to 255 characters consecutively on the screen using the instruction DJNZ–10 hex. This instruction carries out two operations; it reduces the number held in the B register and jumps a specified distance if the number is not zero. In this case it will jump backwards −3 places FD hex. FF is −1, FE is −2, FD is −3 and so forth. The maximum number of places forward is 127 and backwards is 128.

```
16514   3E 1C   LD A, 1C   CHR$ 0
        06 FF   LD B, FF   Load B with 255
        D7      RST 10     Print a CHR
        10 FD   DJNZ-3     Reduce B by 1
                           and if not zero
                           then go back to
                           print a CHR
        C9      RET        RETURN TO
                           BASIC

1  REM Y0 ▚ COPY NOT CLEAR TAN
2  RAND USR 16514
```
Program 2.

If more than 255 characters are required then either repeat program 2, or use program 3 which enables a full screen to be set up. With this program the HL register pair is used because it can hold numbers greater than 255 — a full screen requires 726 characters. It works in a similar way to program 2, except that the check for HL zero is made using the A register. The A register is loaded with the value held in the H register and then an Or L operation is carried out on the A register.

This simply means that if H is not zero, or if L is not zero, then the result is not zero. But if H is zero and L is zero, then the result is zero. This result can be used to jump forwards or backwards.

In this case, the jump is backwards to reload A with the character to be printed and continues until HL is zero.

The quotation marks after the 5 are a shift Q and the P before the 4 is an inverse P. The direct command is necessary because 7C is not available from the keyboard. However, not many games programs use just one character as a background. A method of printing more information on the screen is shown in program 4, where the word "Hello" is printed. This works in a similar way to the Basic

```
10 LET A$ = "HELLO"
20 PRINT A$
```

The first step is to set up Hello as Data to be read, then printed, one letter at a time. The word Hello in program 4 is held at the start of the Rem statement. In other words, address 16514 holds the letter H, 16515 holds E, 16516 holds L, 16517 holds L and 16518 holds O. HL is then loaded with 16514 — that is, it points to the first letter to be printed. The B register is loaded with 5 — the number of letters — and the A register is loaded with the contents of the address held in the HL register pair.

So the first run-through prints the letter H. The HL register pair is then increased by one to point to the letter E and the B register is reduced by one. A check is made to see if B is zero and, if it is not, a jump back to load A with contents of address held in HL is made. This process continues until all the letters are printed, that is, until B = 0.

The final demonstration program shows the memory economy available with machine language. It will print out an eight-by-eight squares checkered board and does the same as the Basic program:

```
10 LET A$ = "▒ █ □ █ ▒ █ ▒ █ ▒"
30 FOR A = 1 TO 4
40 PRINT A$ (to 8)
50 PRINT A$ (2 to)
60 NEXT A
```

This program uses two counters: the B register to count eight characters per line and the C register to count eight lines. To save memory, the C register is also used to select the start of Data to be printed. Each board line either starts with a black square or a grey square and so only nine squares need be stored as Data.

The start address of each line is then 16514 and 16515 alternately. The start is selected by looking at Bit 0 of the number held in the C register, if it is 0 then the start is 16514 and, if it is 1, then the start is 16515. Bit 0 is the first number of the binary notation of the hexadecimal number and runs as follows:

8 = 1000
7 = 0111
6 = 0110
5 = 0101
4 = 0100
3 = 0011
2 = 0010
1 = 0001
0 = 0000

So you can see that with each run through of the program bit 0 changes from 0 to 1 to 0 etc., so that the start of Data changes from 16514 to 16515 to 16514, and so on.

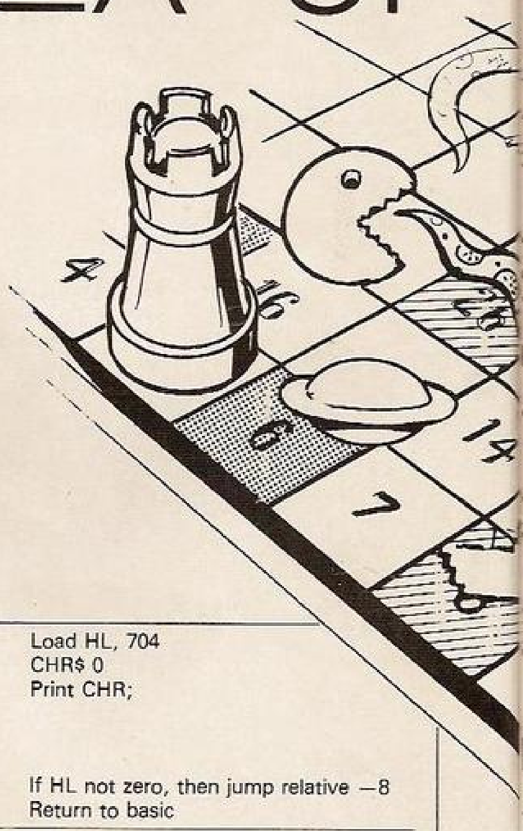
The listing for the programs will look a little strange after the direct commands because of the hex 76 Newline character and the 7E character, but do not worry — the machine code is still there, as is line 2. Just the computer to list line 2. The grey squares are all graphics shift A.

Now to tackle the display for the Frogger

```
16514   2D 2A 31 31 34   "HELLO" DATA
        21 82 40         LD HL, 16514
                         (40 82)
        06 05            LD B, 05
        7E               LD A(HL)
        D7               RST 10
        23               INC HL
        10 FB            DJNZ −5
        C9               RET

1  REM H E L L O 5 ▙ RND ▚ ▌ ?
     NOT 7 ( CLS TAN
   POKE 16524,126
2  RAND USR 16519
```
Program 4.

ZX-81



```
16514   21 C0 02   LD HL 704 dec   Load HL, 704
        3E 1C      LD A, 1C        CHR$ 0
        D7         RST 10          Print CHR;
        2B         DEC HL
        7C         LD A, H
        B5         OR L
        20 F8      JRNZ            If HL not zero, then jump relative −8
        C9         RET             Return to basic

1  REM 5 "" Y0 NOT F ? [P] 4 SAVE TAN
   POKE 16521,124 Direct command
2  RAND USR 16514
```
Program 3.

```
16514   08 80 08 80 08     DATA
        80 08 80 08
        0E 08              LD C, 08
        21 82 40           LD HL, 16514
        06 08              LD B, 08
        7E                 LD A, (HL)
        D7                 RST10
        23                 INC HL
        10 FB              DJNZ -5
        3E 76              LD A 76           Print N/L CHR
        D7                 RST 10            after each row
        0D                 DEC C
        C8                 RET Z             If eight rows return
                                             to Basic
        CB 41              BIT 0, C
        28 ED              JRZ -19
        21 83 40           LD HL, 16515
        18 EB              JR -21

1  REM ▒■▒■■■▒▒■▒ : ▒ 5 ▙ RND
   ▛▒? NOT 7 (CLS Y? NOT $ COS ACS
   INKEY$ C GOSUB 5 ☐ RND / FOR
   POKE 16530,126 Direct commands
   POKE 16536,118 Direct commands
2  RAND USR 16523
```

Program 5.

program. The technique used is exactly the same as program 4, in that the display is held in Data form and is printed from Data to the screen. Because of the length of this program it is necessary to use a hex loader Basic program to Poke the machine code into the Rem statement. So to start, type the Basic:

```
FAST
 1 REM 255 0s
 2 REM 255 0s
10 LET X=16514
20 LET A$=""
30 IF A$="" THEN INPUT A$
40 IF A$="S" THEN STOP
50 POKE X, 16*CODE A$+CODE A$(2)-476
60 PRINT AT 11,); X; ""; A$ (1 TO 2)
70 LET X=X+1
80 LET A$=A$ (3 TO)
90 GOTO 30
   RUN
```

To save typing out Rem statements, type line 1 then Edit it. This will take a second or two to bring the line into the Edit position. Then change it to line 2. The first Rem statement is used to hold the machine code to print the display; the second Rem statement is used to hold the machine code to make it move.

At each input prompt enter the hex numbers as listed. These may be entered in batches of up to 10 pairs, but remember there are no spaces between the codes. After inputting code 32 hex at address 16768 enter S to stop the Basic program and change to Slow mode.

Edit line 10 to read

LET X=16775

and Save the program for use with next month's article.

To check that your machine code is correct, change line 10 to

RAND USR 16702 . POKE 16819, 201

direct command and delete lines 20 to 90.

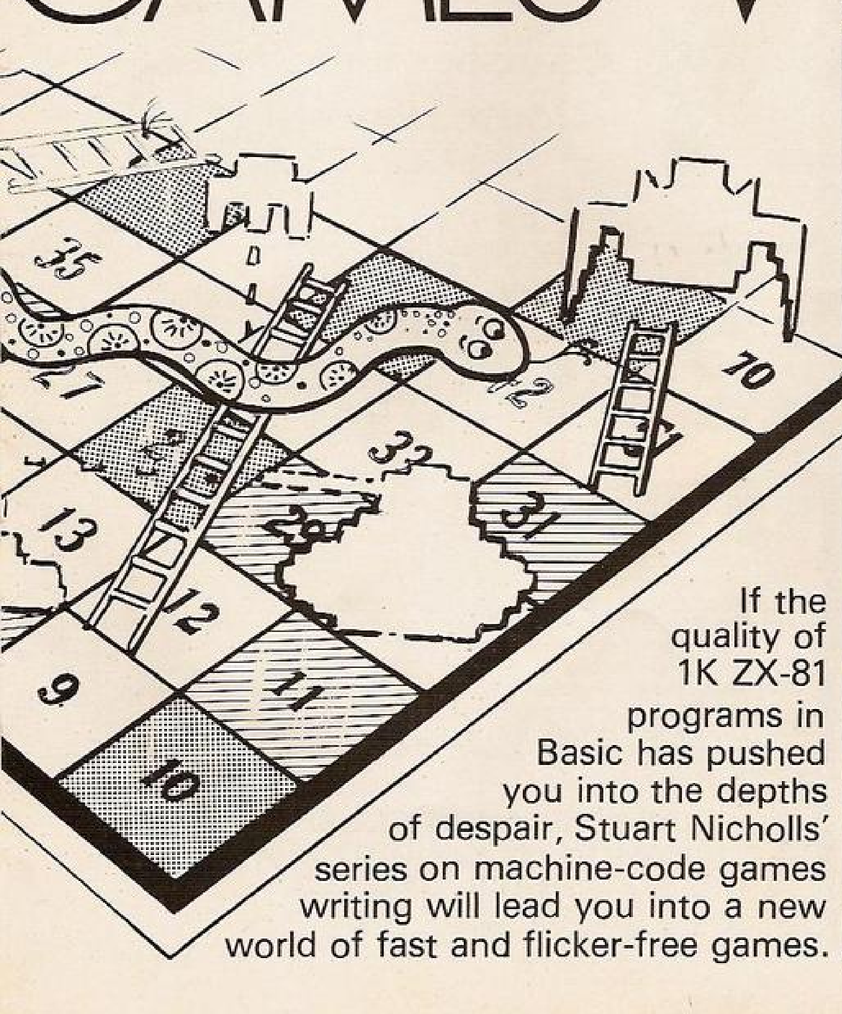
Now enter Run, and you should have a stationary display for the game.

The object of the game is to hop your frog, an inverse *, across the road, avoiding all the obstacles, to the safe middle island, then hop on to the lily pads represented by 0s and logs represented by ▄s and finally into one of the four homes. Each home is represented by a *.

The frog is controlled by pressing key 5 to go left, 8 to go right and 0 to go up. Each move up is counted, and a time limit of 199 seconds is given in which to fill all four home bases. If a frog is hit on the road, jumps into the lake, hits the wall or floats off the screen on a lily pad or log, then it is dead, and another frog is given at the base line. You cannot hop the frog off the screen.

The game finishes when all four home bases are filled or when the counter reads zero. The aim, therefore, is to fill all home bases in the quickest time, with the least number of up hops. ■

GAMES WRITING



If the quality of 1K ZX-81 programs in Basic has pushed you into the depths of despair, Stuart Nicholls' series on machine-code games writing will lead you into a new world of fast and flicker-free games.

The Frogger program.

```
16514   76 00 83 83 83 83 00 00 00 83 83 00 00 83 83 83 00 00 83 83
        00 76 1C 00 00 1C 1C 00 00 1C 00 00 1C 00 00 00 1C 00 00 1C
        00 00 76 83 00 00 83 83 83 00 00 00 83 83 83 00 00 83 83 00
        00 00 83 76 00 1C 00 00 00 1C 00 00 1C 00 00 00 00 1C 00 1C
        00 00 1C 00 76 76 80 80 93 94 8E 80 93 94 8E 80 80 80 93 94
(data)  8E 80 80 93 94 8E 76 80 80 0A 0A 02 0B 84 80 80 80 80 0B 02
        80 0B 02 80 80 0B 02 76 80 93 94 8E 80 80 93 94 8E 80 93 94
        8E 80 80 93 94 8E 80 80 76 80 0A 0A 0A 06 80 80 80 80 0A 0A
        0A 02 80 80 80 0B 02 80 80 76 76 9A 35 14 9C 9C 9C 00 39 2E
        32 2A 14 00 9E A5 A5

16701   3E 80     LD A, 80          Print a row of 20 'inverse' grey
        06 14     LD B, 06          squares on top line of screen.
        D7        RST 10
        10 FD     DJNZ
        21 82 40  LD HL, 16514 (40 82h)   Let HL point to start
        3E 02     LD A, 02          of DATA. Store value 2 on stack.
        F5        PUSH AF           Used to run through Print sequence
        06 55     LD B, 55          2x. Load B with number of Data CHRs
        7E        LD A, (HL)        to be Printed. Load A with character
        D7        RST 10            held in (HL) and print it.
        23        INC HL            Move to next CHR and repeat Print
        10 FB     DJNZ -5           routine until B = 0.
        3E 08     LD A, 08          Print a line of grey squares.
        06 14     LD B, 14
        D7        RST 10
        10 FD     DJNZ -3
        F1        POP AF            Get value stored on stack and reduce
        3D        DEC A             by 1. If value is not zero then
        20 ED     JRNZ -19          store on stack and repeat Print
                                    routine from 16713.
        06 11     LD B, 11          Print last 17 CHRs of DATA.
        7E        LD A, (HL)        NOTE: HL is never reset and is
        D7        RST 10            continually increased through
        23        INC HL            through Data.
        10 FB     DJNZ -5

16739   2A 0C 40  LD HL (D-FILE) Find start of D-FILE and add
        23        INC HL            1 to set position 0,0.
        06 04     LD B, 04          Print four *s every fourth
        11 04 00  LD DE 00 04       column along top of screen.
        19        ADD HL, DE
        36 17     LD(HL), 17
        10 FB     DJNZ -5

16753   2A 0C 40  LD HL (D-FILE) Find start of D-FILE and add 220 to
        11 DC 00  LD DE 00 DC (220)    locate middle of base-line.
        19        ADD HL, DE        Print inverse * to represent frog.
        36 97     LD (HL), 97       Store square occupied by frog at
        3E 08     LD A, 08          address 16444, the grey square.
        32 3C 40  LD (16444), A
        18 32     JR+32             Jumps into line 2 Rem to address
                                    16819.
16769   LINE 2 REM                  At this stage the jump is to
                                    Return to Basic
```

The Vic's operating system interrupts a program 60 times a second to scan the break key and update the time variable. Ian Hegerty shows you how to use the interrupt vector to insert your own routines for fast graphics or to check an input from an alarm bell.

THE INTERRUPT vector on the Vic is located at 788 and 789 — £0314 and £0315 in hex. Every 0.016 seconds, the 6502 processor looks at this location and jumps to a routine, the address of which is stored thus: the address divided by 256 is stored in the second location, 789, and the remainder is stored in the first, 788.

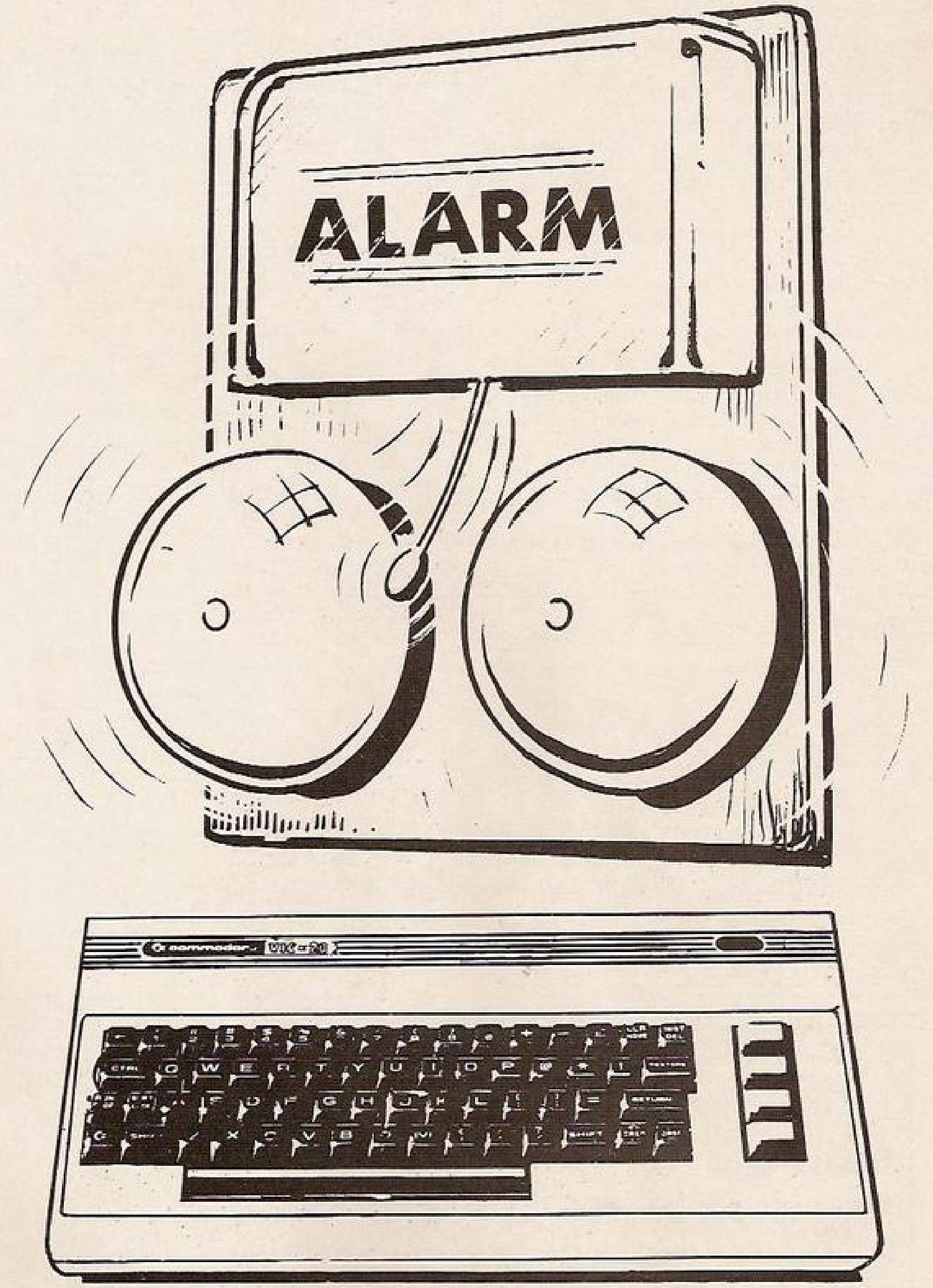
The interrupt vector may be used in the following ways. But first, stop the processor from reading the interrupt vector while you set it. If this is not done, you will get strange results — it might go to a part of the address to which you have pointed, while taking the other byte from the original value. This can be done in machine code with an SEI command: the op-code is £58.

Next, set the vector using the LDA and STA instructions. Then, restart the processor interrupting with a CLI instruction, and return with an RTS instruction. At the end of your machine-code routine, you must jump back to the original value of the vector — this increments TI and TI$ and scans the stop key and is at £EABF.

Here is an example showing the use of the interrupt vector.

```
10 REM *INTERRUPT DEMO*
20 REM *BY I HEGERTY*
30 FOR A=7424 TO 7450:READ B: IF B<>-1
   THEN POKE A,B:NEXT
40 REM *MACHINE CODE*
50 DATA 120,169,13,141,20,3,169,29,141,21,3,
   88,96
```

(continued on next page)



HARNESSING THE VIC'S VECTOR

```
10    REM *KEY DEFINE*
20    REM *BY I.HEGERTY*
30    POKE 55,56:POKE 56,29:S = 7480
40    READ A$:IF A$ = "*" THEN PRINT "QQ TO START, SYS 7480":END
50    H = ASC(A$) - 48
60    L = ASC(RIGHT$(A$,1)) - 48
70    IF H > 9 THEN H = H - 7
80    IF L > 9 THEN L = L - 7
```

(listing continued on next page)

(continued from previous page)

60 DATA 169,8,141,15,144,169,27,141,15,144,
76,191,234

Run it and see what happens, after you have Saved it. If it crashes, turn off the Vic, reload the program and check lines 50 and 60. When the program is successfully Run, Ready should be printed and black lines will be visible. The screen is turning black to white so fast your eye cannot see it. Here is a breakdown of the machine code in lines 50 and 60:

Hex	Mnemonic	Decimal
78	SEI	120
A9 0D	LDA £0D	169 13
8D 14 03	STA £0314	141 20 3
A9 1D	LDA £1D	169 29
8D 15 03	STA £0315	141 21 3
58	CLI	88
60	RTS	96

This listing sets the vector, and the following listing changes screen colour.

A9 08	LDA £08	169 8
8D 0F 90	STA £900F	141 15 144
A9 1B	LDA £1B	169 27
8D 0F 90	STA £900F	141 15 144
4C BF EA	JMP £EABF	76 191 234

There are many applications for the interrupt vector, including graphic effects, sound effects running continuously, giving keys certain functions, and checking inputs like those from a burglar alarm. You could even control the cursor with a joystick. Keys can be programmed by looking at the value in £C5, that is, 197 decimal, and CMParing it to the values of the keys — key f1 equals 39, key f3 equals 47, key f5 equals 55, key f7 equals 63. It is important to note that these are not the ASCII values. If you want the keys plus their Shift values, you can Peek 653 — £028D in hex. If the value in this location is one, the shift key is down, if it is two, the Commodore key is down, and if the CTRL key it will be four. Combinations of these are possible — if the Shift and CTRL are both down, the value will be

1 + 4 = 5

To demonstrate all this, run the program Key Define and then

SYS 7400

Key Define uses the interrupt vector to program the function keys. Yes, those brown things on your Vic can now actually do something useful. The functions are as follows: key f1 turns the screen black; key f2 returns screen to normal; key f3 turns sound volume to full; key f4 turns off sound; key f5 turns motor power off on the cassette unit; key f6 turns motor power on on the cassette unit; key f7 makes all the keys repeat; key f8 returns to normal key repeating.

Pressing CTRL,Shift,Commodore and function key f3 results in a total reset — the same as turning off, but with the advantage that this routine may be recalled with another

SYS 7400 ■

(listing continued from previous page)

```
90     M = H*16 + L:POKE S,M:S = S + 1:GOTO 40
100    DATA 78,A9,52,8D,14,03,A9,1D,8D,15,03,58,60
110    DATA 78,A9,BF,8D,14,03,A9,EA,8D,15,03,58,60
120    DATA A2,00,A5,C5,C9,27,D0,18,BD,8D,02,C9,00,D0,05,A9,08,8D,0F,90,BD,8D,02,C9,01,D0,05
130    DATA A9,1B,8D,0F,90
140    DATA A5,C5,C9,2F,D0,18,BD,8D,02,C9,00,D0,05,A9,0F,8D,0E,90,BD,8D,02,C9,01,D0,05
150    DATA A9,00,8D,0E,90
160    DATA A5,C5,C9,37,D0,22,BD,8D,02,C9,00,D0,05,A9,00,8D,1C,91,BD,8D,02,C9,01,D0,05
170    DATA A9,FE,8D,1C,91,BD,8D,02,C9,07,D0,03,4C,22,FD
180    DATA A5,C5,C9,3F,D0,22,BD,8D,02,C9,00,D0,05,A9,FF,8D,8A,02,BD,8D,02,C9,01,D0,05
190    DATA A9,00,8D,8A,02,BD,8D,02,C9,07,D0,03,4C,22,FD
200    DATA 4C,BF,EA,*
```

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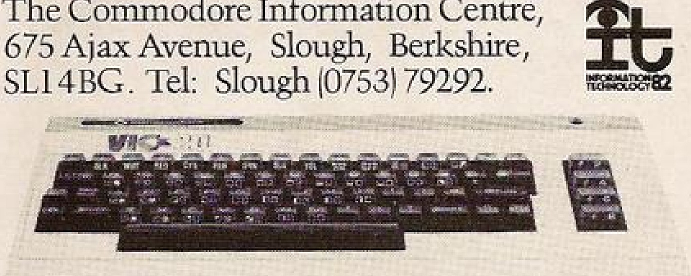

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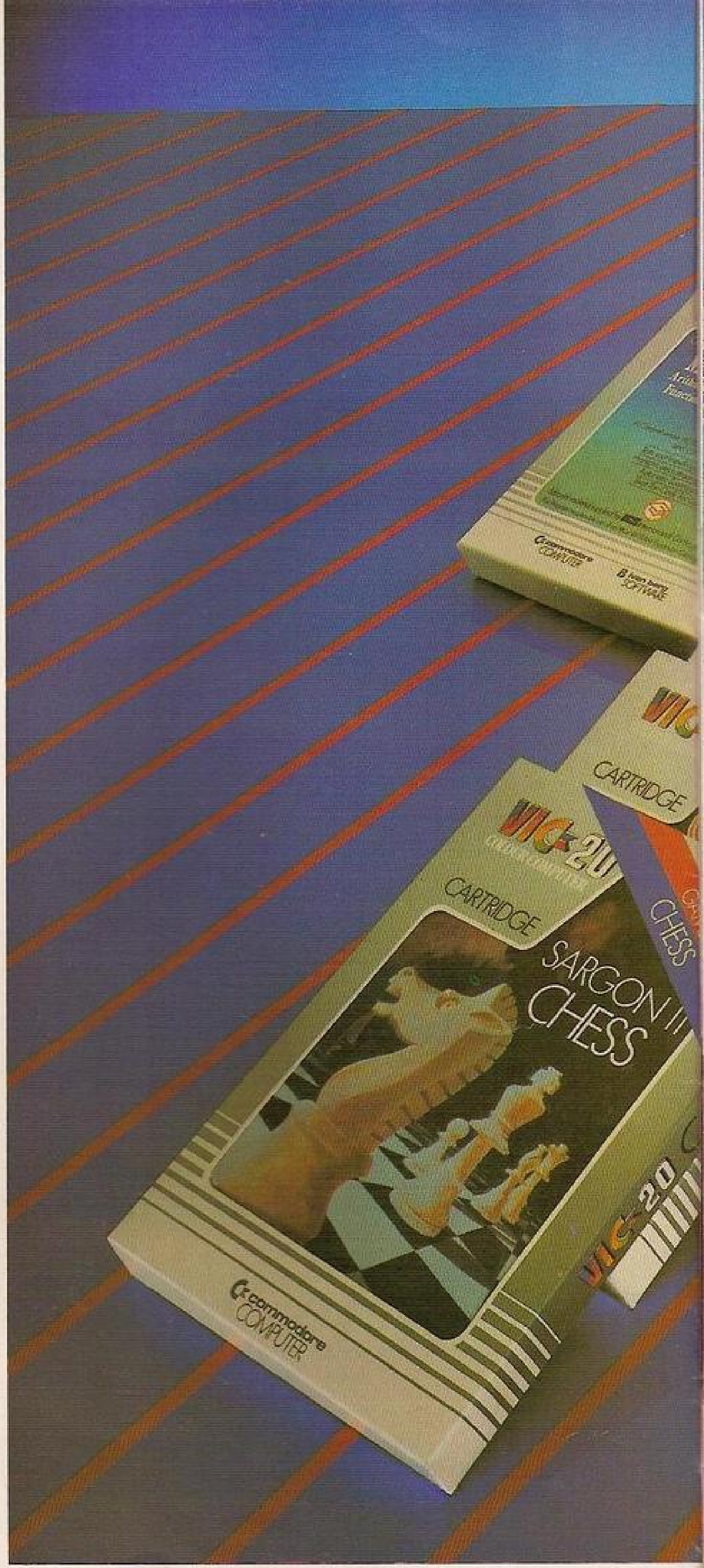

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VCYOC 11/82

Martin Glass's Teletext Editor is a program with features common to commercial word-processing packages. It will run on both the Models A and B.

TELETEXT ED

THE PROGRAM options are listed in the form of a menu giving five choices of action. The menu's third option gives a blank screen on which can be drawn a teletext picture with colour, graphics and double-height characters. In this mode, the four cursor keys can still be used to position the cursor anywhere.

The special teletext control codes are made available through the soft-function Copy and Tab keys. Thereby all the special teletext functions can be used to build up pictures similar to Ceefax, Oracle and Prestel. Once the picture is complete, it can be saved on tape, using the first option in the menu. Previously-stored pictures can be re-loaded using the second option. The fourth option allows you to continue editing from where you left off.

The fifth option on the menu is the Help option. This details each of the special functions available and which keys to use. See figure 1.

Key	Function
f0	Conceal Display
f1	Red
f2	Green
f3	Yellow
f4	Blue
f5	Magenta
f6	Cyan
f7	White
f8	Flashing characters
f9 + colour	Graphics
f9 + f8	Hold graphics
Tab	New background colour
f9 + Tab	Pixel-separated graphics
Copy	Double-height characters
Cursor	Move around
Escape	Return to menu
Return	Negate prior function
Control/L	Shift text left
Control/R	Shift text right
Control/D	Insert a line
Control/U	Delete a line

Figure 1. The fifth option — Help.

Different colours are chosen on keys f1 to f7, but alternative graphic characters can be selected by pressing f9 before the colour key. Pressing f0 conceals the display line by changing the foreground colour to the background.

Characters can be made to flash with key f8. To return to steady mode, press f8 then the Return key. It is important to note that the Delete key has been given the new value of 255 and not 127, so its use will produce a block character. It will not erase the previous character, but it does complete the full set of 64 graphics characters.

The Hold graphics mode — which covers over subsequent teletext control codes with the most recent graphics character — can be selected by pressing f8 immediately after f9.

Similarly, f9 followed by Tab will define the separated graphics mode, which causes each pixel in the three-by-two graphics matrix to be detailed individually.

The Tab key on its own will change the background colour to the most recently-defined colour. Therefore, a new foreground colour must be set immediately after Tab, otherwise the text will be concealed.

Double-height characters have been simplified by the program and can be accessed after using the Copy key. The program takes care of all the duplication of text usually associated with the double-height effect on the BBC Micro. To return to normal height press Copy followed by Return.

In general, the Return key will move the cursor to the start of the next line, but when used immediately after one of the special teletext functions, then the effect will be to negate that function. For example, Tab followed by Return restores the background to black.

Four functions

Four Edit mode functions move text around the screen by inserting or deleting characters. The first extra function is Control/L, that is, the Control key is held down whilst the letter L is pressed. This function deletes the character pointed at by the cursor and shifts a line of text to the left. Similarly, Control/R inserts a space and shifts the line to the right. In a likewise manner, Control/D moves text down by inserting a blank line, whilst Control/U deletes the current line and thus moves text up.

When the Editing is finished, pressing

```
10 REM * TELETEXT EDITOR *  (c) July 1982 Martin Glass.
20 MODE 7
30 HIMEM=HIMEM-&400
40 DIM A% 100
50 FOR PASS=0 TO 3 STEP 3
60 P%=A%
70[OPT PASS
80.getscreen LDA £0
90STA &70
100STA &72
110LDA £&7C
120STA &73
130LDA £&78
140STA &71
150.main LDX £4
160 .block LDY £0
170 .block1 LDA (&70),Y
180 STA (&72),Y
190INY
200 CPY £0
210 BNE block1
220 INC (&71)
230 INC (&73)
240 DEX
250 CPX £0
260 BNE block
270 RTS
280.putscreen LDA £0
290STA &70
300STA &72
310LDA £&7C
320STA &73
330LDA £&78
340STA &71
350 LDX £4
360 .block2 LDY £0
370 .block3 LDA (&72),Y
380 STA (&70),Y
390 INY
400 CPY £0
410 BNE block3
420 INC &71
430 INC &73
440 DEX
450 CPX £0
460 BNE block2
470 RTS
480 ]
490 NEXT PASS
500 ON ERROR GOTO 1060
510REM * SET UP SOFT KEYS *
520 FOR I%=0 TO 25
530?(I%+&B00)=17+I%-(I%>17)*92-(I%>10ANDI%<18)*(10-I%)
540NEXT I%
550 ?(I%+&B00)=140 :  ?(I%+&B01)=27
560 ?&B12=151
570GOTO 1080
580 KEY1%=0
590 *FX4,1
600 DOUBLE%=-2
610B%=0
620REM * MAIN ROUTINE *
630KEY%=GET
640IF KEY%=13 THEN PROCRET : GOTO 630
650 IF KEY%=18 THEN PROCINSERT : GOTO 610
660 IF KEY%=12 THEN PROCDELETE : GOTO 610
670 IF KEY%=4 THEN PROCINSERTLINE : GOTO 610
680 IF KEY%=21 THEN PROCDELETELINE : GOTO 610
690 IF KEY%=151 OR (KEY%>127 AND KEY%<135) THEN KEY%=KEY%+1 :
     PROCKEY : B%=0 : GOTO 790
700 IF KEY%=127 THEN KEY%=255:PROCKEY : GOTO 610
710 IF KEY%>31 AND KEY%<128 THEN PROCKEY : GOTO 610
720 IF B%<>16 THEN B%=-1
730 IF KEY%=9 THEN KEY%=157:KEY1%=156:PROCKEY
740IF KEY%>135 AND KEY%<140 THEN KEY%=KEY%-128 : B%=0 : PROCKEY :
     GOTO 610
750IF KEY%=27 THEN B%=16 : GOTO 630
760 IF B%<>16 THEN B%=-1
770IF KEY%=140 THEN KEY%=136 : KEY1%=137: PROCKEY
780 IF KEY%=135 THEN KEY%=141 : KEY1%=140:B%=-1 : DOUBLE%=VPOS : PROCKEY
790GOTO 630
800DEF PROCRET
810IF B%<>-1 THEN 860
820 IF KEY1%>0 THEN KEY%=KEY1%
830 KEY1%=0
840IF DOUBLE%=VPOS THEN VDU 10,8,KEY%,11
850 VDU 8,KEY%
860 IF KEY%=13 AND VPOS<24 THEN VDU13,10
870 IF KEY%=13 AND DOUBLE%=VPOS-1 THEN VDU 10
880 IF KEY%=140 THEN DOUBLE%=-2
890 B%=0
900 ENDPROC
910DEF PROCKEY
920 IF KEY%=10 AND VPOS=24 THEN 1040
930 IF KEY%=10 AND DOUBLE%=VPOS THEN VDU 10
940 IF (KEY%<>11 AND KEY%<>8) AND VPOS=24 AND POS=39 THEN 1040
950 IF KEY%=11 AND VPOS=0 THEN 1040
960 IF VPOS=0 AND POS=0 AND KEY%=8 THEN 1040
970 IF B%=16 THEN KEY%=KEY%+B%
980 IF B%=16 AND KEY%=168 THEN KEY%=152:B%=0
990 IF B%=16 AND KEY%=173 THEN KEY%=154:KEY1%=153:B%=-1
1000 IF B%=16 AND KEY%=152 THEN KEY%=158:KEY1%=159:B%=-1
1010VDU KEY%
1020 IF KEY%>31 AND DOUBLE%=VPOS OR ( DOUBLE%=VPOS-1 AND POS=0 AND
     KEY%<>11) THEN  VDU 8,10,KEY%,11
1030 IF (KEY%=9 OR KEY%>31) AND DOUBLE%=VPOS-1 AND POS=0 THEN VDU 10
1040ENDPROC
1050DEF PROCDOUBLE(A$,X,Y,C):PRINT TAB(X,Y);CHR$(C+128);CHR$(141);
     A$ TAB(X,Y+1);CHR$(C+128);CHR$(141);A$;:ENDPROC
1060IF ERL<>630 THEN 1080
1070 CALL putscreen
1080 VDU 12
1090*FX 4,0
1100IF ERL=1220  THEN END
1110 PROCDOUBLE("TELETEXT EDITOR",9,1,6)
```

ITOR

Escape will return control to the main menu. Back in the menu, the page can be saved on tape by choosing option 1. The screen can then be wiped clean using option 3, or the previous page can be recalled for further editing with the fourth option.

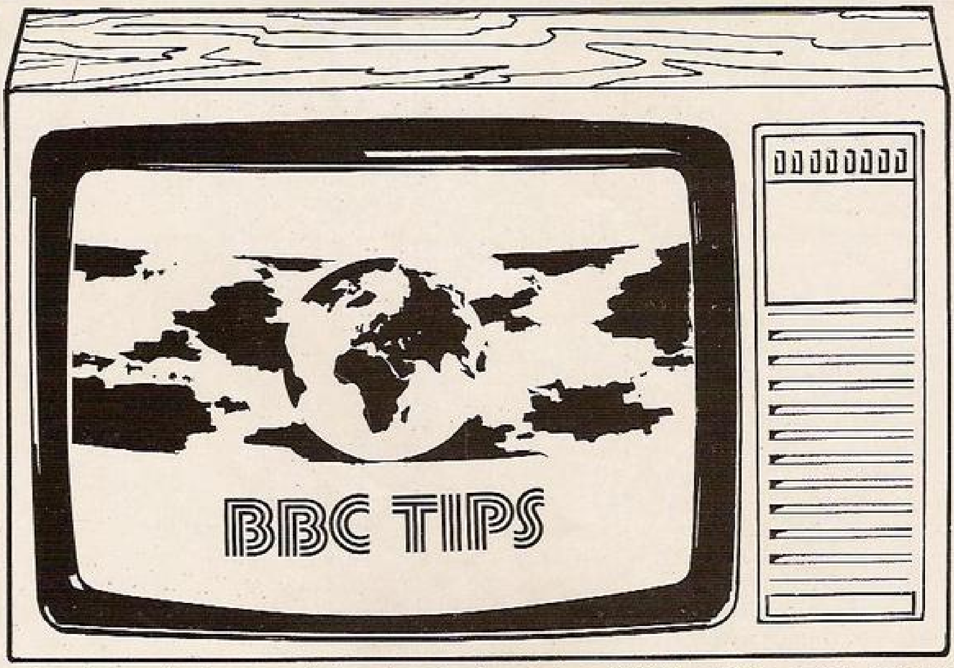
Option 2 in the menu will load a previously-stored page from tape back into memory for further editing; follow this option with option 4 to recall the edit screen. Pictures will be stored on tape, in option 1, in Filename Screen, which is constant in the program and not user-defined because the BBC OS command *Save cannot be suffixed with a Basic string-variable.

Option 3 will clear the editing-screen memory area, so be careful to save any useful pages on tape before using this option.

In Mode 7 on the BBC Micro, the screen display is stored in locations &7C00 to &7FE8 and HiMem is originally set to &7C00. The first action of the program, in line 30, is to set aside a 1K byte spare area between &7800 and &7C00 which can be later used to store a copy of the editing screen.

The machine-code routines, GetScreen and PutScreen, in lines 70 to 480 perform the function of copying the screen display — stored between &7C00 and &7FFF — to or from the secondary store, which is stored between &7800 and &7BFF.

The next section of program, lines 510 to 560, assigns the soft-function keys with single-code values, which are used for changing colour and other effects. Note that these codes do not match the values given in the table of teletext control codes, but are altered later in the program.



The *FX 4,1 command, in line 590, disables the action of the cursor control and Copy keys, so they can be controlled by the program. The Double% variable keeps tracks of the most recent line of double-height text.

Lines 620 to 790 are the core of the Editor, which Gets a key code and acts on it. Procedures ProcRet and ProcKey are used by the Editor. The Escape key is trapped in lines 1060 to 1100, where the display screen is copied to &7800 and the cursor keys are restored to their original functions with the command *FX 4,0.

The menu-display routine is given in lines 1110 to 1240 which uses ProcDouble to write a string in double height to a specified place on the screen, in any colour.

Lines 1390 to 1690 display the Help page, Option five, while routines ProcSaveScreen and ProcLoadScreen, in lines 1700 to 1770 are used to record or recall pictures on tape, in Filename Screen. Procedures ProcInsert, ProcDelete, ProcInsertLine and ProcDeleteLine in lines 1830 to 2230 control the extra Editing functions of Control with R, L, D and U. ■

```
1120 PROCDOUBLE("M E N U",13,4,3)
1130PRINT TAB(7,10);CHR$(130);"1. Save the last screen on tape."
1140PRINT TAB(7,11);CHR$(130);"2. Load the screen from tape."
1150PRINT TAB(7,12);CHR$(130);"3. Clear the screen and start"
1160 PRINT TAB(10,13);CHR$(130);"afresh."
1170PRINT TAB(7,14);CHR$(130);"4. Continue with the edit."
1180PRINT TAB(7,17);CHR$(129);"5. Help - Edit and Function"
1190PRINT TAB(17,18);CHR$(129);"Key description."
1200PRINT TAB(8,21);"Enter the number of your"
1210 PRINT TAB(11,22);"choice (1_5)";CHR$(134);"]";
1220 B%=VAL(GET$)
1230ON B% GOTO 1250,1290,1320,1350,1390
1240GOTO 1080
1250REM * OPTION 1 - SAVE SCREEN *
1260PROCSAVESCREEN
1270B%=0
1280 GOTO 1080
1290 REM *-OPTION 2 - LOAD SCREEN *
1300 PROCLOADSCREEN
1310GOTO 1270
1320 REM * OPTION 3 - CLEAR SCREEN *
1330VDU 12
1340 GOTO 580
1350 REM * OPTION 4 - CONTINUE *
1360 VDU 12
1370 CALL getscreen
1380 GOTO 580
1390 REM * OPTION 5 - HELP *
1400 VDU 12
1410 DATA "CONCEAL DISPLAY",RED,GREEN,YELLOW,BLUE,MAGENTA,CYAN,WHITE
1420 DATA FLASHING,GRAPHICS,"DOUBLE HEIGHT"
1430 RESTORE
1440 VDU 10,13,130,157,132 : PRINT " KEY    ";:VDU129,156,156,156,157,
     135: PRINT" A C T I O N    ";CHR$(156)
1450 FOR B%=0 TO 8
1460 PRINT CHR$(128+B%);"f";B%;".";SPC(10);
1470 READ A$
1480 PRINT A$
1490 NEXT B%
1500 PRINT " f9+colour.    ";
1510 READ A$
1520 PRINT A$;" e.g.";CHR$(145);"0123"
1530 READ A$
1540 PRINT " f9+f8";SPC(8);"Hold graphics";CHR$(158);"e.g.";
1550 VDU 146,255,255,150,255,255
1560 PRINT '" tab.";SPC(9);"Background = prev. colour"
1570 PRINT " f9+tab";SPC(6);;CHR$(154);"Pixel graphics e.g."; :
     VDU 147,255,57,59
1580 PRINT '" copy. ";
1590 PROCDOUBLE(A$,12,15,7)
1600PRINT '" Use the return key to negate a function  (e.g. f8+return)"
1610PRINT " Use the escape key to return to menu."
1620 PRINT " Use the cursor keys to move around."
1630PRINT " Control/L shifts text left."
1640PRINT " Control/R shifts text right."
1650PRINT " Control/D inserts a line."
1660PRINT " Control/U deletes a line."
1670 VDU 130,157,131,136 : PRINT "   NOW PRESS 'Escape' FOR MENU";
1680 REPEAT UNTIL 0
1690 GOTO 1080
1700DEF PROCSAVESCREEN
1710PROCFILENAME("SAVE")
1720*SAVE SCREEN 7800 +0400
1730ENDPROC
1740DEF PROCLOADSCREEN
1750PROCFILENAME("LOAD")
1760*LOAD SCREEN 7800
1770ENDPROC
1780DEF PROCFILENAME(F$)
1790VDU 12,130
1800PRINT TAB(15,0);F$;" SCREEN"
1810PRINT TAB(12,15);"Align the cassette tape"'''
1820ENDPROC
1830DEF PROCINSERT
1840 V%=VPOS*40
1850 IF POS=39 THEN 1920
1860FOR INS%=39 TO POS+1 STEP -1
1870 PO%=&7C00+V%+INS%
1880?PO%=?(PO%-1)
1890NEXT
1900?(PO%-1)=32
1910IF DOUBLE%=V%/40 THEN V%=V%+40 : GOTO 1860
1920ENDPROC
1930DEF PROCDELETE
1940V%=VPOS*40
1950FOR DEL%=POS TO 38
1960PO%=&7C00+V%+DEL%
1970?PO%=?(PO%+1)
1980NEXT
1990?(PO%+1)=32
2000IF DOUBLE%=V%/40 THEN V%=V%+40 : GOTO 1950
2010ENDPROC
2020DEF PROCINSERTLINE
2030IFVPOS=24 THEN 2120
2040V%=(VPOS+1)*40+&7C00
2050FOR INS%=&7FE7 TO V% STEP -1
2060?INS%=?(INS%-40)
2070NEXT
2080 FOR INS%=V%-40 TO V%-1
2090?INS%=32
2100NEXT
2110 IF DOUBLE%>=VPOS THEN DOUBLE%=DOUBLE%+1
2120ENDPROC
2130DEF PROCDELETELINE
2140V%=VPOS*40+&7C00
2150FOR DEL%=V% TO &7FBF
2160?DEL%=?(DEL%+40)
2170NEXT
2180FOR DEL%=&7FC0 TO &7FE7
2190?DEL%=32
2200NEXT
2210IF DOUBLE%>=VPOS THEN DOUBLE%=DOUBLE%-1
2220IF DOUBLE%=VPOS-1 THEN DOUBLE%=-2 : GOTO 2150
2230ENDPROC
```

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These two articles, the first by Michael Fox and the second by Dale McLoughlin, set out handy machine-code routines, with a variety of uses.

ZX-81 TOO

MANY USERS WHO have no knowledge of machine code may, nevertheless, want to use it in their Basic programs to enhance speed and presentation. But most machine-code routines lead only to the development of one game or objective. The utility machine-code routines in this article are for the ZX-81, but they can also be used on a ZX-80 with 8K ROM. The effect on the last routine will be lost on the ZX-80 because of the lack of a Slow mode.

The routines contain no absolute addresses, except subroutine calls, so that you can stack them on top of another routine that does use absolute addresses, or on top of each other and they can be called individually.

The routines need a 16K RAM because they all manipulate the display file. There are four routines and I have also supplied a comprehensive loader program. The four routines are;

- A screen fill
- A downward scroll
- A text-window system
- A super-cursor

Line 1 of the machine-code loader program should contain the number of Qs needed for the machine code plus a few extra — just in case. It is best to use line 1, although any number will do as long as it is the first line. Line 1 is best because there is no risk of putting a line before it — the ZX-81 has no line 0. The length of the line can be checked by

PRINT (PEEK 16511)-2 or
PRINT (PEEK 16511+256* PEEK 16512)-2
if the length of the line contains more than 254 Qs.

To enter the machine code, run the program and enter the start location of the machine code, which is usually 16514. Now start entering the values in the third column. If you make a mistake or enter a wrong value — it has a safeguard against entering an empty string — then enter R for repeat and the program will reinput a value for the last byte address.

If you find a discrepancy in the addresses or some such fault, type L to list the code. The program will input a new start location and list from that point onwards. If at any time you want to pause while you are checking the copy, just hold down any key — other than R — or Space and Break, and the listing will stop until the key is released.

If you press R, the program will return to loading mode and input a new start location. Whenever the location you broke out from is to be retained, enter A and it will carry on from where it left off.

It may be a good idea to type in a large line 1 and then Save the program on tape, rather than typing it in every time it is needed. To stack two or three machine-code routines in one Rem statement, the best way is to type them in one after the other and note the starting address of each routine. This is the address you should Rand USR to call the sub-

```
REM Listing 1 screenfill
ADDRESS INSTRUCTION               CODE        COMMENTS
16514                             118,118     disable list
        ld B,22                   6,22        No of lines
        ld HL,(DFILE)             42,12,64
   *1   inc HL                    35
        ld A,(HL)                 126
        cp 118                    254,118     check for N/L
        jr z,*2                   40,4
16527   ld (HL),128               54,128      CHR$ to print
        jr *1                     24,246
   *2   djnz *1                   16,244
        ret                       201         return to basic
                        20 Bytes
```

```
REM Listing 2 downward scroll
ADDRESS INSTRUCTION               CODE        COMMENTS
16514                             118,118     disable list
        ld HL,D FILE bottom       33,0,0      to be poked
        ld C,21                   14,21       No of lines
    *   ld A,(HL)                 126
        cp 118                    254,118     check for N/L
        jr z,NL                   40,11
        ld D,H                    84
        ld E,L                    93
        ld B,33                   6,33        down a line
        inc DE                    19
        djnz 253                  16,253
        ld (DE),A                 18
        dec HL                    43
        jr *                      24,240
   NL   dec HL                    43          N/L found
        dec C                     13          dec count
        ret z                     200
16541   jr *                      24,235
                        28 Bytes
```

```
REM Listing 3 Text window
ADDRESS INSTRUCTION               CODE        COMMENTS
16514                             118,118     disable list
        ld C,5                    14,5        No of lines(5)
        ld D,23-5                 22,18       23-No of lines
        ld HL,(16396)             42,12,64    DFILE
        inc HL                    35
    *   ld B,33                   6,33        move down to
        inc HL                    35          top of window
        djnz 253                  16,253
        dec D                     21
        jr nz,*                   32,248
   *1   ld A,(HL)                 126         start scroll
        cp 118                    254,118
        jr nz,NL                  40,11
        ld D,H                    84
        ld E,L                    93
        ld B,33                   6,33
        dec DE                    27
        djnz 253                  16,253
        ld (DE),A                 18
        inc HL                    35
16546   jr *1                     24,240
   NL   inc HL                    35
        dec C                     13
        jr nz,*1                  32,237
        ld B,32                   6,32        set next print
16554   dec DE                    27          position to
        djnz 253                  16,253      bottom of window
        ld (print pos),DE         237,83,14,64
        ld HL,16442               33,58,64
16564   ld (HL),21                54,21
        ret                       201
                        53 Bytes
```

```
REM Listing 4 super cursor
ADDRESS INSTRUCTION               CODE        COMMENTS
16514                             118,118     disable list
        ld HL,(DFILE)             42,12,64
        inc HL                    35
   F1   ld A,8                    62,8        cursor CHR$
        call NN                   205,168,64  draw first line
   F2   inc HL                    35
        ld A,(HL)                 126
        cp 118                    254,118
        jr z,C2                   40,14
16531   ld A,8                    62,8
        call NN                   205,168,64  draw line
   C1   dec HL                    43
16537   ld A,0                    62,0
        call NN                   205,168,64  clear line
        inc HL                    35
        jr F2                     24,236
   C2   dec HL                    43
16546   ld A,0                    62,0
        call NN                   205,168,64  clear last line
        ret                       201
   NN   ld (HL),A                 119         line draw routine
        ld C,21                   14,21       cursor size
        ld D,H                    84
        ld E,L                    93
    *   ld B,33                   6,33        down a line
        inc DE                    19
        djnz 253                  16,253
        ld (DE),A                 18
        dec C                     13
        jr nz,*                   32,247
        ret                       201
                        53 Bytes
```

```
0 REM MACHINE CODE LOADER
1 REM 00000000000000000000000000000000000000 ENOUGH FOR THE MACHINE,CODE
9000 SCROLL
9010 PRINT "START LOCATION"
9020 INPUT A
9030 INPUT A$
9040 IF A$="" THEN GOTO 9030
9050 IF A$="L" THEN GOTO 9140
9060 IF A$="R" THEN GOTO 9120
9070 POKE A,VAL A$
9080 SCROLL
9090 PRINT A;"=";PEEK A
9100 LET A=A+1
9110 GOTO 9030
9120 LET A=A-1
9130 GOTO 9030
9140 SCROLL
9150 PRINT "START LOCATION"
9160 INPUT B
9170 SCROLL
9180 PRINT B;"=";PEEK B
9190 LET B=B+1
9200 IF INKEY$="R" THEN GOTO 9000
9210 IF INKEY$<>"" THEN GOTO 9210
9220 GOTO 9170
```

LKITS

routine — all subroutines, when on their own, should be called by

RAND USR 16516

Also note that only in the first routine should the two 118s Newline appear. These disable the listing of the Rem statement but should only appear at the start. You will find that on listing only 1 Rem appears, the rest of the Basic program can be listed by List 2, or the number of any other Basic line. To avoid this problem Poke 16419 with the number of the lowest line below 255; then list that line.

Listing 1 is the screen-fill routine which fills the screen with any CHR$ except tokens and 118 which will crash the system. It works by filling the line, looking ahead one square for a Newline and when it finds one it jumps over that square.

It counts the number of Newlines and after a specified number it returns to Basic. This number — the number of lines filled can be Poked into location 16517 — is set at 22. Do not Poke it with more than 24 or with 0 for there are only 24 lines on the screen and 0 will be decremented to 255 which is above 24 and so will cause a crash. The character printed is at location 16528; it is set as a black square in the listing.

The second listing, listing 2, is a downward scroll. It works by starting at the bottom of the display file and going up loading the accumulator with what is on the screen, copies HL into DE, adds 33 to DE. This is equivalent to moving it down a line. Then it puts the contents of the accumulator in that location and goes on to the next square.

It also looks ahead for a Newline, counts the number of the Newlines found — the number of lines scrolled — and after 22 it returns to Basic. The number of lines scrolled can be altered by Poking location 16520 with the number of lines −1. If it is less than 21, the lines scrolled will be at the bottom of the screen. When you move the bottom of the screen location and reduce the number of lines scrolled, it will only scroll the top lines of the screen.

The top line of the display should be only background as this is what is copied. It must not be used after computer scrolling but can be used before. Values higher than 21 and value 0 should not be used for the number of lines.

To set the bottom of the display file the program must contain these four lines:

```
LET P=1+PEEK 16396+256*PEEK 16397
LET P=P+(22*33)-2
POKE 16517,P-256*INT(P/256)
POKE 16518,INT (P/256)
```

The number 22 in the second of these lines is the number of lines to move down. If you move the bottom of the display file as mentioned, this number should be altered accordingly. It does not upset the display file as the computer's upward scroll does.

After seeing Timothy Gilbert's article on how to protect lines at the bottom of the screen by creating a text window at the top in the February issue of *Your Computer,* I decided to write a routine to produce a text window at the bottom of the display, thereby protecting the top of the screen.

The program works by finding the start of the display file and then moving down to the top of the text window. It then moves each square on the screen up a line, looking ahead for Newlines and counting them. When it has scrolled the correct number of lines, it sets the next print position to the bottom scrolled line and sets the column number to 21. This number in the window is at location 16517 and is set at 5. Location 16519 should be Poked with 23 minus the number of lines.

The bottom line of the window is left clear after a scroll because it scrolls the top line of the bottom part of the screen which is always blank. Input does not affect the routine and vice versa. When using it in a program, rather than using scroll, use

RAND USR 16516

but do not type this in every time it is needed — it is quicker to type in the program and make a list on paper of all the scroll lines. Then, after and typing in the rest of the program, insert a

RAND USR 16516

then edit it and change the line number to produce the other Rand USRs needed as this is quicker and easier on the fingers.

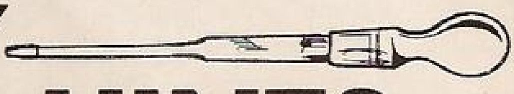
The routine can also be used to generate windows at any height anywhere on the screen. To do this, Poke 16517 with the number of lines and 16519 with the number of lines down to the top line of the window. Then use the routine as normal but you will have to leave a blank line below the window and, because it looks better, a blank line above as well. This enables two protected, separate and unmoving pictures or text to be displayed above and below a window.

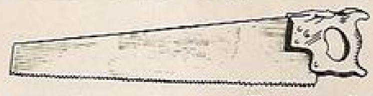
The fourth and final listing is a Super Cursor. It runs a vertical line from left to right across the screen leaving a clear screen behind it. This is very impressive and the only routine which contains absolute addresses. They are in the form of subroutine calls, so if you stack the routines on top of each other; this one would have to be placed at location 16514.

The routine sets itself for the first line and calls a subroutine to draw the line. It then draws another line which clears the first and moves on in this manner across the screen looking for the end of the line. When found, it clears the last line and returns to Basic.

The location of the first cursor line CHR* is at 16521 and is set to 8; the location of the main cursor line CHR$ is at 16532 and is also set to 8. The location of the trail left is at location 16538 and the last trail line is at 16547.

HANDY HINTS





The ZX-81 instruction set offers very little in the way of screen-controlling commands. To make up for this deficiency, these machine-code routines provide a variety of functions including flashing single characters or whole lines, a fast CLS, reverse scrolling and much more.

By far the easiest method of using machine code is to store it in a Rem statement at the beginning of a Basic program. Program 1 enables you to enter a group of machine-code instructions into the first line of the program, which can then be Saved, Loaded and used as part of longer Basic routines. Lines 10 to 80 can be removed once all the machine code has been entered — but under no circumstances should the Rem line be edited as this can remove vital instructions from the machine code.

Each routine can be used on its own since each is totally independent of the others, or they could all be entered together to form one large toolkit to be called at various points throughout a long Basic program.

Some of the routines require a Poke of some data before they are called — a line number to be deleted — and where this is necessary it is assumed that the data has already been checked for validity. For example, you cannot delete line 25 since it will cause the system to crash.

Most of the routines are called by the Basic

RAND USR 16514

where it is the first or only routine in the Rem line. If you intend to use more than one at a time you will have to calculate the appropriate calling address by adding the length of previous routines to 16514.

As a convention I have used the label Start to indicate the calling point of each routine, and any bytes to be Poked are shown in relation to this. For example:

POKE START +5;

if

START=16514

then

POKE 16519

To enter the machine code, type in program 1, counting carefully the number of Xs in line 1 — it may be best to enter them in Fast mode — and Run it. Then input the machine code in manageable blocks. Use the hex codes and watch carefully as you do it as mistakes are difficult to locate afterwards. When the code is finished enter S to stop the program.

These routines are for the ZX-81 with expanded display file — that is, with more than 3.25K of RAM — and they apply to the later ROM design. If some of them do not work it is because your ZX-81 is an early model and consequently you should change all occurrences of CD1D15 to CD1915. Additionally, if Scroll has been used to create the display then it must be cleared with CLS to recreate the expanded file, since Scroll collapses the display as if there were less than 3.25K present. Routine 10 will of course work with any memory size.

(continued on page 79)

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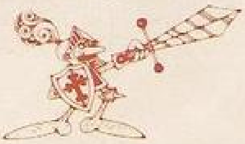

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(continued from page 77)

Routine 1 will fill the whole screen with a specified character if you,

POKE START + 21

with the code of that character. It must be a non-expanded one — that is, not

RND, PI; INPUT etc.

Repeatedly calling routine 2 — for example within a For-Next loop — appears to flash the whole screen. The following Basic program would flash the screen until a key was pressed:

```
100 RAND USR 16514
110 IF INKEY$<>""THEN GOTO 130
120 GOTO 100
130 rest of program . . .
```

```
1 REM XXXX enough for all the machine code XXXX
10 LET X=16514
20 LET X$=""
30 IF X$="" THEN INPUT X$
40 IF X$="S" THEN STOP
50 POKE X, 16*CODE X$ + CODE X$(2) - 476
60 LET X=X+1
70 LET X$=X$(3 TO)
80 GOTO 30
```

Program 1.

Length 25 bytes

ld hl, (Dfile)	START	2A0C40
ld de, (Vars)		ED5B1040
ld b, h	NEXT	44
ld c, l		4D
and a		A7
sbc hl, de		ED52
ret z		C8
ld h, b		60
ld l, c		69
ld a, (hl)		7E
cp 76h		FE76
jr z, INC		2802
ld(hl), 0		3600
inc hl	INC	23
jr NEXT		18EE

Routine 1. A fast clear screen.

Length 26 bytes

ld hl, (Dfile)	START	2A 0C 40
ld de, (Vars)		ED 5B 10 40
ld b, h	NEXT	44
ld l, c		4D
and a		A7
sbc hl, de		ED 52
ret z		C8
ld h, b		60
ld l, c		69
ld a, (hl)		7E
cp 76h		FE 76
jr z, INC		28 03
add a, 80h		C6 80
ld (hl), a		77
inc hl	INC	23
jr NEXT		18 ED

Routine 2. Invert the screen.

Length 31 bytes

ld a, CHR	START	3E 00
ld hl, (Dfile)		2A 0C 40
ld b, 20h		06 20
inc hl	TOP	23
ld (hl), a		77
djnz, TOP		10 FC
ld b, 14h		06 14
inc hl	ENDS	23
inc hl		23
ld (hl), a		77
ld de, 001F		11 1F 00
add hl, de		19
ld (hl), a		77
djnz, ENDS		10 F6
inc hl		23
ld b, 20h		06 20
inc hl	BOT	23
ld (hl), a		77
djnz, BOT		10 FC
ret		C9

POKE START+1, CODE OF CHR to be printed.

Routine 3. Draw a border.

Length 28 bytes

ld a, LINE	START	3E 00
call stack a		CD 1D 15
ld a, 21h		3E 21
call stack a		CD 1D 15
rst 28		EF
multiply		04 34
call unstack		CD A7 0E
ld hl, (Dfile)		2A 0C 40
add hl, bc		09
ld b, 20h		06 20
inc hl	INC	23
ld (hl), 0		36 00
djnz, INC		10 FB
ret		C9

POKE START+1, line number to be cleared (0 to 21).

Routine 4. Clear single lines.

Length 33 bytes

ld a, LINE	START	3E 00
call stack a		CD 1D 15
ld a, 21h		3E 21
call stack a		CD 1D 15
rst 28		EF
multiply		04 34
call unstack		CD A7 0E
ld hl, (Dfile)		2A 0C 40
add hl, bc		09
inc hl		23
ld d, h		54
ld e, l		5D
ld a, (hl)		7E
inc hl		23
ld bc, 001F		01 1F 00
ldir		ED B0
dec hl		2B
ld (hl), a		77
ret		C9

POKE START+1, line number to be scrolled (0 to 21).

Routine 5. Scroll a line to the left.

Length 55 bytes

ld a, LINE	START	3E 00
ld (4040), a		FD 77 40
ld (4029), 0		FD 36 39 00
call stack a		CD 1D 15
ld a, 21h		3E 21
call stack a		CD 1D 15
rst 28		EF
multiply		04 34
call unstack		CD A7 0E
ld hl, (Dfile)		2A 0C 40
add hl, bc		09
ld (DF.CC), hl		22 0E 40
inc (DF.CC)		FD 34 0E
ld de, (Vars)		ED 5B 10 40
inc hl	NEXT	23
ld b, h		44
ld c, l		4D
and a		A7
sbc hl, de		ED 52
ret z		C8
ld h, b		60
ld l, c		69
ld a, (hl)		7E
cp 76h		FE 76
jr z, NEXT		28 F2
ld (hl), 0		36 00
jr NEXT		18 EE

POKE START+1, line number to CLS from (0 to 21).

Routine 6. Clear down from a given line.

Length 28 bytes

ld bc, 014A	START	01 4A 01
ld hl, (Dfile)		2A 0C 40
add hl, bc		09
ex de, hl		EB
ld bc, 016B		01 6B 01
ld hl, (Dfile)		2A 0C 40
add hl, bc		09
ldir		ED B0
ld b, 20h		06 20
dec hl	CLR	2B
ld (hl), 0		36 00
djnz, CLR		10 FB
ld bc, 0015		01 15 00
ret		C9

Call with PRINT AT USR START, 0; " up to 32 characters "

Routine 7. Scroll bottom 12 lines only.

(continued on next page)

(continued from page 79)

Length 53 bytes

ld a, LINE	START	3E 00
call stack a		CD 1D 15
ld a, 21h		3E 21
call stack a		CD 1D 15
rst 28		EF
multiply		04 34
call unstack		CD A7 0E
ld hl, (Dfile)		2A 0C 40
add hl, bc		09
inc hl		23
ld bc, COLUMN		01 00 00
add hl, bc		09
ld d, FLASH		16 00
ld c, (hl)		7E
ld (hl), 0	GO	36 00
ld c, 0		0E 00
ld b, OFF	DLA2	06 00
djnz, DLA1	DLA1	10 FE
dec c		0D
jr nz, DLA2		20 F9
ld (hl), a		77
ld c, 0		0E 00
ld b, ON	DLA4	06 00
djnz, DLA3	DLA3	10 FE
dec c		0D
jr nz, DLA4		20 F9
dec d		15
jr nz, GO		20 E8
ret		C9

POKE START+1, Line number of character
POKE START+22, Column number of character
POKE START+26, Number of flashes (0 to 255)
POKE START+33, Time off (0 to 255)
POKE START+43, Time on (0 to 255)

Routine 8. Flash a single character.

Length 67 bytes

ld a, LINE	START	3E 00
call stack a		CD 1D 15
ld a, 21h		3E 21
call stack a		CD 1D 15
rst 28		EF
multiply		04 34
call unstack		CD A7 0E
ld hl, (Dfile)		2A 0C 40
add hl, bc		09
ld d, FLASH		16 00
ld b, 20h	GO	06 20
inc hl	INC	23
ld a, (hl)		7E
push af		F5
djnz, INC		10 FB
push hl		E5
ld b, 20h		06 20
ld (hl), 0	OUT	36 00
dec hl		2B
djnz, OUT		10 FB
ld c, 0		0E 00
ld b, OFF	DLA2	06 00
djnz, DLA1	DLA1	10 FE
dec c		0D
jr nz, DLA2		20 F9
pop hl		E1
ld b, 20h		06 20
pop af	IN	F1
ld (hl), a		77
dec hl		2B
djnz, IN		10 FB
ld c, 0		0E 00
ld b, ON	DLA4	06 00
djnz, DLA3	DLA3	10 FE
dec c		0D
jr nz, DLA4		20 F9
dec d		15
jr nz, GO		20 D4
ret		C9

POKE START+1, Line number to be flashed
POKE START+21, Number of flashes (0 to 255)
POKE START+38, Time off (0 to 255)
POKE START+57, Time on (0 to 255)

Routine 9. Flash a single line.

Length 13 bytes

ld hl, 0000	START	21 00 00
add hl, sp		39
ld de, (Stk end)		ED 5B 1C 40
sbc hl, de		ED 52
ld b, h		44
ld c, l		4D
ret		C9

PRINT USR START gives number of free bytes remaining in memory

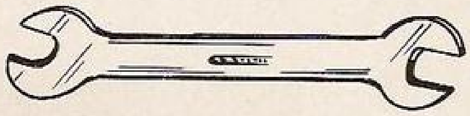
Routine 10. Remaining memory.

Length 26 bytes

ld hl, (Dfile)	START	2A 0C 40
ld de, 02D6		11 D6 02
add hl, de		19
ex de, hl		EB
ld hl, (Dfile)		2A 0C 40
ld bc, 02B5		01 B5 02
add hl, bc		09
lddr		ED B8
ld bc, 2000		01 00 20
inc hl	INC	23
ld (hl), 0		36 00
djnz, INC		10 FB
ret		C9

Call with PRINT AT USR START, 0; " up to 32 characters "

Routine 11. Reverse scroll.



Length 62 bytes

ld a, LINE	START	3E 00
call stack a		CD 1D 15
ld a, 21h		3E 21
call stack a		CD 1D 15
rst 28		EF
multiply		04 34
call unstack		CD A7 0E
ld hl, (Dfile)		2A 0C 40
add hl, bc		09
ld d, FLASH		16 00
ld b, 20	GO	06 20
inc hl	INC	23
ld a, (hl)		7E
add a, 80h		C6 80
ld (hl), a		77
djnz, INC		10 F9
ld c, 0		0E 00
ld b, OFF	DLA2	06 00
djnz, DLA1	DLA1	10 FE
dec c		0D
jr nz, DLA2		20 F9
ld b, 20h		06 20
ld a, (hl)	BACK	7E
add a, 80h		C6 80
ld (hl), a		77
dec hl		2B
djnz, BACK		10 F9
ld c, 0		0E 00
ld b, ON	DLA4	06 00
djnz, DLA3	DLA3	10 FE
dec c		0D
jr nz, DLA4		20 F9
dec d		15
jr nz, GO		20 D9
ret		C9

POKE START+1, Line number to flash
POKE START+21, Number of flashes (0 to 255)
POKE START+34, Time off (0 to 255)
POKE START+52, Time on (0 to 255)

Routine 12. Flash a line in inverse.

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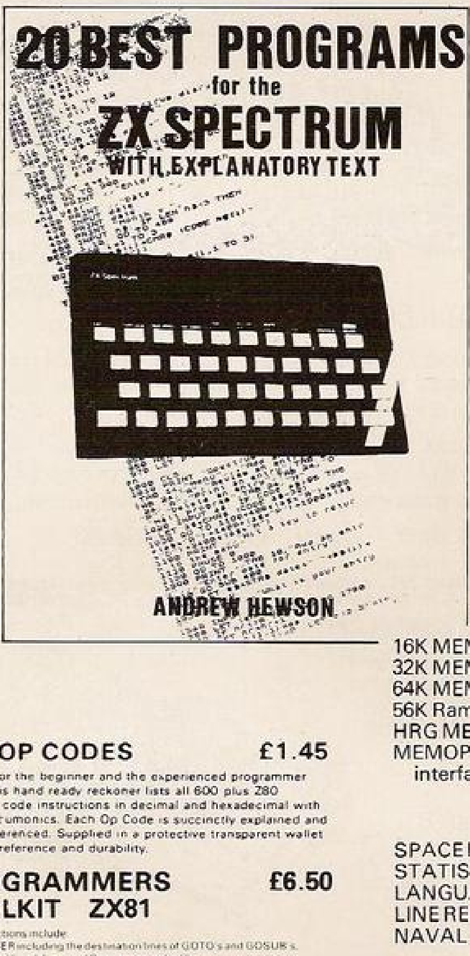

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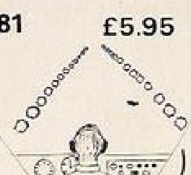

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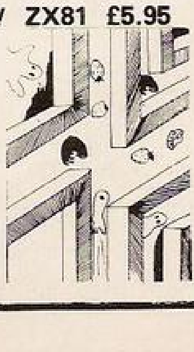

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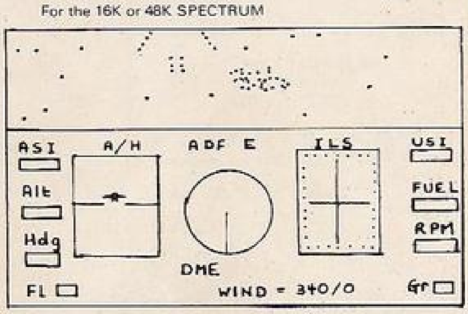

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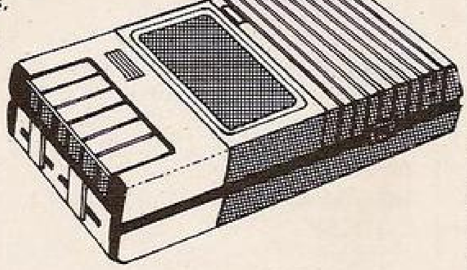

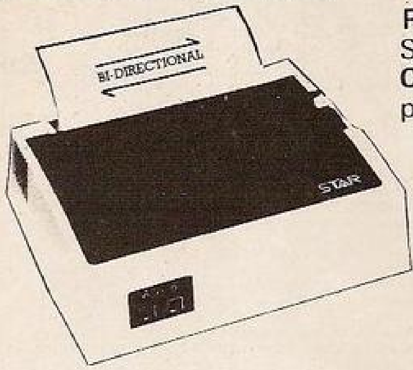

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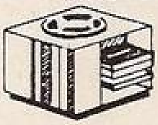

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Kathleen Peel reveals some rather more problematical commands, which would have introduced unnecessary difficulties if mentioned earlier. These will enhance commands covered in the previous instalments of her machine-code series.

EXTENSIONS

THESE COMMANDS have been left until last because of the problems they can create if not used carefully. Problems are the last thing you require when dealing with machine code.

This small group of commands is, for the most part, either extensions to previous commands or special operational commands.

Dealing with the extensions first, I previously stated that A was the only variable to which one of the other variables could be added or subtracted. It is also possible to add or subtract a constant.

Basic	Mnemonic	Machine code
LET A=A+52	ADD A N	198 N
LET A=A−32	SUB A N	214 N

Remember A is single variable so that the constant has to be in the range of 0 to 255.

In the first article we mentioned the F variable, flag, and said that after certain operations it was tested for zero. In fact it is tested for rather more than that.

If the A variable is less than the value of the variable or constant with which you are comparing or operating then the flag variable C, carry, is set.

If the A variable is greater than, or equal to, the value of the variable or constant that you are comparing it with, then the flat variable NC, No Carry, is set.

In Basic terms where X is a constant or a variable:

Relation	Variable	Flags set
A=X	Z	NC
A<>X	NZ	can be either
A<X	C	NZ
A>=X	NC	can be either

Now you can use these additional flag-variable relationships with your jump commands.

JP	NC	DIS	48	N
JP	C	DIS	56	N
JP	NC	NN	210	NN
JP	C	NN	218	NN

We can also compare the contents of the A variable with either a constant or one of the other variables, code 184 to 190. The result of this will set flag variable Z if they are equal, or NZ if they are not, and the flag variable Carry, if A is less than the variable, and No Carry if not.

Basic	Mnemonic	Machine code
IF A=N THEN LET F=Z	CP N	255 N
IF A<>N THEN LET F=NZ		
IF A>=N THEN LET F=NC		
IF A<N THEN LET F=C		

Note that the flag variable can be considered as a string rather than a number. Thus it is capable of holding the string NZNC, that is, non-zero, No Carry, if A is greater than the compared variable.

There is a group of commands similar to JP known as Call commands. The difference is that when you Call a return address is Pushed onto the stack. Later when a Ret instruction is met, the machine code Pops the return address off the stack and jumps to it.

```
CALL NN >>>>>INC B
             LD (HL) B
LD B A <<<<<RET
```

Great care must be exercised when using Push, Pop and nested Calls, so that return addresses are not mixed up with Pushed and Popped variables.

Should your machine-code program ever fail to work, look at this first and ensure that for every Push there is a Pop within a subroutine, and that you have not Popped your return at the beginning of your subroutine.

Main Program	Subroutine
PUSH HL	LD A N
CAL NN	POP H L
:	:
:	:
	RET

Pop HL pulls the return address off the stack, not the Pushed HL. Remember, Pop pulls off the last variable pushed.

The Call routines can be made by the same relationships as Jumps.

CALL	NN	205	N	N
CALL NC	NN	212	N	N
CALL C	NN	220	N	N
CALL NZ	NN	196	N	N
CALL Z	NN	204	N	N

Now for some special functions that you may encounter.

XOR A

There is a simple way of making the A variable equal to zero — LD A 0 — and that is to use the mnemonic XOR A, Code 175.

EX DE HL

More can be done with the HL variable pair than with the DE pair. We can load a constant into HL, or any of the other variables. It is useful to be able to exchange the contents of DE and HL. The mnemonic is EX DE HL, Code 235.

AND A

With the Sinclair character code, the difference between a character and its inverse is 128. See page 181 of the Sinclair manual.

Therefore, if we just wish to know a character and not worry about its colour then by using the A variable we can mask off the colour by using the command And N, Code 230.

And 127 blocks out the colour and just leaves the character, And 128 blocks out the character and just leaves the colour.

BIT 7A

A related command is Bit 7, A, Code 203 127. This tests to see whether the 128 part of the character is there and sets the flag variable NZ if it is and Z if it is not.

This command does not alter the A variable, it only tests it and sets up the flag variable according to the result.

Next month *Your Computer* begins a series of articles on machine-code chess. The range of code used has now been covered by the machine-code articles and this supplement. You will see how machine code can be used to produce fast compact programs. ■

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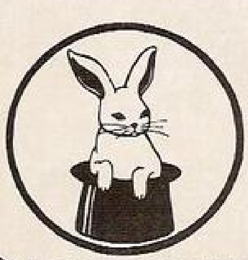

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PROJECT

SIMPLE WAYS TO HANDICAP

John Dawson casts a clinical eye over the winning entries in our competition to help the disabled.

JOHN HEATH has won an Epson MX80F/T printer for a simple, but powerful device for putting information into a Sinclair Spectrum computer. Tony Higham, who is 17 years old, wrote a program to allow a disabled person to write Basic programs on the Tangerine Microtan computer, using only three keys or switches. He wins the under-18 section of the competition and will receive a BBC Micro. Sinclair Research has generously donated three ZX-81 computers as special merit prizes.

The competition rules stated that, in the under-18 section, we were looking for original and stimulating ideas, aimed at the practical needs of someone handicapped in a particular way. In the over-18 competition, we hoped to see a working, prototype device with some associated software. The idea was to encourage people to think about mass production of their inventions. Bright ideas in isolation are of little use.

No-one doubts that handicapped people's lives can be enriched via micro-electronics, but a discouragingly long catalogue of factors has limited their widespread application. When he built the pneumatic switch for the Spectrum, John Heath was aware of these problems.

People who are handicapped are disadvantaged as wage-earners, and support for the disabled is never high on the list of priorities for governments.

Although there are many disabled people, there is a conflict between the need to supply cheap, mass-produced aids, and the wide range of individual disabilities.

It is usually essential to adapt aids to the particular needs of the individual. If the customisation involves a health-care professional, costs rise dramatically.

Safety aspects

Maintenance of specialised, complex equipment installed at widely-separated sites throughout the country is also very expensive.

Very high standards of safety are necessary for electrical devices to be operated by handicapped people, who may be caught off-balance more easily than an able person. If the equipment uses mains power, simple aspects of the design such as the cord grips that hold the mains input wire may become much more important if users ever put all their weight on the anchorage between the wire and the case.

Figure 1 shows how John Heath plans to get a signal from a handicapped person using a simple rubber bulb full of air. When the bulb is squeezed, there is an analogue change in pressure in the pipe leading from the bulb. The tube is connected at the computer end to an adaptor which terminates at a diaphragm. Mylar film about 0.2 mm thick is an ideal material for the diaphragm, providing bi-directional motion in response to pressure changes.

A short rod or flag is attached to the centre of the diaphragm. This can be made to obscure a silicon photo-diode proportionally to the position of the diaphragm. The source of illumination is an infra-red light-emitting diode (LED).

A person pressing on the bulb will cause the diaphragm to bulge, thus changing the current flowing through the photo-diode.

The change in current through the diode can be detected by various circuits. One low-cost method of digitising the photo-diode current is to allow it to discharge a capacitor, and to measure the discharge time which will be inverseley related to the current flowing through the diode.

Figure 1 shows how the software and hardware provide a binary on/off output from the changing pressure in the pneumatic actuator.

The computer is programmed to turn on an output Bit on one of the computer ports for a fixed period. The pulse provided by the computer charges the capacitor. During and after the pulse, the photo-diode discharges the capacitor, and the time that it takes for the voltage to reach a fixed low level, is determined by a program which reads in the input port continually, until it sees a signal that the Bit has dropped to the off — low level — state.

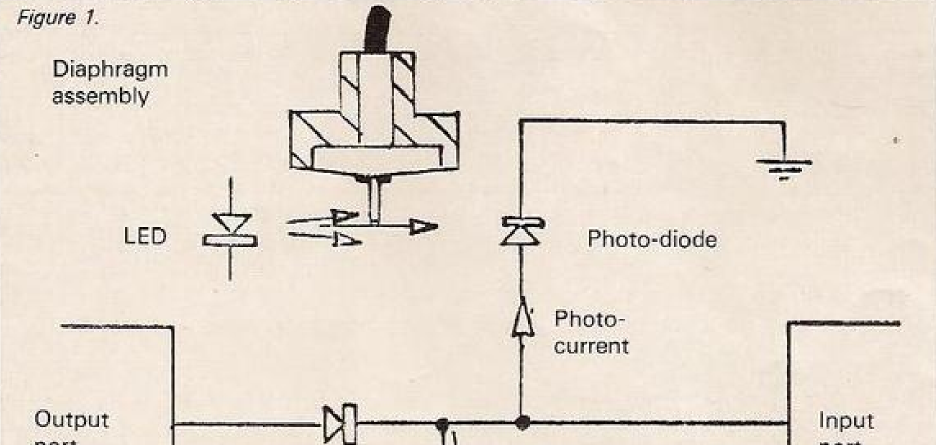
The input section of the program provides a digital measurement of the pressure in the tube by counting the number of times it has to go round in a loop while it waits for the state of the input latch to change.

Individual setting of the current flowing through the LED is necessary to compensate for variation in the sensitivity of the opto-electronic components, and the position of the components relative to the position of the rod attached to the diaphragm.

Existing devices for the handicapped are similar to other menu-driven data processing programs, in that the user controls the position of the cursor which moves among a selection of characters and commands.

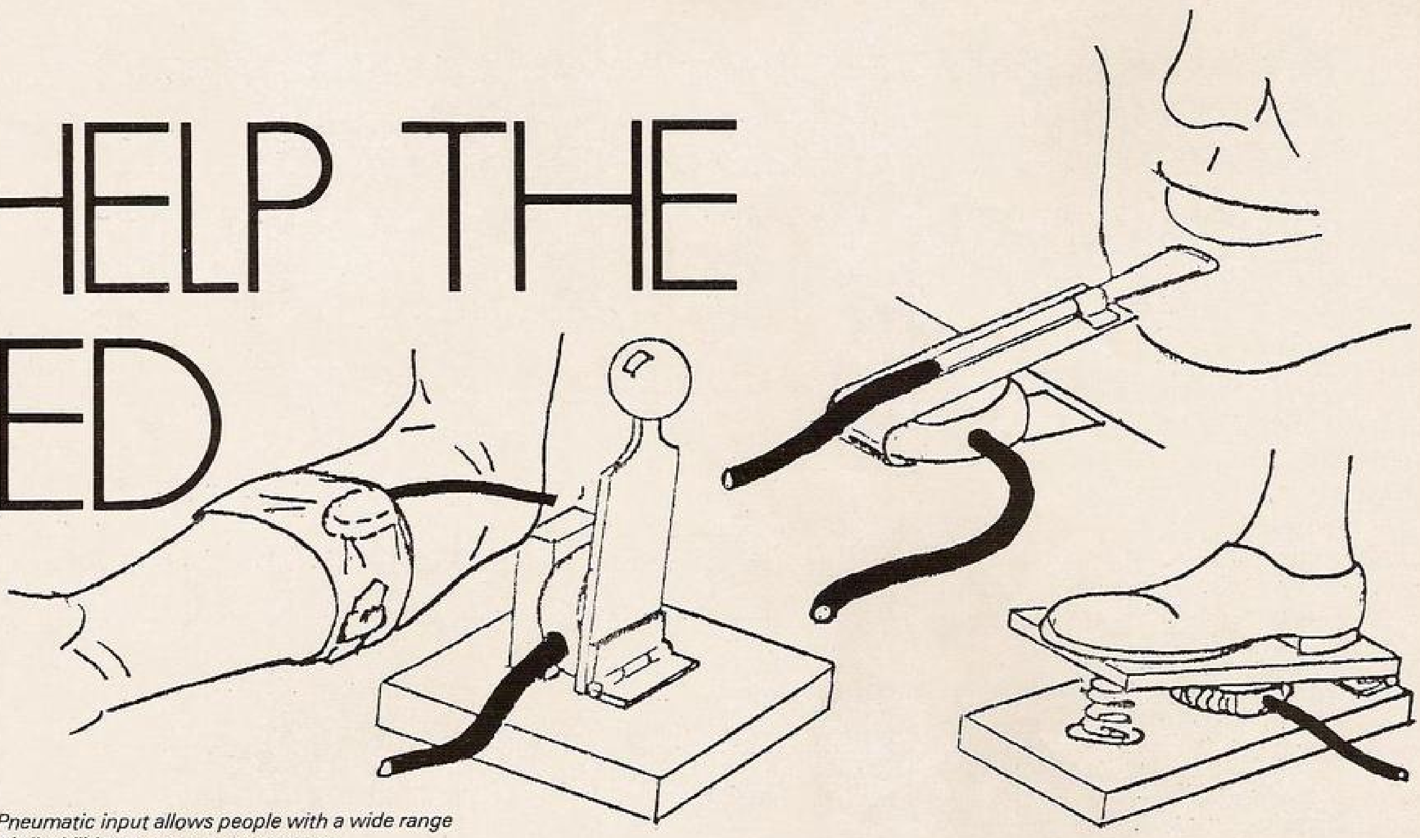
John Heath's program makes the cursor go

Figure 1.



HELP THE

PED



Pneumatic input allows people with a wide range of disabilities to operate a computer.

forward by increasing the pressure in the tube, either by squeezing the bulb or by blowing into the tube. The user can choose commands by giving a short, hard puff down the tube in contrast to the lower steady pressure which makes the cursor move forwards. Because the pneumatic and opto-electronic parts of the switch are analogue components it is possible for the software to sense a range of pressures. This can be used to control the speed of the cursor. Negative pressure in the tube, caused by sucking, can be detected and used to move the cursor backwards.

John Heath found factors which were essential for the successful operation of the system. First, a significant margin must exist between the pressure giving fast cursor motion and the pressure that signals that a command or character is to be selected.

Secondly, when the user relaxes, the cursor velocity must fall to zero immediately if the user is to be able to operate the device at its fastest rate. Thirdly, the user should be able to adjust the response time of the system to suit the speed at which he or she can react. The speed at which a disabled person can use the system may vary from day to day, and the means of adjustment should be built into the software rather than designed as part of the hardware.

Keyboard aid

The program that 17-year old Tony Higham wrote was designed to help handicapped people to program a computer in Basic. He said that the program was to be used with a joy-stick or some other device to make operation easier for a disabled person.

When you run the program, the top-half of the screen displays a set of letters and commands which simulate the ordinary key-board. Three keys control the movement of a cursor.

4 Move cursor to the left
6 Move cursor to the right
5 Select the letter or command beneath the cursor

Pressing the key to move the cursor to the right will transfer the cursor from the end of one line to the beginning of the next. When you select a character by pressing key 5, the letter appears on the bottom line of the screen and an asterisk character marks the point where the next character will be displayed. The user can select any of the keyboard functions, such as Return or Delete by positioning the cursor over the simulated Return or Delete keys.

Tony Higham built a shorthand command function into his program to increase the Basic writing speed. To get into the shorthand command program, the user types an Escape character by placing the cursor over the simulated Escape key. The asterisk character, which acts as a cursor on the bottom line of the screen, is replaced by S and then the keyboard can be used as before. When the user enters a single letter command, the complete Basic instruction is displayed on the bottom line.

Paul Coker developed a computer program to help people cope with dyslexia. This is an inability to gain access to information and to transmit it effectively to other people. Dyslexics cannot remember accurately the order in which letters are set down to form words due to the information about a word's structure being jumbled up between their eyes and their long-term memory.

Using a dictionary to check spellings, due to the complexities of the English language, is not always possible. For example, words like Know and No.

To overcome the problem Paul Coker wrote a program which he calls a Reverse Dictionary. The program will search for a correctly-spelt version of a word entered by the user. The average time to find the right match for a word typed into the computer is eight seconds if the first letter is correct.

If the first letter is wrong, the computer — A ZX-81 with 64K RAM — will take up to two minutes to find the word. Paul Coker says that his ZX-81 program is limited to 1,000 words as the tape take over six minutes to Load from cassette. A larger program could be used easily in a faster machine.

Help for dyslexics

I have not seen this program in operation, but the structure of the program appears to be divergent: more than one word might be taken to be a correctly-spelt version of the incorrect keyboard entry.

The single most telling point in this entry, and part of the reason why Paul won a special merit prize, is this: "My Reverse Dictionary is not meant to help a dyslexic to overcome the disability but to allow him or her to cope with it. The dictionary can be used in schools or colleges, but will be most useful at home where the person may not be able to get help with writing from a friend, and in cases where the writing is private."

I hope that as a result of the competition John Heath and Tony Higham will get together to combine their hardware and the software. Forth is a more powerful control language than Basic, allowing people who are handicapped to achieve a greater mastery of their environment. The health section of the IT 82 Committee will encourage the commercial assessment and development of the winning entries. ■

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.

CLG A function to calculate the base 10 logarithm of its argument. The argument must be greater than 0. On the BBC Micro this is a statement which clears the graphics area of the screen and homes the graphics pointer to 0,0.

CLK This function returns the date and time. An argument is usually required but it is a dummy playing no part in the function.

CLK$ A similar function to CLK.

CLOAD A special command — which can also be used as a statement — found in Microsoft Basic. It loads a Basic program from a cassette. It is often followed by additional parameters identifying the cassette port and the program name.

CLOAD? Another Microsoft Basic command which verifies that the program stored in the memory is identical to that on a cassette tape. It may be followed by additional parameters identifying the cassette port and the program name.

CLOSE A statement used by many micros to close disc files. If no files are specified, it closes all files except in BBC Basic which uses CLOSE # 0 to close all files.

CLOG *See CLG*

CLR This may be used as a statement or a command and is used on the Pet and Apple II as an abbreviation for CLEAR. *See CLEAR*

CLS This is a command or a statement which clears the screen and homes the cursor without disturbing the program or variables. On the BBC Micro it only clears the text area of the screen. *See CLG*

CMD A command used by the Pet to control the IEEE device named by the argument.

CO An abbreviation of the CONT statement. *See CONT*

CODE The ZX series equivalent of ASC. Note however that these machines do not use standard ASCII Codes. *See ASC.*

COLOUR Also spelt COLOR on American machines. A command and a statement which identifies the code of the colour required to be used for output.

CON The Apple II abbreviation for CONT. *See CONT*

CONT A command used to restart a program which has been halted by BREAK or STOP. The program restarts from the point at which it has halted, with all variables intact.

COS A standard trig function which returns the cosine of the argument. The argument is normally in radians.

COUNT This is a BBC Basic function which returns the number of characters printed since the last new line.

CSAVE A special command — which can also be used as a statement — used by Microsoft Basic. It saves a Basic program on to a cassette. It must be followed by the program name and may also identify the cassette port.

CSNG A function which changes double-precision numbers and numeric variables to single precision. The double-precision value is not lost and can be recovered later.

D

D Used to indicate double precision when expressing numbers in standard scientific notation, exponential notation. For example:

1.23456789 D + 20

indicates

$1.23456789 \times 10^{20}$

D. An abbreviation for DATA.

DAT An abbreviation for DATA.

DATA A standard ANSI statement indicating that the rest of the line contains data to be read by a READ statement.

DEEK A similar statement to PEEK. It returns the value stored at the address indicated but in two adjacent addresses.

DEF FN A standard ANSI statement which allows the user to define his own functions. It can be simulated by using a subroutine which calculates the desired function.

DEFDBL A statement which defines the variables following it as double-precision variables, until redefined.

DEFINT A statement which defines the variables following it as integer variables, until redefined.

DEFSNG A statement which defines the variables following it as single precision variables, until redefined.

DEFSTER A statement which defines the variables following it as string variables until redefined.

DEG A command which causes trigonometrical functions to be operated in degrees rather than radians. It is also used as a function to convert radians to degree on some computers, including the BBC Micro.

DEL An abbreviation for the DELETE command.

DELETE A command which erases specified lines from the computer's memory.

DIM A standard ANSI statement which is used to specify the size and format of an array variable.

DIV A special function used by the BBC Micro which returns the integer quotient of two variables, or expressions, which themselves need not be integers.

DO . . . UNTIL A statement pair which causes a loop of statements following the Do to be implemented until the loop ends — that is, when the condition following the Until is satisfied. Control then passes to the statements on the following line. It can be faked with a For-To-Next loop. See *Your Computer* June 1982.

DOKE A similar statement to POKE but which places a two-byte value into adjacent memory locations.

DRAW This statement will draw a line from the current cursor position to a position specified by the co-ordinates following it, using the current foreground colour.

DRAW . . . AT This statement is used in Apple II Basic to draw the shape specified after DRAW in the position indicated after AT. The shape must have been previously defined and numbered.

DSP A statement used in debugging. It causes the line number and the value of variables indicated to be printed each time the program encounters them.

E

E Used to indicate exponential notation (standard scientific notation) for example: 1.01 E + 10 indicates the value 1.01×10^{10} *See also D.*

E. The Microsoft Level I Basic abbreviation for EDIT.

EDIT A widely-used command to call up the machine's Editor so that changes can be made in existing Basic lines. There are many different Editors and each has its own command vocabulary. This command is used as a direct command and only very rarely finds a use inside a program.

ELSE A statement used to redirect the program operation sequence when the condition specified for an IF-THEN statement is not met. It can be mimicked by additional statements, see *Your Computer* September 1982, page 64, program 2 for details.

END The statement used to terminate execution of the program. In some computers it must be the highest line-numbered statement, but in others it can appear anywhere in the program and multiple ENDs are allowed. It differs from STOP in that it returns control to the Basic interpreter whereas STOP returns to the command mode. An ANSI standard word — *See STOP.* ■

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TV GRAPHICS

■ **I own a ZX-80 and a ZX-81 which both work fine on a 14 in. black-and-white TV, but when I try them out on a remote control colour TV the picture is very grey and the graphics are unclear. Altering contrast and brightness brings little improvement. I am thinking of buying an Atari or Dragon with colour and sound, but I am reluctant to do so in case I cannot obtain a decent picture. Is the problem with Sinclair's machines, or the TV?**

L Adrian,
Wallasey, Merseyside.

THE MOST likely problem is the ZX computers. Many do not produce an ideal picture on a colour television, although they work perfectly linked with a black and white set. To some extent the problem exists with all microcomputers. For example, my BBC Microcomputer works perfectly on my TV, but extremely poorly on a friend's set. You should not have problems with Atari or Dragon; there have been no reports regarding television-matching problems. Why not ask if you can have a demonstration of the computer on your own television?

POKE PROBLEM

■ **I am the lucky owner of a Spectrum, but one problem causes me headaches. The display file, as you know, is a little weird. When trying to Poke characters to the screen I become lost.**

Richard Baldwin,
Harefield Road, Maidenhead.

THERE IS NO simple answer. Why not stick with the Screens and Print At commands which do the job in a more simple manner?

COUNT THE DAYS

■ **In your September Response Frame, Derek Chadwick asked for a routine for counting the days between specific dates. My subroutine does the job in three lines, most of the work being done by line 9530:**

```
9500 REM DAY NUMBER ROUTINE
9510 LET M=VAL A$ (4 TO 5)
9520 LET Y=VAL A$ (7 TO )
9530 LET DAYNO=VAL A$ ( TO 2) +
     INT ((Y-1981) *365.3)+ (1 AND
     (M >=3 AND Y/4=INT
     (Y/4))) + (31 AND M=2) + (59
     AND M=3) + (90 AND M= 4) +
     (120 AND M=5) + (151 AND
     M=6) + (181 AND M=7) + (212
     AND M=8) + (243 AND M=9) +
     (273 AND M=10) + (304 AND
     M=11) + (334 AND M=12)
9540 RETURN
```

Line 9510 assigns the month number to variable M, line 9520 assigns the year number to Y. Line 9530 calculates the day number, using the first of January 1981 as a base, and allows for such things as leap years. The date must be entered as a string, A$, in the form 01.07.1982. I have found the routine useful in two ways. First, it can be used prior to sorting arrays into date order. Second, it can be used for Mr Chadwick's application. I have used it to calculate interest accumulated between two dates.

Gordon Clarke,
Ruislip, Middlesex.

THANKS VERY MUCH for your routine, Gordon. It is certainly compact, and looks fairly robust.

JOIN THE CLUB

■ **I won a Vic-20 which I intend to expand to its full potential. However, I am having trouble finding out about peripherals. I am also interested in business software for the Vic. Where can I get some information on available products?**

S Knye,
Kids Grove,
Stoke on Trent, Staffordshire.

COMMODORE HAVE recently organised Vicsoft, their own club for Vic users. It supplies information on a number of products and services, along with members' discounts. You can get details and a catalogue, by writing to Vicsoft, 818 Leigh Road, Trading Estate, Slough, Berkshire.

A GOOD READ

■ **I have a Vic-20 which I received at the beginning of the year. I have learned some Basic from *Introduction to Basic 1*, but now I feel I have come to a stop in my programming. Please could you advise me.**

David Murray,
Chelmsford, Essex.

ONE BOOK I would recommend is the *Vic-20 Programmer's Reference Guide*, published by Howard Sams, for £12.50. Other books on the Vic include my own *Getting Acquainted with your Vic-20*, which is a first-time users' guide to programming, and the games book *Symphony for a Melancholy Computer*. Mark Ramshaw's book *Zap! Pow! Boom!* which has 30 arcade games for the Vic-20 may prove of interest. *The Vic Revealed*, by Nick Hampshire, has been very popular. You can get it from your Vic dealer, or by mail.

VIC VOICE

■ **I am a Vic-20 owner, and recently purchased a voice synthesiser. The notes on how to actually make it work using Read and Data statements are brief to say the least, but I have managed to incorporate it into many programs successfully. What I have been trying to do is allocate words or short phrases to certain keys, but either all the Data statements are read at once, or the first statement is read, no matter which key is pressed.**

John Nicholls,
Kingsley, Northampton.

MICROSOFT BASIC includes the facilities of a selective Restore, which effectively acts as a pointer within lines of Data statements. What you need to do is incorporate the relevant Data statements for one word or phrase in only one line of Data. Then, to get just that line (if it was, say, line 2700) your key press will have to select a line saying Restore 2700 just before you Read. This should solve the problem. If you want it to stop Reading at a certain point, put a dummy value — like 999 — in the Data statement, which the Vic can use as a stop indicator.

ROUTINE ENQUIRY

■ **Having bought a ZX-81 to increase my knowledge of computers, I soon mastered its Basic. I then decided to branch out into machine code using Toni Baker's *Mastering Machine Code on Your ZX-81* and have since then sold my ZX-81 and bought a Spectrum. I have made enquiries at various computer stores and have found out that both computers use the same machine code. What I would like to know is whether there are any books which give the addresses of the useful subroutines in the Spectrum ROM.**

Zarek Langridge,
Whaddon, Hertfordshire.

TO MY KNOWLEDGE, such books do not yet exist. However, Melbourne House has a book planned by Ian Logan which discusses, among many other things, useful address of subroutines. Hilderbay has a booklet on making the most of the Spectrum ROM and I have received very favourable reports about this.

LIST LOOK

■ **I have owned a ZX-81 for about a year now, and *Your Computer* has proved an invaluable source of information and inspiration for me. However, I have found several program listings difficult to read. One example is the Landscape program by Gary Ownes in the September issue. It is very difficult to discern the difference between some of the numbers and letters, particularly 6, 8 and B in one of the strings. Also, I found the graphic characters in the Othello program in the June issue almost unreadable. Is there no better way of printing the listings, and if not, could a system of checking be introduced to ensure that at the final printing stages of the magazine, the listings can still be read?**

Frank Warnes,
King's Lynn, Norfolk.

I AM GLAD that the magazine is proving a useful asset for your computing. The listing of programs is a constant problem for all computer magazines. It seems there are only two things that can be done. Either the listings can be reset, as the other material in the magazine is, and then printed, or a direct copy of the printout can be used. If the listing is set, it seems that no matter how well the proofs are read, errors will creep in. Using a direct printout produces the problems of legibility you mentioned. On balance, it seems better to use direct listings.

DRAGON SECRET

■ **After having used a ZX-81 computer for over 12 months, I would now like to buy myself a micro. I read with some interest about the Dragon 32 in *Your Computer* but having sent for the brochure, I feel some vital information has been left out:**

■ What is the speed of its Basic interpreter compared with the Vic-20, and is the 6809E processor superior to the 6502 as Dragon claims it to be?

■ How many colours may appear on the screen at any one time?

■ Does it have a white-noise generator and normal tone generators, and can they work independently of the screen so that on-screen action is not halted while the sound effects are in operation?

Peter Arnfield,
Stockport, Cheshire

I DO NOT have the results of any benchmarks on the Dragon. The 6809E is a more modern chip than the 6502 which suggests it bears the fruit of later development. The number of colours you can use at any time falls as the resolution increases. You can use only two colours at once in the highest mode, but they are point by point colours, not grid colours as on the Spectrum. There is only a single channel for sound, and it is music, not white noise. If you want to get a good idea of what a Dragon looks like in action, go to a Tandy store and play with the Color Computer. It seems to me to have been built around the same extended colour Basic ROM written by the American company Microsoft, and in many respects could almost be described as the same machine — as in fact the Binatone computer promises to be. ■

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FINGERTIPS

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

A SOLUTION TO the Birthdays problem set in the September Fingertips column was sent in by Alan Stevens of Derby. This program for the Texas TI-59 gives the probability, Pr, that in a group of r people at least two of them have birthdays on the same day of the year by:

$$Pr = 1 - \frac{N!}{(N-r)!N^x}$$

where N=365, ignoring leap years. This can be rewritten as:

$$\prod_{k=o}^{r-l} (l-k/N) = 1-Pr$$

where Pi indicates "product of".

For a particular Pr the program below calculates the above product for successively increasing values of r, which is in STOre 00, until the product equals 1−Pr, or rather until the product is just less than 1−Pr.

Address	Key
000	(
001	l
002	−
003	RCL 00
005	÷
006	365
009	)
010	×
011	2nd Op 20
013	2nd x>t 000
016	RCL 00
018	R/S

Before running ensure that STOre 00 is zeroed, and enter the value of l−Pr in the t register.

	Enter	Press	Display
1		2nd CMs	0
2	1−Pr	x⇔t	0
3		RST	0
4		R/S	r

For Pr=0.6 we find r=27 people.

One may quibble that the x>t at address 013 should strictly be x>t, but this is not available on the TI-59. This may be overcome by using negative rather than positive numbers and INV 2nd x>t (≡ x<t), which requires three extra steps in the program. However, the likelihood of getting exact equality is so remote that there seems little point in doing it.

As well as this Birthdays solution, Alan Stevens has sent us Undercut, a calculator game based on a number game invented by Douglas R Hofstadter. It is for two players: here, the calculator is one player. Each guesses a number from one to five. If the two numbers differ by one, the player with the smaller number increases his score by the sum of the two numbers, the other player's score being unaltered. If the two numbers do not differ by exactly one each player increases his score by the number he or it guessed.

Thus, guessing a five will increase your score significantly — unless your opponent guesses a four. Guess a one and you cannot be undercut — but your opponent might guess more than two and hence score more heavily than you. Can you outguess the calculator over a series of trials? Needless to say, the calculator doesn't cheat.

Initialise the program by entering any number to be used as a seed for the random number generator, and press E. Then enter your guess — an integer in the range one to five and press A. Repeat the last operation for as long as you want to play the game. After each of your guesses the calculator guesses a number which it displays for about half a second. It then calculates and updates both its own and your score and displays the cumulative difference. If the result is positive you are ahead, if negative the calculator is ahead that is, it displays "player cumulative score — calculator cumulative score".

The program turns negative guesses into positive ones, and takes the integer part of a non-integer guess. Other guesses outside the range one to five are rewarded by a flashing one — press CLR to continue.

The number of trials is not used by the program, but is recorded and may be found by pressing RCL 00.

The program uses the random number generator of the TI-59's master module. This puts the calculator in a fixed format state, so if the program is to be recorded on magnetic card, INV 2nd Fix should be pressed first.

Alan Stevens' Undercut.

ADDRESS	KEY
000	2ND X=T 012
003	RCL 11
005	SUM 13
007	RCL 12
009	SUM 14
011	INV SBR
012	RCL 10
014	2ND X>T 024
017	13
019	STO 06
021	GTO 028
024	14
026	STO 06
028	(
029	RCL 11
031	+
032	RCL 12
034	)
035	SUM 2ND IND 06
037	INV SBR
038	2ND LBL A
040	2ND |X|
041	2ND INT
042	STO 12
044	2ND X=T 102
047	−
048	6
049	=
050	2ND X>T 102
053	2ND OP 20
055	2ND PGM 15
057	SBR 2ND D.MS
059	STO 11
061	CLR
062	STO 06
064	2ND OP 26
066	(
067	RCL 11
069	−
070	RCL 2ND IND 06
072	)
073	2ND X>T 064
076	RCL 06
078	STO 11
080	2ND PAUSE
081	−
082	RCL 12
084	=
085	STO 10
087	2ND |X|
088	−
089	1
90	=
091	SBR 000
094	(
095	RCL 14
097	−
098	RCL 13
100	)
101	R/S
102	1 +/−
104	√x
105	R/S
106	2ND LBL E
108	STO 09
110	.152
114	STO 01
116	.545
120	STO 02
122	.742
126	STO 03
128	.985
132	STO 04
134	1
135	STO 05
137	CLR
138	STO 00
140	STO 13
142	STO 14
144	R/S

Memory contents:

STOre	Contents
00	number of trials
01	.152
02	.545
03	.742
04	.985
05	1
06	indicator
07	used by random number generator
08	" " " "
09	seed
10	player no. − calculator no.
11	calculator
12	player's number
13	calculator's cumulative score
14	player's cumulative score

Concerning Roy Sirl's TI-57 Probability Program, September, 1982, A M Simpson of Perth sent us the following table of timings achieved on his TI-58, using the two examples in the article:

	LOCS	EX 1	EX 2
A	92	140	145
B	63	43	50
C	75	15	8
D	80	12	6

Time in seconds

A is Sirl's program adapted for TI-58; B is Sirl's algorithm via library program 16; C is Simpson's program, user-defined labels version and D is as C but using absolute addresses.

An example of the latter is printed here, with some background notes, including proof of equivalence to Roy Sirl's algorithm.

As you can see from C above, A M Simpson's program should be easily adapted to run on a TI-57; it is for this reason that the four parameters required by it still need to be entered outside the program.

TI-58/59 users, on the other hand, might find it easier to use user-defined labels to control entry of the parameters, and they should have no difficulty in developing A M Simpson's program into an automatic probability table generator.

Here are the background notes on A M Simpson's program. The algorithm used was:

$$P_{(r)} = \frac{(n-r)^{(a-u)} . a^{(u)} . r^{(u)}}{u! . n^{(a)}}$$

where:

$$x^{(y)} = x(x-1) \ldots \text{to y terms}$$

The proof of equivalence to Roy Sirl's algorithm is set out as follows, expressing 1 in factorials:

$$P_{(r)} = \frac{a!\, b!\, r!\, (n-r)!}{u!\, v!\, n!\, (a-u)!\, (b-v)!}$$

where:

$$b=n-a; \; v=r-u$$

Sirl's algorithm, using capitals to minimise confusion, is:

$$P_{(A,B,M,N)} = \frac{C^A_M \times C^B_{N-M}}{C^{A+B}_N}$$

where:

$$C^X_Y = \frac{X!}{Y!(X-Y)!}$$

(continued on next page)

Below: A M Simpson's probability listing.

KEY	LOC	CODE
2ND CP	000	29
RCL	001	43
3	002	03
−	003	75
RCL	004	43
4	005	04
=	006	95
2ND X=T	007	67
0	008	00
42	009	42
STO	010	42
05	011	05
1	012	01
X ↔ T	013	32
RCL	014	43
1	015	01
−	016	75
RCL	017	43
2	018	02
=	019	95
SBR	020	71
0	021	00
64	022	64
RCL	023	43
4	024	04
STO	025	42
5	026	05
SBR	027	71
0	028	00
64	029	64
RCL	030	43
4	031	04
STO	032	42
5	033	05
RCL	034	43
3	035	03
SBR	036	71
0	037	00
64	038	64

(listing continued on next page).

(continued from previous page)

Expressing the above in factorials:

$$P_{(A,B,M,N)} = \frac{A!\,B!\,N!\,(S-N)!}{M!\,L!\,S!\,(A-M)!\,(B-L)!}$$

where:

$S = A+B;\ L = N-M$

Therefore, the second and fourth equations are equal, as corresponding factors are identical:

Fourth	Second	
S	n	The universal set; (=a+b)
N	r	The sample size; (=u+v)
A	a	No in n of required class;
B	b	n-a;
M	u	No in r to be of required class;
L	v	r-u

M J Robertson's program is for a Casio FX-602P and MP-10. It is designed to produce a sketch of a mathematical function.

To execute the program, the function required must first be keyed into P1 using Mode2. Then revert back to Mode1 and press P0. The program halts and asks for "x max". This is entered using EXE. The program then asks for "x min" and a similar procedure is adopted.

The program then asks for the Y Scale, the number of lines of output from the printer that you wish the graph sketch to take up. Enter the appropriate value and press EXE. The calculator then responds with "points".

There are two options with this prompt, EXE or O EXE. Entering O EXE will produce a list of co-ordinates of the points to be plotted (the first pair of digits are for the far left column of the printer, and the last pair for the far right of the printer output). Pressing EXE only leads to the calculation of the co-ordinates: they are not printed. When all the points have been calculated the calculator responds with Ymax. This facility allows the breaking up of a curve into several parts.

If the maximum value of the part of the curve you want is known, by differentiation, entered, and EXE pressed then that value will be used. Hence if you divide a curve up into equal parts in relation to the x axis, then you can enter these one by one and the Y scale will be the same for all of them. This enables a long, or more accurate, curve to be produced since the resulting output can be linked side by side, each with the same scale.

However, if you just wish for a single curve to be produced, just pressing EXE after the Ymax prompt will result in the calculator automaticaly taking the maximum value it has just calculated and using that to determine the scale. Having entered the appropriate response to Ymax, the calculator will then set about plotting the graph as desired.

Mode .40 must be used. This allows only nine steps for P1, however if a larger function is required some of the alpha comments can be temporarily deleted.

The following programs by T Briggs were designed for the ambitious occasional punter aiming for big returns. Program P0 provides a quick and accurate calculation of Yankee bets in which all combinations of two or more horses are covered. The stake is entered first, followed by the number of horses to be covered. The display then shows the number of bets involved.

When the results are known, the odds of each winner are entered. Non-runners are entered as 0, losers as -1. After the final entry is made, the profit or loss is displayed followed by the amount to be collected from the bookie, including stakes.

Program P1 is designed for calculation of straightforward multiple bets, doubles, trebles and unlimited accumulators. As in the previous program, the stake and number of horses are entered. Results are keyed in, after which nett and gross returns are displayed, followed by the cumulative total of winnings if more than one bet is made. ■

(listing continued from previous page)

GTO	039	61
0	040	00
44	041	44
1	042	01
X↔T	043	32
RCL	044	43
3	045	03
STO	046	42
5	047	05
RCL	048	43
1	049	01
SBR	050	71
0	051	00
64	052	64
RCL	053	43
4	054	04
STO	055	42
5	056	05
RCL	057	43
2	058	02
SBR	059	71
0	060	00
64	061	64
X↔T	062	32
R/S	063	91
STO	064	42
0	065	00
X↔T	066	32
1/X	067	35
X	068	65
RCL	069	43
0	070	00
2ND OP	071	69
30	072	30
2ND DSZ	073	97
5	074	05
0	075	00
68	076	68
=	077	95
X↔T	078	32
INV SBR	079	92

TO RUN	r STO 02
	a STO 03
Press RST	u STO 04
n STO 01	R/S

M J Robertson's mathematical function stretcher.

```
PROGRAM LIST
M00-39,F-1F 352steps
FILE :  GRAPH

*** P0
9 EXP 99 Min10
9 +/- EXP 99 Min11
"X max"
HLT MinF
"1: #"
GSBP9
"X min"
HLT Min1F Min20
"2: #"
GSBP9
" "
19 Min15
GSBP2
21 Min00
"Y Scale ?"
HLT - 1 = Min15
"Points ?"
HLT Min18
LBL0
MR1F + MR01 = IND
Min00 Min1F
1 M+00
MR00 - 40 = x=0
GOTO1
GOTO0
LBL1
20 Min00
LBL2
IND MR00 Min01
GSBP1
Min13
MR18 x=0
GSBP8
MR13 IND Min00
MR11 MinF
IND MR00 x≥F Min11
MR10 MinF
IND MR00 x≥F GOTO4
Min10
LBL4
1 M+00
MR00 - 40 = x=0
GOTO3
GOTO2
LBL3
" "
GSBP9
MR11
"Y max ?"
HLT Min11 FIX4 =
"Y max: #"
GSBP9
MR10 FIX4 =
"Y min: #"
GSBP9
" "
GSBP9
MR11 MinF
MR10 Min1F
20 Min00
GSBP2
9 EXP 99 MinF
LBL5
IND MR00 ÷ MR01 =
FIX0 IND Min00 x≥F
GOTO8
IND MR00 MinF
LBL8
1 M+00
MR00 - 40 = x=0
GOTO6
GOTO5
LBL6
MRF x≥0 GOTO9
GSBP6
LBL9
GSBP5
MR15 x=0 GOTO7
1 M-15 GOTO9
LBL7
          ···245steps

*** P1
sin
          ···002steps

*** P2
MRF - MR1F = ÷ MR15
= Min01
          ···009steps

*** P5
20 Min00
MR15 MinF
LBL4
IND MR00 x=F GOTO1
"; "
LBL2
1 M+00
MR00 - 40 = x=0
GOTO3
GOTO4
LBL1
"1*"
GOTO2
LBL3
":"
GSBP9
          ···037steps

*** P6
20 Min00
LBL0
MRF IND M-00
1 M+00
MR00 - 40 = x=0
GOTO1
GOTO0
LBL1
          ···019steps

*** P8
" "
GSBP9
MR01 FIX4 =
"X = #"
GSBP9
MR13 FIX4 =
"Y = #"
GSBP9
          ···029steps

*** P9
SAVE invEXE
          ···003steps
```

```
P0: 337 STEPS
  5 PRT CSR 4;"-**Y
    ANKEES**-":VAC
 10 INP "STAKE",A,"
    NO.OF HORSES",X
    :Y=X
 20 IF X=6;X=58
 21 IF X=5;X=27
 22 IF X=4;X=12
 23 IF X=3;X=5
 30 Z=X-1:PRT Z;" B
    ETS",
 35 FOR N=1 TO Y
 40 INP "ODDS,L(-1)
    ,NR(0)",A(N):A(
    N)=A(N)+1
 45 NEXT N
 50 O=(A1*A2+A1+A2+
    1)*(A3*A4+A3+A4
    +1)*(A5*A6+A5+A
    6+1)
 60 X=X+A1+A2+A3+A4
    +A5+A6:P=A*(O-X
    )
 65 SET F2
 70 IF P>0 THEN 85
 80 PRT "LOSE";P*-1
    :GOTO 90
 85 PRT "WIN";P
 90 PRT "COLLECT";P
    +(Z*A):VAC :GOT
    O 10
P1: 151 STEPS
 10 PRT "MULTIPLE B
    ETS":VAC
 20 INP "STAKE",A,"
    NO.OF HORSES",I
    :C=A
 30 FOR N=1 TO I
 40 INP "ODDS",B
 50 C=C*B+C
 60 NEXT N
 65 SET F2
 70 D=D+C-A:PRT "CO
    LLECT";C,"WIN";
    C-A
 80 PRT "TOTAL WON"
    ;D:GOTO 20
```

Horse-racing programs by T Briggs.

Example of $Y=-x^2$ with co-ordinates displayed.

```
X max: 19      X = 1
X min: -19     Y = -1

X = -19        X = 3
Y = -361       Y = -9

X = -17        X = 5
Y = -289       Y = -25

X = -15        X = 7
Y = -225       Y = -49

X = -13        X = 9
Y = -169       Y = -81

X = -11        X = 11
Y = -121       Y = -121

X = -9         X = 13
Y = -81        Y = -169

X = -7         X = 15
Y = -49        Y = -225

X = -5         X = 17
Y = -25        Y = -289

X = -3         X = 19
Y = -9         Y = -361

X = -1         Ymax:-1
Y = -1         Ymin:
                 -361
```

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

Submarine

M Fox,
Aldridge,
West Midlands.

ZX-81

THIS IS A complex game of naval strategy in about 12K of RAM, based on a visual map of the area of battle and is an excellent example of the use of multi-dimensional arrays for the storage of certain types of data.

You are the captain of a submarine attacking a horde of enemy ships at anchor in a lagoon. You have to destroy them without running out of power, being destroyed by depth-charges, eaten by sea monsters, hitting a mine or running aground. The game is relatively self-explanatory when being played but the actual commands do need some explanation.

First, you may move in any one of eight directions using the command 1:

```
8  1  2
7     3
6  5  4
```

100 power moves you one square. You must be careful not to ram anything when moving. After you move, the sea-monsters also move — this is done in fast mode to save time. During this process **BADOOM** represents the demise of a sea-monster on a mine.

Second, you have two options for the command 2, Sonar. Option 1 draws a map of the battle area, in which:

- ● Edge of the battle area
- * Mine
- X Your submarine
- S Enemy ship
- H Your H Q
- $ Sea monster
- \+ Island

The second Sonar option enables you to track the path that a torpedo or missile would take. It prints a list of the things that it would hit.

Torpedoes, command 3, is used to launch a torpedo which has a range of three. They cannot destroy islands. Missiles, launched by command 4, have a variable range and use fuel. 100 fuel is equal to one square range. Missiles can destroy islands but ignore sea monsters.

Command 5, Repairs, is a command enabling you to repair damage — though it does use some power. There is a Status/Damage Report command. The Headquarters command, number 7, enables you to get extra supplies and power. It can only be used with over 16 enemy ships and you must be within two squares of your HQ.

Command 8, Sabotage, is a useful way of getting rid of enemy ships, and has a range of two. Conversion is used to convert fuel to power or power to fuel, at a one to one exchange rate. This is command 9. The symbol 0 gives a list of the commands. If you enter a wrong command Break the program and Goto 240. It is advisable to start games with a map.

The map is held in the array A(15,20) and is set up in lines 10 to 140. If the number 0 is held in the array then the corresponding square on the map is empty, 1 represents a mine, 2 your submarine, 3 an enemy ship, 4 your HQ, 5 a sea monster and 6 an island. This enables the printing of the map to be a very easy process — a string is set up containing the symbols used for each character on the map, line 2055

LET A$ = "*XSHS$ + "

Then that string is sliced and the character from the section of the string of the value of that square of the array, +1, is printed — lines 2052 to 2150.

All the inputs wherever possible are done by Inkeys to make the game easier and more pleasant to play. The crew, power, fuel, torpedoes and missiles are located at lines 160 to 200. Lines 230 to 260 input your choice of command and 270 to 290 print the possible options. Damage is kept in the variable D(9) corresponding to the command option. Damage is caused by the enemy depth-charging you after the commands Movement, Torpedoes, Missiles, Sabotage and Conversion. This is done at 6200 onwards to 6640 where a varying degree of damage is selected and inflicted from No Damage, 6260, to Critical Damage, 6490, where you have to send Help in a code which is printed on the screen for one second then removed — if you get it wrong no help comes and you die. The time can be changed at line 6550. You may find that you need 100 — two seconds — to start with, but later this will become too easy. After every command where damage is received, 1,3,4,8 and 9, the damage is automatically repaired by 1 at 5200.

Lines 1000 to 1080 collect the information for movement — direction and distance; 1090-1190 move the submarine checking if it hits anything and making sure that it does not go off the edge. Some clever manoeuvres can be devised making use of this facility. If you hit something when moving line 1160 sends

(continued on next page)

```
   5 DIM A(15,20)
   6 RAND
   7 LET R$=" DAMAGED"
   8 LET G$="HOW MUCH TO USE ?"
   9 LET ZC=2
  10 LET S=INT (RND*8)+12
  13 LET S1=10
  15 LET S2=10
  17 LET A(S1,S2)=2
  22 LET S4=INT (RND*20)+1
  24 LET S3=INT (RND*15)+1
  26 LET A(S3,S4)=4
  30 PRINT AT 10,5;"SETTING UP B
OARD"
  35 FOR N=1 TO 6
  40 IF N=2 OR N=4 THEN NEXT N
  50 IF N=1 THEN FOR M=1 TO INT
(RND*5)+10
  60 IF N=3 THEN FOR M=1 TO 5
  70 IF N=5 THEN FOR M=1 TO INT
(RND*8)+8
  80 IF N=6 THEN FOR M=1 TO 5
  90 LET X=INT (RND*15)+1
 100 LET Y=INT (RND*20)+1
 110 IF A(X,Y)<>0 THEN GOTO 90
 115 IF N=1 OR N=6 THEN IF X=1 O
R X=15 OR Y=1 OR Y=20 THEN GOTO
90
 120 LET A(X,Y)=N
 130 NEXT M
 140 NEXT N
 145 CLS
 150 DIM D(9)
 160 LET C=30
 170 LET P=6300
 180 LET F=2500
 190 LET T=10
 200 LET M=3
 210 LET D=0
 220 IF S>16 THEN LET D=1
 230 PRINT "THERE ARE ";S;" SHIP
S TO DESTROY"
 240 PRINT
 245 PRINT "WHAT ARE YOUR ORDERS
?"
 247 IF INKEY$="" THEN GOTO 247
 249 LET A$=INKEY$
 250 IF A$<"0" OR A$>"9" THEN GO
TO 247
 253 LET A=CODE A$-28
 255 CLS
 260 IF A<>0 THEN GOTO A*1000
 270 PRINT "(1) MOVING",,"(2) SO
NAR",,"(3) FIRE TORPEDOES","(4)
MISSILE CONTROL","(5) REPAIRS",,
"(6) STATUS REPORT"
 280 PRINT "(7) H.Q.",,"(8) SABO
TAGE",,"(9) POWER CONVERSION"
 290 GOTO 240
1000 IF D(1)<0 THEN PRINT "ENGIN
E";R$
1020 IF D(1)<0 THEN GOTO 240
1030 PRINT "COURSE? 812",,TAB 8;
"7*3",,TAB 8;"654"
1033 LET A$=INKEY$
1035 IF A$<"1" OR A$>"8" THEN GO
TO 1033
1040 LET Z=CODE A$-28
1045 PRINT AT 1,9;A$;"3",,,
1050 PRINT "POWER=";P,,,G$
1060 INPUT P1
1065 LET ZC=1
1070 IF P1>P OR P1<100 THEN GOTO
 1050
1080 LET P1=INT (P1/100)
1090 LET X=S1
1100 LET Y=S2
1110 FOR N=1 TO P1
1120 IF X<>15 THEN IF Z=6 OR Z=5
 OR Z=4 THEN LET X=X+1
1130 IF Y<>20 THEN IF Z=2 OR Z=3
 OR Z=4 THEN LET Y=Y+1
1140 IF Y<>1 THEN IF Z=6 OR Z=7
OR Z=8 THEN LET Y=Y-1
1150 IF X<>1 THEN IF Z=8 OR Z=1
OR Z=2 THEN LET X=X-1
1160 IF A(X,Y)<>0 THEN GOTO 1200
1170 NEXT N
1175 LET P=P-P1*100
1183 LET A(S1,S2)=0
1185 LET S1=X
1187 LET S2=Y
1190 LET A(S1.S2)=2
1192 PRINT "MOVEMENT OVER POWER=
";P
1194 GOTO 6200
1200 IF A(X,Y)=1 THEN PRINT "BAD
OOM A MINE"
1210 IF A(X,Y)=3 THEN PRINT "YOU
 RAMMED A SHIP"
1220 IF A(X,Y)=4 THEN PRINT "YOU
 RAMMED H.Q."
1230 IF A(X,Y)=5 THEN PRINT "GUL
P SLURP"
1240 IF A(X,Y)=6 THEN PRINT "YOU
 RAN AGROUND"
1250 IF A(X,Y)=3 THEN LET S=S-1
1255 IF S=0 THEN GOTO 9500
1260 PRINT ,,"YOU LOSE",,"THERE
WERE ";S;" SHIPS LEFT"
1270 STOP
1280 PRINT "REACTOR DEAD SUB SIN
KS"
1290 GOTO 1260
2000 IF D(2)<0 THEN PRINT "SONAR
";R$
2020 IF D(2)<0 THEN GOTO 240
2030 PRINT " OPTION?",,,,"(1) MA
P",,"(2) TRACKING"
2040 IF INKEY$="2" THEN GOTO 216
0
2045 IF INKEY$="1" THEN GOTO 205
1
2050 GOTO 2040
2051 CLS
2052 FOR N=0 TO 21
2053 PRINT AT 0,N;".";AT 16,N;".
"
2054 NEXT N
2055 LET A$=" *XSH$+"
2060 FOR X=1 TO 15
2065 PRINT AT X,0;".";
2070 FOR Y=1 TO 20
2110 PRINT A$(A(X,Y)+1);
2120 NEXT Y
2130 PRINT "."
2140 NEXT X
2145 LET P=P-50
2150 GOTO 240
2160 PRINT ,,"RANGE=?"
2165 IF INKEY$<>"" THEN GOTO 216
5
2170 LET A$=INKEY$
2173 IF A$<"1" OR A$>"9" THEN GO
TO 2170
2175 LET A=CODE A$-28
2177 PRINT AT 5,6;A$
2180 LET P=P-A*20
2190 FOR X=S1-A TO S1+A
2200 FOR Y=S2-A TO S2+A
2210 IF X<1 OR Y<1 OR X>15 OR Y>
20 THEN GOTO 2250
2215 IF A(X,Y)=0 THEN GOTO 2250
2220 IF A(X,Y)=1 THEN PRINT "MIN
E"
2225 IF A(X,Y)=2 THEN PRINT "YOU
"
2230 IF A(X,Y)=3 THEN PRINT "ENE
MY SHIP"
2235 IF A(X,Y)=4 THEN PRINT "H.Q
."
```

(listing continued on next page)

(continued from previous page)

you to 1200 which prints the message.

After Movement, the sea monsters move. These home in on you by one square each time. This is done in Fast mode at 5210. It scans the board square by square, 5240-5260, and when it finds a sea monster it homes him in by one square, 5270-5320, and if he has landed safely it saves his co-ordinates in B — number of sea monsters found so far,1 — and B(A,2) then removes the old image, 5450-5470. If a sea monster lands on a mine both it and the mine are removed from the map, 5530-5550. If it lands on you then it eats your whole submarine and you lose. If it lands on anything else it is replaced in its old position and does not destroy it. Sea monsters can be blocked this way and it is a good strategic move. At the end of this process lines 5570-5600 restore the re-positioned sea monsters to the map.

Lines 2160 to 2270 produce the torpedo or missile tracking by searching an area of three squares all around you in horizontal stripes going down.

The torpedo routine at 3000 is used for both torpedoes and missiles, 3030 to 3070 checking the area, in the same way as 2160-2270, and 3100-3160 printing the appropriate message. The short section at 4000 merely sets up missiles before jumping to 3030.

At 5000-5050 is the damage-repair routine. A status report is printed at 6000; 7000 is the HQ facility resetting your power and fuel. The sabotage routine is 8000. It checks an area two squares around you and destroys a random selection of the ships in that area around you. At 9000 is the conversion routine for converting fuel to power and power to fuel on a one-to-one basis.

Due to its immense size and the heartbreak if it is lost after typing it all it, it is best to save this program twice. This takes about four minutes each when finished. Remember to Clear the variables when saving, as these can add another minute to the time. This is done by 9900-9930. Do not forget to put in line 6475, which is at the end of the listing. To make the game harder or easier you can alter the original power, line 170; fuel, line 180; torpedoes, line 190; missiles, line 200; crew, line 160; ships, line 10; mines, line 50; sea monsters, line 70; and islands, line 80.

The variables are: A(15,20) is the map; ZC is the flag for whether to move sea monsters or not — 1 means yes, 2 means no; S represents number of ships left; S1+S2 are the co-ordinates of your submarine; S3+S4 are the co-ordinates of your HQ; D(9) is damage; P is power; F is fuel; C is crew; T is torpedoes; M is missiles; D is whether or not an HQ is allowed to be used — 1 means yes, 0 means no; P1,A,N,X,Y,M,R$,G$,A$,V,W,Z+SC are general usage variables.

```
2240 IF A(X,Y)=5 THEN PRINT "SEA MONSTER"
2245 IF A(X,Y)=6 THEN PRINT "ISLAND"
2250 NEXT Y
2260 NEXT X
2270 GOTO 240
3010 IF D(3)<0 THEN PRINT "TUBES ";R$
3015 IF T=0 THEN PRINT "NO TORPEDOES"
3020 IF T=0 OR D(3)<0 THEN GOTO 240
3025 LET Z=3
3030 FOR X=S1-Z TO S1+Z
3040 FOR Y=S2-Z TO S2+Z
3045 IF Y<1 OR X<1 OR Y>20 THEN GOTO 3060
3050 IF A(X,Y)<>0 THEN GOTO 3100
3060 NEXT Y
3070 NEXT X
3080 LET P=P-150
3085 LET T=T-1
3090 GOTO 6200
3100 IF A(X,Y)=1 THEN PRINT "YOU HIT A MINE"
3105 IF A=4 AND A(X,Y)=5 THEN GOTO 3060
3110 IF A(X,Y)=2 THEN PRINT "**YOU HIT YOURSELF**"
3115 IF A(X,Y)=6 AND A=4 THEN GOTO 4250
3120 IF A(X,Y)=3 THEN PRINT "ENEMY SHIP SUNK"
3125 IF A(X,Y)=4 THEN GOTO 3165
3130 IF A(X,Y)=5 THEN PRINT "A SEA MONSTER HAD A TORPEDO FOR LUNCH"
3135 IF A(X;Y)=6 THEN PRINT "TORPEDO WASTED ON AN ISLAND"
3140 IF A(X,Y)=2 THEN GOTO 1260
3145 IF A(X,Y)=3 THEN LET S=S-1
3155 IF A(X,Y)<>6 THEN LET A(X,Y)=0
3160 IF A=3 THEN GOTO 3080
3163 GOTO 6200
3165 LET A(X,Y)=0
3170 LET D=0
3175 LET S3=0
3180 LET S4=0
3190 IF A=3 THEN GOTO 3080
3195 GOTO 6200
4000 IF M=0 THEN PRINT "SILOS EMPTY"
4010 IF D(4)<0 THEN PRINT "SILOS ";R$
4020 IF C<23 THEN PRINT "NOT ENOUGH CREW"
4030 IF M=0 OR C<23 OR D(4)<0 THEN GOTO 240
4040 PRINT "FUEL=";F,,G$
4050 INPUT Z
4060 LET F=F-Z
4070 LET Z=INT (Z/100)
4080 LET M=M-1
4090 GOTO 3030
4250 LET A(X,Y)=0
4260 PRINT "YOU BLASTED AN ISLAND"
4270 GOTO 6200
5000 IF D(5)<-5 THEN PRINT "REPAIR IMPOSSIBLE"
5005 IF D(5)<-5 THEN GOTO 240
5009 PRINT "HOW MUCH TO REPAIR?"
5010 INPUT A
5011 LET P=P-(A*15)
5020 FOR N=1 TO 9
5030 LET D(N)=D(N)+A
5040 NEXT N
5045 PRINT "DAMAGE REPAIRED"
5050 GOTO 240
5200 PRINT "-=UPDATE=-"
5201 FOR N=1 TO 9
5202 LET D(N)=D(N)+1
5203 NEXT N
5204 LET P=P-15
5205 IF ZC=2 THEN GOTO 5620
5207 FAST
5210 LET ZC=2
5220 DIM B(16,2)
5230 LET A=0
5235 LET Z=1
5240 FOR X=1 TO 15
5250 FOR Y=1 TO 20
5260 IF A(X,Y)<>5 THEN GOTO 5480
5270 LET V=X
5275 LET A=A+1
5280 LET W=Y
5290 IF W>S2 THEN LET W=W-1
5300 IF W<S2 THEN LET W=W+1
5310 IF V<S1 THEN LET V=V+1
5320 IF V>S1 THEN LET V=V-1
5330 IF A(V,W)=2 THEN GOTO 5500
5340 IF A(V,W)=0 THEN GOTO 5450
5350 IF A(V,W)=1 THEN GOTO 5520
5360 IF A(V,W) THEN GOTO 5480
5450 LET A(X,Y)=0
5460 LET B(A,1)=V
5470 LET B(A,2)=W
5480 NEXT Y
5490 NEXT X
5495 GOTO 5570
5500 PRINT "SLURP GULP"
5505 SLOW
5510 GOTO 1260
5530 LET A(X,Y)=0
5540 LET A(V,W)=0
5550 PRINT "**BADOOM**"
5555 LET Z=Z+1
5560 GOTO 5480
5570 FOR X=1 TO A
5580 IF B(X,1) AND B(X,2) THEN LET A(B(X,1),B(X,2))=5
5600 NEXT X
5605 SLOW
5610 GOTO 240
5620 IF D(1)>0 OR D(9)>0 THEN GOTO 240
5630 PRINT "BOOM-SUB SUNK"
5635 IF P<1 THEN GOTO 1280
5640 GOTO 1260
6000 IF D(6)<0 THEN PRINT "REPORTS UNAVAILABLE"
6005 IF D(6)<0 THEN GOTO 240
6010 PRINT ,"POWER......=";P
6015 PRINT ,"FUEL.......=";F
6020 PRINT ,"CREW.......=";C
6025 PRINT ,"ENEMY SHIPS=";S
6030 PRINT ,"TORPEDOES..=";CHR$ (T+28)
6035 PRINT ,"MISSILES...=";CHR$ (M+28)
6040 PRINT ,,,,,,,,"YOU ARE AT (";S1;",";S2;")"
6050 IF D THEN PRINT ,,"H.Q. IS AT (";S3;",";S4;")"
6053 IF S=0 THEN STOP
6080 LET A$="ENGINES..SONAR....TORPEDOESMISSILES.REPAIR...STATUS...H.Q.....SABOTAGE.CONVERTER"
6090 FOR N=1 TO 9
6100 PRINT AT N-1,0;A$(N*9-6 TO N*9);"=";INT D(N)
6110 NEXT N
6115 PRINT AT 13,0;
6120 GOTO 240
6200 IF S=0 THEN GOTO 9500
6203 IF P<1 THEN GOTO 1280
6205 PRINT "DEPTH CHARGES TO ";
6210 LET A=RND
6220 IF A>.5 THEN PRINT "STARBOARD"
6230 IF A<=.5 THEN PRINT "PORT"
6250 IF RND>.13 THEN GOTO 6280
6260 PRINT "NO DAMAGE"
6270 GOTO 5200
6280 IF RND>.36 THEN GOTO 6330
6290 PRINT "LIGHT DAMAGE"
6300 LET P=P-50
6310 LET D(INT (RND*9)+1)=-(RND*2)
6320 GOTO 5200
6330 IF RND>.6 THEN GOTO 6410
6340 PRINT "MODERATE DAMAGE"
6350 LET P=P-75+INT (RND*30)
6360 FOR Y=1 TO 2
6370 LET X=INT (RND*9)+1
6380 LET D(X)=D(X)-(RND*6)
6390 NEXT Y
6400 GOTO 5200
6410 IF RND>.75 THEN GOTO 6490
6420 PRINT "HEAVY DAMAGE"
6430 LET P=P-(200+INT (RND*76))
6440 FOR X=1 TO 4+INT (RND*2)
6450 LET Y=INT (RND*9)+1
6460 LET D(Y)=D(Y)-INT (RND*9)+1
6470 NEXT X
6480 GOTO 5200
6490 PRINT "DAMAGE CRITICAL SEND ""HELP"" IN CODE "
6500 LET A$=""
6510 FOR X=1 TO 4
6520 LET A$=A$+CHR$ (INT (RND*26)+38)
6530 NEXT X
6540 PRINT AT 10,10;A$
6550 PAUSE 50
6560 PRINT AT 10,10;"    "
6570 INPUT B$
6580 IF A$<>B$ THEN GOTO 6610
6590 PRINT "THAT WAS CLOSE"
6600 GOTO 6630
6610 PRINT "MESSAGE GARBLED"
6620 GOTO 1260
6630 LET C=C-2
6640 GOTO 5200
7000 IF D(7)<0 THEN PRINT "H.Q.";R$
7010 IF D=0 THEN PRINT "HARD LUCK"
7015 LET A=SQR ((S1-S3)*(S1-S3)+(S2-S4)*(S2-S4))
7016 IF A>2 THEN PRINT "TOO FAR TO DOCK"
7020 IF A>2 OR D=0 OR D(7)<0 THEN GOTO 240
7030 PRINT "REFIT"
7040 LET D=0
7050 LET P=4000
7060 LET T=8
7070 LET M=2
7080 LET F=1500
7090 LET C=25
7100 GOTO 240
8000 IF D(8)<0 THEN PRINT "HATCHES JAMMED"
8010 IF D(8)<0 THEN GOTO 240
8013 LET Z=0
8014 LET P=P-30
8015 LET SC=0
8020 FOR X=S1-2 TO S1+2
8030 FOR Y=S2-2 TO S2+2
8040 IF X<1 OR X>15 OR Y<1 OR Y>20 THEN GOTO 8080
8050 IF A(X,Y)<>3 THEN GOTO 8080
8060 LET A=RND
8070 IF A>.3 THEN LET Z=Z+1
8073 IF A>.3 THEN LET A(X,Y)=0
8075 LET SC=SC+1
8080 NEXT Y
8090 NEXT X
8100 IF SC=0 THEN GOTO 8170
8110 PRINT "SHIPS NEAR=";CHR$ (SC+28)
8111 LET P=P-30
8120 PRINT "SHIPS SUNK=";CHR$ (Z+28)
8125 LET S=S-Z
8130 LET A=INT (RND*SC)
8140 PRINT "MEN CAUGHT=";CHR$ (A+28)
8150 LET C=C-A
8160 GOTO 6200
8170 PRINT "NO SHIPS NEAR"
8180 GOTO 240
9000 IF D(9)<0 THEN PRINT "CONVERTER";R$
9020 IF D(9)<0 THEN GOTO 240
9030 PRINT "(1) F-P   (2) P-F"
9035 IF INKEY$="2" THEN GOTO 9200
9040 IF INKEY$="1" THEN GOTO 9053
9050 GOTO 9035
9053 IF F<1 THEN PRINT "NO FUEL"
9057 IF F<1 THEN GOTO 240
9060 PRINT "FUEL=";F,,G$
9070 INPUT A
9080 IF F-A<0 THEN GOTO 9060
9090 LET F=F-A
9100 LET P=P+A
9105 PRINT "POWER=";P
9110 GOTO 6200
9200 PRINT "POWER=";P,,G$
9210 INPUT A
9220 IF P-A<0 THEN GOTO 9200
9230 LET F=F+A
9240 LET P=P-A
9250 GOTO 6200
9500 CLS
9510 PRINT TAB 7;"*****YOU  WON*****"
9520 PRINT ,,,,,"WELL DONE"
9530 GOTO 6010
9900 SAVE "S█"
9910 FOR N=1 TO 75
9920 NEXT N
9930 SAVE "S█"
6475 IF P<1 THEN GOTO 1280
```

Alien shootout

Steven Lilley,
Rearsby,
Leicester.

DRAGON

THIS KIND of program uses quite a few interesting features available on the Dragon 32 computer, such as music and colour. The object of the game is to use the small laser base at the bottom of the screen to shoot the aliens which appear one at a time on or near the top of the screen.

First, you are asked what speed you require between 1 and 10. It is best to start at about 2. Then, there is a short pause, long enough to get to the operating keys. The keys used are A to go left, S to go right and L to fire.

The variables are D for score, S for your speed, Q for your primary laser-base position, T for aliens position, M1$ for your laser-base and M2$ for the aliens ship. The program only takes 724 bytes, so it can be expanded and modified many times over.

```
10 CLS0
20 INPUT"SPEED(.1 TO 10)";S
30 D=0:CLS
40 PMODE0:SCREEN 1,1
50 Q=464
60 M1$=CHR$(143)+CHR$(135+16)+CHR$(126)+CHR$(132+16)+CHR$(143)
70 X=Q
80 FOR F=0 TO10
90 SOUND 200,1:NEXT F
100 PRINT @Q,M1$
110 T=RND(28+6)
120 PRINT @Q,M1$
130 M2$=CHR$(134+48)+CHR$(48+D)+CHR$(137+38)
140 A$=INKEY$
150 IF A$="L" THEN 240
160 IF A$="A" THEN Q=Q-1
170 IF A$="S" THEN Q=Q+1
180 PRINT @T,M2$
190 PRINT @T,"   "
200 SOUND 20,1
210 T=T+S
220 IF T>=160 THEN 360
230 GOTO 120
240 Z=Q-448
250 SOUND 100,1
260 FOR F=Q TO Z STEP-32
270 PRINT @F,"↑":PRINT @F," "
280 IF F=T THEN 330
290 IF F=T+1 THEN 330
300 IF F=T+2 THEN 330
310 NEXT F
320 GOTO 120
330 D=D+1
340 PLAY"V31L255ABCDEFGABCDEFG3ADD"
350 GOTO 110
360 PLAY"V31L200ABCDEGFACBGFFDAEEDFBGACBGFEADBGFFAEAFG"
370 PCLS
380 PRINT:PRINT"TO BAD!":PRINT:PRINT"your mission failed--the aliens have landed"
390 PRINT:PRINT"YOUR TOTAL SCORE -)";D
400 PRINT:PRINT"ANOTHER GO?(Y/N)"
410 INPUT A$:IF A$="Y" THEN RUN
420 END
```

Random graphics

Jack Schofield,
London W3.

ATARI

THE ATARI micros have some 37 graphics characters, but these are not used as often as they might be, because the implementation is odd, not to say bizarre. They can be entered from the keyboard, though they are not marked on the keys, by pressing the CTRL key at the same time. But when these characters are used in graphics modes 1 and 2 as double-width and double-depth characters, different ones appear from the ones you typed in. Unless, that is, you have also remembered to change the character-set base to the graphics characters by using

POKE 756,226

Another way to go is to print

CHR$(Y)

for each character you want. Table 9.6 on page 55 of the Basic Reference Manual tells you which is which.

This also lets you change the colour of the character shown by adding 32, 128 or 160 to the CHR$ number. This simple graphics routine illustrates the technique. Line 10 sets Mode 2 without the text window. Line 15 sets the character base for lower-case and graphics characters.

The loop simply fills the screen with random examples. Lines 55 and 60 display the same graphics character, Y, but in three different colours — yellow, Y, magneta, Y+128, and blue, Y+160, respectively.

The program loops forever so press Break to stop it, and type End to stop the sound.

```
10 GRAPHICS 2+16
15 POKE 756,226
20 FOR X=1 TO 64
30 Y=INT(RND(0)*30)
35 IF X/4=INT(X/4) THEN 50
45 PRINT #6;CHR$(Y+32);:SOUND 0,Y,10,8
50 Y=INT(RND(0)*20):SOUND 1,Y,10,8
55 PRINT #6;CHR$(Y);:SOUND 2,Y,10,6
60 PRINT #6;CHR$(Y+128);CHR$(Y+160);
65 NEXT X
70 GOTO 10
```

Dodgems

Nagaraj Jayakumar,
Royton,
Oldham.

VIC-20

THE FOLLOWING PROGRAM is for the Commodore Vic-20 with 3.5K and is an arcade game. You are driving a car and the computer is driving another car chasing you. There are five lanes in which you can manoeuvre. The object of the game is to stay alive as long as possible before the computer car crashes into you.

01 — 09	Rem statements
10 — 13	Sound tune
14 — 25	Instructions
200 — 290	Set up board
340 — 610	Movement of cars
800 — 890	Searching for car
900 — 960	Ending routine
1000 — 1080	Change of lane

```
1 REM****************
2 REM*              *
3 REM*   DODGEMS    *
4 REM*              *
5 REM*     BY       *
6 REM*              *
7 REM*N.M.JAYAKUMAR*
8 REM*              *
9 REM****************
10 PRINT"JQQQQQ]]]NAGARAJ JAYAKUMAR■":PRINT"Q]]]]]]PRESENTS■"
11 FORA=1TO2000:NEXT
12 POKE36878,15:FORA=1TO8:READB,C:POKE36876,B:FORD=1TOC:NEXT:POKE36876,0:NEXT
13 DATA175,200,175,200,175,200,151,1200,163,200,163,200,163,200,147,1200
14 PRINT"JQQQQQQ":FORA=1TO29:PRINT"▾";:NEXT:PRINT"DODGEMS";:FORA=1TO30:PRINT"▾"
;:NEXT
15 FORA=1TO2000:NEXT
16 PRINT"Q]]]]]]INSTRUCTIONS"
17 PRINT"QTHIS IS A GAME IN     WHICH YOU DRIVE A"
18 PRINT"MOTOR CAR AND ANOTHER CAR WHICH IS BEING    CONTROLED BY THE      COMP
UTER IS"
19 PRINT"CHASING YOU. THERE AREFOUR LANES,AND TO MOVE INTO AN INNER LANE   YOU
USE THE KEY"
20 PRINT" 'L' AND TO MOVE INTO AN OUTER LANE YOU USE THE KEY 'A'.THE OBJECTOF T
HE GAME IS"
21 GETA$:IFA$=""THEN21
22 PRINT"QQQQQQQQTO TRY AND STAY ALIVE THE LONGEST BEFORE THECOMPUTER'S CAR CO
MES  AND"
23 PRINT"CRASHES INTO YOU. YOU HAVE A TIMING SCORE   O.K..GET READY!!!!!!!!"
24 PRINT"PRESS ANY KEY TO BEGIN"
25 GETA$:IFA$=""THEN25
200 PRINT"J":FORG=38400TO38906:POKEG,2:NEXT
210 A=160:FORB=1TO26:READC,D,E:FORF=CTODSTEPE:POKEF,A:NEXTF:NEXTB
220 DATA7702,7723,1,7748,7755,1,7757,7765,1,7794,7807,1,7840,7843,1,7845,7849,1
,7886
230 DATA7891,1,7974,7979,1,8016,8019,1,8021,8025,1,8058,8071,1,8100,8107,1,8109
,8117,1
240 DATA8142,8163,1,7702,8142,22,7770,8078,22,7816,7904,22,7948,8036,22,7862,79
94,22
250 DATA7745,8142,22,7787,8099,22,7829,7917,22,7961,8049,22,7871,8003,22,7908,7
930,22
260 DATA7913,7935,22
270 POKE7909,20:POKE7910,9:POKE7911,13:POKE7912,5
290 TI$="000000":PRINT"QQQQQQQQQQQQQQ]]]]]]]]]";:CLR
295 B=7725:C=8002:L=4
300 PRINTTI$;"■■■■■■";
320 GETA$:IFA$="L"THENGOSUB1040
330 IFA$="A"THENGOSUB1000
340 IFC=8121ORC=8079ORC=8037ORC=7995THENZ=1
345 IFB=8121ORB=8079ORB=8037ORB=7995THENY=1
350 IFC=7725ORC=7771ORC=7817ORC=7863THENZ=2
355 IFB=7725ORB=7771ORB=7817ORB=7863THENY=2
360 IFC=7744ORC=7786ORC=7828ORC=7870THENZ=3
365 IFB=7744ORB=7786ORB=7828ORB=7870THENY=3
370 IFC=8002ORC=8048ORC=8094ORC=8140THENZ=0
375 IFB=8002ORB=8048ORB=8094ORB=8140THENY=0
590 POKEC,32:POKEB,32
600 IFZ=0THENC=C-1
601 IFZ=1THENC=C-22
602 IFZ=2THENC=C+1
603 IFZ=3THENC=C+22
```

(continued on page 103)

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(continued from page 101)

```
604 POKEC,90:IFC=BTHEN900
607 IFY=0THENB=B-22
608 IFY=1THENB=B+1
609 IFY=2THENB=B+22
610 IFY=3THENB=B-1
620 POKEB,86:IFB=CTHEN900
800 IFL<2ANDB=7778THENPOKEB,32:B=B-44:POKEB,86
805 IFL<4ANDB=7866THENPOKEB,32:B=B-44:POKEB,86
810 IFL<2ANDB=8086THENPOKEB,32:B=B+44:POKEB,86
815 IFL<4ANDB=7998THENPOKEB,32:B=B+44:POKEB,86
820 IFL<3ANDB=7927THENPOKEB,32:B=B-2:POKEB,86
830 IFL<3ANDB=7938THENPOKEB,32:B=B+2:POKEB,86
840 IFL=4ANDB=7822THENPOKEB,32:B=B+44:POKEB,86
845 IFL>1ANDB=7734THENPOKEB,32:B=B+44:POKEB,86
850 IFL>1ANDB=8130THENPOKEB,32:B=B-44:POKEB,86
855 IFL=4ANDB=8042THENPOKEB,32:B=B-44:POKEB,86
860 IFL>2ANDB=7925THENPOKEB,32:B=B+2:POKEB,86
870 IFL>2ANDB=7940THENPOKEB,32:B=B-2:POKEB,86
890 GOTO300
900 A$=TI$:FORA=1TO506
910 POKE7680+(INT(RND(1)*506)+1),160
915 POKE36874,(INT(RND(1)*255)+1):NEXT
920 POKE36874,0:PRINT"YOUR SCORE IS "A$
930 INPUT"TRY AGAIN";B$
940 IFB$="YES"THENRUN
950 IFB$="NO"THENPRINT"BYE BYE":END
960 PRINT"I DO NOT UNDERSTAND    USE YES/NO":GOTO930
1000 IFC=7866ORC=7778THENPOKEC,32:C=C-44:POKEC,90:L=L-1
1010 IFC=7998ORC=8086THENPOKEC,32:C=C+44:POKEC,90:L=L-1
1020 IFC=7927THENPOKEC,32:C=C-2:POKEC,90:L=L-1
1030 IFC=7938THENPOKEC,32:C=C+2:POKEC,90:L=L-1
1035 RETURN
1040 IFC=7734ORC=7822THENPOKEC,32:C=C+44:POKEC,90:L=L+1
1050 IFC=8042ORC=8130THENPOKEC,32:C=C-44:POKEC,90:L=L+1
1060 IFC=7925THENPOKEC,32:C=C+2:POKEC,90:L=L+1
1070 IFC=7940THENPOKEC,32:C=C-2:POKEC,90:L=L+1
1080 RETURN
READY.
```

Slalom

Jonathan Yeomans,
Solihull,
West Midlands.

SPECTRUM

SPECTRAL SKI-ING involves a slalom skier manoeuvring down a course to the finishing post. The graphics are printed by a Read and Data statement on to the screen and Bin statements allow the user to use the high-resolution graphics.

A full set of instructions is contained in the listing, along with Rem statements to tell the user what the computer is doing. Lines 5-40 set up high-resolution graphics; lines 40-80 print out the board; lines 80-160 get the skier moving and lines 160-210 are the ATTR lines that detect if you have hit anything that you should not have.

Lines 300-320 are for when you hit a flag; lines 400-420 are the routine for when you hit a tree and lines 500-530 are the routine for when all your skiers have bitten the snow.

Lines 800-840 are the instructions; lines 900-940 are the routine for when you have finished the course; lines 9000-9030 are the data for the Bin statements, and lines 9030-9040 are the data for printing out the course.

The graphics used are: lines 40 and 50 graphics D, line 60 graphics B, line 80 graphics A, line 115 graphics E, line 125 graphics A and line 190 graphics C and F.

```
   1 GO TO 800
   4 CLS
   5 CLS
   6 FOR n=1 TO 11: PRINT ,,,,:
NEXT n
   8 BORDER 1: PAPER 7: INK 4: L
ET p=5
   9 RESTORE
  10 FOR n=0 TO 7: READ a: POKE
USR "a"+n,a: NEXT n
  15 FOR n=0 TO 7: READ d: POKE
USR "d"+n,d: NEXT n
  20 FOR n=0 TO 7: READ b: POKE
USR "b"+n,b: NEXT n
  25 FOR n=0 TO 7: READ f: POKE
USR "f"+n,f: NEXT n
  30 FOR n=0 TO 7: READ c: POKE
USR "c"+n,c: NEXT n
  35 FOR n=0 TO 7: READ e: POKE
USR "e"+n,e: NEXT n
  40 INK 4: FOR n=0 TO 21: PRINT
 AT n,0;"▲";AT n,31;"▲": NEXT n:
 PRINT AT 0,0;"▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲
▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲";AT 21,0;"▲▲▲▲▲▲
▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲▲"
  50 FOR n=0 TO 41: READ a,b,c:
FOR m=a TO b: BEEP .01,m: PRINT
AT c,m;"▲": NEXT m: NEXT n
  60 INK 2: FOR n=0 TO 27: READ
a,b: PRINT AT a,b;"⚑": BEEP .01,
n: NEXT n: PRINT AT 4,5; INK 7;"
"
  70 PRINT AT 1,1; INK 0;"S";AT
2,1;"T";AT 3,1;"A";AT 4,1;"R";AT
 5,1;"T";AT 15,30; INK 3;"F";AT
16,30; INK 3;"I";AT 17,30; INK 3
;"N";AT 18,30; INK 3;"I";AT 19,3
0; INK 3;"S";AT 20,30; INK 3;"H"
;AT 5,3; INK 7;" "
  80 LET e$="♟"
  90 LET x=3: LET y=3: LET a=0:
LET b=0:
 100 LET a$=INKEY$
 105 IF a$="" THEN GO TO 150
 110 IF a$="5" THEN LET b=-1: IF
a$="5" THEN LET a=0
 115 IF a$="5" THEN LET e$="♟"
 120 IF a$="8" THEN LET b=1: IF
a$="8" THEN LET a=0
 125 IF a$="8" THEN LET e$="♟"
 130 IF a$="6" THEN LET b=0: IF
a$="6" THEN LET a=1
 140 IF a$="7" THEN LET b=0: IF
a$="7" THEN LET a=-1
 150 LET x=x+a: LET y=y+b
 160 INK 0: PRINT AT x,y;e$: BEE
P .01,15: PRINT AT x,y;" "
 170 IF ATTR (x+a,y+b)=60 THEN G
O TO 400
 180 IF ATTR (x+a,y+b)=58 THEN G
O TO 300
 185 IF ATTR (x+a,y+b)=59 THEN G
O TO 900
 190 PRINT AT 21,6;"♟ ♟ ♟ ♟ ♟ ♟
♟ ♟ ♟ ♟ ♟": BEEP .01,5: PRINT AT
 21,8;"♟ ♟ ♟ ♟ ♟ ♟ ♟ ♟ ♟ ♟ ♟"
 210 GO TO 100
 300 FOR n=50 TO -50 STEP -5: BE
EP .01,n: NEXT n
 310 INK 3: PRINT AT x+a,y+b; IN
K 2;"⚑": PRINT AT 21,8; FLASH 1;
"HA HA YOU HIT A FLAG ": FOR N=
0 TO -45 STEP -2: BEEP .01,N: NE
XT N: PRINT AT 21,8; FLASH 0;"LO
OSE ANOTHER LIFE       ": FOR N=-5
0 TO 50 STEP 4: BEEP .01,N: NEXT
 N
 315 LET p=p-1: IF p=0 THEN GO T
O 500
 320 GO TO 90
 400 FOR n=0 TO 50 STEP 2: BEEP
.01,n: BEEP .01,60-n: NEXT n
 410 INK 2: PRINT AT x+a,y+b; IN
K 4;"▲": PRINT AT 21,8; FLASH 1;
"BAD LUCK YOU HIT A TREE": FOR N
=0 TO 45 STEP 1.75: BEEP .01,N:
NEXT N: PRINT AT 21,8; FLASH 0;"
LOOSE ANOTHER LIFE      ": FOR N=
-50 TO 50 STEP 4: BEEP .01,N: NE
XT N
 415 LET p=p-1: IF p=0 THEN GO T
O 500
 420 GO TO 90
 500 CLS : FOR n=0 TO 21: PRINT
AT n,0; INK 2;"████████████████
████████████████": BEEP .01,n: NE
XT n
 510 PRINT AT 7,8; INK 3;"██████
██████████";AT 13,8;"██████████
██████": FOR n=7 TO 13: PRINT A
T n,8; INK 3;"█";AT n,24; INK 3;
"█": NEXT n
 520 PRINT AT 9,10; INK 0;"GUESS
 YOU RAN";AT 11,10; INK 0;"OUT O
F LIVES!"
 530 INPUT "DO YOU WANT TO PLAY
AGAIN Y/N";T$: IF T$="y" THEN RU
N : STOP
 540 STOP
 800 PAPER 7: BORDER 1: INK 1
 810 CLS
 820 PRINT AT 1,6;"SPECTRUM SKII
NG BY";AT 3,6;"©JONATHAN YEOMANS
";AT 6,1;"WELCOME TO SKIING.MAKE
 YOUR ";AT 8,1;"WAY DOWN THE COU
RSE USING THE";AT 10,1;"CURSOR K
EYS TO DODGE THE FLAGS";AT 12,1;
"AND FOREST TO REACH THE BOTTOM
";AT 14,1;"AND A COLOURFULL CELE
BRATION!";AT 17,4;"BUT BE WARNED
 YOU ONLY";AT 19,8;"HAVE 5 LIVES
"
 830: FOR M=0 TO 50: BEEP .01,M:
```

(continued on next page)

(continued from previous page)

```
BEEP .01,60-M: NEXT M
 835 PAUSE 600
 840 CLS : GO TO 5
 900 FOR N=-50 TO 50: BORDER INT
 (RND*7): BEEP .01,N: BEEP .01,N
+5: NEXT N
 910 CLS : PAPER 2: INK 6
 920 FOR N=7 TO 13: PRINT AT N,8
;"■";AT N,24;"■": NEXT N: PRINT
AT 7,8;"[redacted]";AT 13,
8;"[redacted]"
 930 PRINT AT 9,10; PAPER 7; INK
 0;"   WE HAVE";AT 11,10;"  A WI
NNER!"
 940 INPUT "DO YOU WANT TO PLAY
AGAIN Y/N";T$: IF T$="y" THEN RU
N : STOP
 950 STOP
9000 DATA BIN 00001100,BIN 00001
100,BIN 00011001,BIN 00011110,BI
N 00011000,BIN 00001000,BIN 0000
1001,BIN 11111110
9010 DATA BIN 00010000,BIN 00010
000,BIN 00111000,BIN 00111000,BI
N 01111100,BIN 01111100,BIN 1111
1110,BIN 00010000
9020 DATA BIN 00001100,BIN 00111
100,BIN 01111100,BIN 00111100,BI
N 00001100,BIN 00000100,BIN 0000
0100,BIN 00000100
9022 DATA BIN 00111000,BIN 00111
000,BIN 00010000,BIN 11111110,BI
N 10111010,BIN 10111010,BIN 0010
1000,BIN 01101100
9024 DATA BIN 00111000,BIN 10111
010,BIN 10010010,BIN 11111110,BI
N 00111000,BIN 00111000,BIN 0010
1000,BIN 01101100
9026 DATA BIN 00110000,BIN 00110
000,BIN 10011000,BIN 01111000,BI
N 00011000,BIN 00010000,BIN 1001
0000,BIN 01111111
9030 DATA 5,30,1,6,8,2,13,30,2,2
5,30,3,28,30,4,27,30,5,1,3,6,9,1
0,6,22,22,6,29,30,6,1,23,7,30,30
,7,1,7,8,12,23,8,30,30,8,1,6,9,1
7,22,9,1,4,9,30,30,9,1,1,10,30,3
0,10,1,1,11,29,30,11,1,1,12,10,1
1,12,29,30,12,1,1,13,9,14,13,22,
30,13,1,1,14,5,15,14,21,30,14,1,
1,14,1,1,15,5,30,15,1,1,16,6,30,
16,1,1,17,1,1,18,19,24,18,1,6,19
,1,30,20
9040 DATA 3,8,3,5,5,5,5,8,2,11,4
,11,4,17,6,17,3,22,5,22,7,24,7,2
8,9,28,9,25,12,23,10,23,11,19,13
,19,10,15,12,15,8,10,10,10,10,7,
12,7,13,2,13,4,16,4,16,2,17,9,19
,9,19,12
```

Atom squash

Robin Ager,
Wimbledon,
London SW19.

ATOM

HERE IS A simple, but smooth and fast-moving, game of squash for the Acorn Atom. It only uses 1K of graphics memory to allow it to Run in a small amount of memory. To make the program even more compact, full use of the Atom's abbreviated commands should be. Use the Q and R keys to control the bat up and down the screen in order to hit the ball against the wall. Due to the bat being curved the ball will be deflected at steeper angles when it hits the far top or far bottom of the bat.

The score is kept by the line at the top of the display, which increases until the target score of 110 is reached. If your three balls are used before you reach this score, the score you have achieved will be displayed at the end of the game.

10	Set up arrays
20	Assembler keyboard scan
12 to 13	Set up court display
20 to 50	See if keys are being pressed or if ball is at edge of court
60	Move ball
70 to 80	Control vertical bounce of ball
89 to 95	See if ball hits or missed bat and acts accordingly and controls horizontal bounce of ball.
2000 to 2030 & 5000 to 5010	End of game routines

```
>L LIST
   1DIMP(-1),B(3);P.#21
   2[;JSR#FE71;STY#80;RTS;]
   3P.$6
   4S=0;D=9
  10 CLEAR1
  11 X=40;Y=40;G=1;H=3;A=1;R=0;L=1;K=0;S=30
  12 GOSUB 1000
  13 GOSUB 4000
  20 IFX>=118 GOS.d
  25 LINK TOP
  26 IF ?#80=49 GOS.b
  27 IF?#80=33 GOS.c
  30 IF X<=10 GOS.e
  40 IF Y>=53 GOS.f
  50 IF Y<=11 GOS.g
  60 PLOT 15,X,Y;WAIT;X=X+H;Y=Y+G;PLOT13,X,Y
  65 GOTO 20
  70gZ=SGN(G)*-1;G=L*Z;R.
  80fZ=SGN(G)*-1;G=L*Z;R.
  89ePLOT13,(10+R),57;IFR=110G.5000
  90IFY>=(S+1)ANDY<=(S+4)T.LETH=3;Z=SGN(G);L=1;G=L*Z;R=R+1;R.
  91 IFY=S ORY=(S+5)THENLETH=3;Z=SGN(G);L=2;G=L*Z;R=R+1;R.
  92 A=A+1;IF A=4G.2000
  93 PLOT15,X,Y
  94 X=10;Y=A.R.%43;Y=Y+11;H=3
  95 FOR T=1TO1500;NEXTT;GOS.1000;R.
 100dH=-3;R.
 200bPLOT 15,D,S;PLOT15,D,(S+1);S=S+2;MOVED,S;DRAW D,(S+5)
 201R.
 300cPLOT15,D,(S+5);PLOT15,D,(S+4);S=S-2;MOVED,S;DRAWD,(S+5)
 301 R.
1000 MOVE10,55;DRAW119,55;DRAW119,9;DRAW10,9;RETURN
2000 P.$12;P."GAME OVER";P.';P."YOU SCORED "R
2005P.''
2010 INPUT"PLAY AGAIN(Y/N)"$B
2020 IF $B="Y"THENRUN
2030END
4000 MOVE10,59;DRAW119,59;RETURN
5000 P.$12;P."WELL DONE YOU REACHED THE MAX."'"SCORE OF 110"
5010 GOTO 2010
```

Soft key

Robert Rancans,
London SW1.

BBC

THE USER-DEFINABLE keys on the BBC Micro can be used to implement useful functions during every programming session by employing this short program.

To start, use the 11 highest line numbers the operating system will allow — 32757-32767 — and assign the desired command to each key thus:

32757	*KEY0L.|M	
32758	*KEY1VDU14|M	Page mode on
32759	*KEY2VDU15|M	Page mode off
32760	*KEY3CLS|M	Clear screen
32761	*KEY4AUTO	Enter your starting line and increment
32762	*KEY5RENUMBER|M	
32763	*KEY6MODE7|M	
32764	*KEY7REM	
32765	*KEY8*CAT|M	More convenient as it combines CAT with a motor-on facility for rewinding tapes, press Escape to cancel
32766	*KEY9RUN|M	
32767	*KEY10OLD|ML.|M	To get out of tricky situations when Escape is treated as an error

Note that you do not have to use quotes when assigning keys. Save this, preferably on a new tape so you can locate it easily. To check the operation of the program press Break twice quickly, rewind the tape and Chain "Soft-keys" or whatever you have called it. Now type New and start entering your main program, making use of the soft keys. Do not press the Break key before typing New as, for some odd reason, the first line number of the soft-key program will then appear on the screen as line 245.

The commands will remain active after pressing Break once. To enter a new program without clearing the soft keys, type New — obviously you must not use the highest line numbers in your main program.

Pascal functions

*D M Woolley,
Hathersage,
Derbyshire.*

MZ-80K

USERS OF SHARP MZ-80K Pascal are probably missing the Set/Reset graphics functions provided by the Basic. This assembly-language program fills that gap. Those with less than 48K will have to adjust the origin appropriately. Here are the instructions:

```
E$CFAA    ; reserve space for routine
Q/        ; return to monitor
LOAD etc. ; load routine from tape and control
            returns to Pascal
```

Set X,Y can now be accessed by Call (−12373) X,Y and Reset X,Y by Call(−12356)X,Y.

It is probably best to incorporate these in procedures to aid clarity and to allow X and Y to be constants, thus:

```
        Procedure Set (X,Y: Integer);
        BEGIN
            CALL (-12373) X,Y
        END;
```

An easier way of converting hexadecimal addresses greater than $8000 to decimal (2's complement) than shown in the Pascal manual is to first convert the hexadecimal directly into decimal, and then to subtract 65536.

Users of Basic SP-5025 may be interested in INP# port, variable and OUT# port, data. These are not in the manual and are the I/O port equivalents of Peek and Poke.

```
                ;************************************
                ;*     SET/RESET                    *
                ;*  MZ-80K HI-RES GRAPHICS          *
                ;*     M. WOOLLEY   23/7/82         *
                ;************************************
                ;
                        ORG  0CFA8H
CFA8 C30212             JP   1202H      ;GOTO PASCAL
CFAB E5         SET:    PUSH HL         ;SAVE X
CFAC D5                 PUSH DE         ;SAVE Y
CFAD CDC6CF             CALL COMMON     ;COMMON ROUTINE
CFB0 3005               JR   NC,ADPXL   ;YES,ADD PIXEL
CFB2 78                 LD   A,B        ;GET PIXEL
CFB3 C6F0               ADD  A,240      ;GEN NEW CHAR
CFB5 1801               JR   RETURN     ;RETURN
CFB7 B0         ADPXL:  OR   B          ;GEN NEW CHAR
CFB8 77         RETURN: LD   (HL),A     ;PLOT
CFB9 D1                 POP  DE         ;RESTORE Y
CFBA E1                 POP  HL         ;RESTORE X
CFBB C9                 RET
CFBC E5         RESET:  PUSH HL         ;SAVE X
CFBD D5                 PUSH DE         ;SAVE Y
CFBE CDC6CF             CALL COMMON     ;COMMON ROUTINE
CFC1 38F5               JR   C,RETURN   ;NO,RETURN
CFC3 A8                 XOR  B          ;REMOVE PIXEL
CFC4 18F2               JR   RETURN     ;RETURN
                ;
                ;**COMMON ROUTINE**
                ;
                ;CALCULATE PIXEL
CFC6 CB45       COMMON: BIT  0,L        ;IS X EVEN
CFC8 280C               JR   Z,XEVEN    ;YES,JUMP
CFCA CB43               BIT  0,E        ;IS Y EVEN ?
CFCC 2804               JR   Z,YEVEN    ;YES,JUMP
CFCE 1608               LD   D,8        ;PIXEL IS ▗
CFD0 180E               JR   ADDRES
CFD2 1602       YEVEN:  LD   D,2        ;PIXEL IS ▝
CFD4 180A               JR   ADDRES
CFD6 CB43       XEVEN:  BIT  0,E        ;IS Y EVEN ?
CFD8 2004               JR   NZ,YODD    ;NO,JUMP
CFDA 1601               LD   D,1        ;PIXEL IS ▘
CFDC 1802               JR   ADDRES
CFDE 1604       YODD:   LD   D,4        ;PIXEL IS ▖
                ;CALCULATE SCREEN CO-ORDS
CFE0 CB3D       ADDRES: SRL  L          ;/2 TO GET NEW X
CFE2 CB3B               SRL  E          ;/2........NEW Y
                ;CALCULATE SCREEN ADDRESS
CFE4 97                 SUB  A          ;ZERO ACC
CFE5 0608               LD   B,8        ;LOOP COUNTER
CFE7 0E28               LD   C,40       ;MULTIPLICAND
CFE9 CB43       MLTPLY: BIT  0,E
CFEB 2801               JR   Z,SKIPAD   ;SKIP ADDITION
CFED 81                 ADD  A,C
CFEE CB3F       SKIPAD: SRL  A
CFF0 CB1B               RR   E
CFF2 10F5               DJNZ MLTPLY
CFF4 4F                 LD   C,A
CFF5 42                 LD   B,D
CFF6 51                 LD   D,C        ;DE=Y*40
CFF7 19                 ADD  HL,DE      ;HL=Y*40+X
CFF8 1100D0             LD   DE,0D000H  ;BASE ADDRESS
CFFB 19                 ADD  HL,DE      ;=SCREEN ADDRESS
                ;CALCULATE NEW CHAR
CFFC 7E                 LD   A,(HL)     ;GET OLD CHAR
CFFD FEF0               CP   240        ;CHAR PLOTTED ?
CFFF C9                 RET
                        END
```

Graph screen

*K G Staller,
Birkenhead,
Merseyside.*

VIC-20

THE GRAPH-PLOTTING procedure for the Vic-20 published in April's *Your Computer* produces a graph whose size is limited by the need to cover the whole area of the graph with high-resolution graphics. Here are two programs that overcome this difficulty and produce screen-size graphs.

The first program uses instructions given in *Your Computer* October 1981. These prepare the computer to use high-resolution, user-defined graphics. It also defines the character for axes.

This program, having been Run and Cleared from the computer by typing New, makes way for the graph-drawing program. It produces screen-size graphs by defining new characters only when the line or curve passes through a screen location. Thus most of the screen is filled by blank characters.

The desired functions can be inserted at line 240 as Y=f(x). On Running the program, four input parameters must be given: first, XL — value of X where the plotting of the curve starts; second, XH — value of X where the plotting of the curve ends; third, XM — value of X at the edge of the screen; fourth, YM — value of Y at the edge of the screen.

For XM⩾XH, XM⩾XL, and XH>XL care must be taken to avoid trying to plot impossible points, for example, $\sqrt{-1}$ or 1/0.

No compensation is made in the program for the fact that, due to the shape of the screen, n units in the y direction are shorter than n units in the x direction.

I have used this program to draw many different functions on the screen and hope that you find it of interest. I am uncertain as to why what should be one-bit dots on the screen appear as short lines.

```
5 FORI=6176TO7192
6 POKEI,0:NEXTI
10 INPUTXL,XH,XM,YM
20 FORI=0TO7
30 F(I)=2↑(7-I)
40 NEXTI
50 FORI=1TO506
60 POKE7679+I,131
70 POKE38399+I,0
80 NEXTI
90 FORI=1TO22
100 POKE7691+22*I,128
110 POKE7921+I,129
120 NEXTI
130 POKE7933,130
140 CO=0
170 G=11/YM:GG=8*G
180 S=INT((XH-XL)*88/XM)-1
190 XP=XL*11/XM
200 C=7933+INT(XP)
210 D=INT((XP-INT(XP))*8)-1
220 FORI=0TOS
230 X=XL+(I*XM/88)
```

(continued on page 108)

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Manchester, M19 3DQ**

(continued from page 105)

```
240 Y=X↑3-X
250 Y=Y*G
270 IFI=0THENY1=Y
280 D=D+1
290 IFD>7THENC=C+1:D=0
295 IF11<ABS(Y)GOTO380
300 GOSUB1000
380 NEXTI
400 GETA$:IFA$=""THEN400
410 PRINT"]":END
1000 P=C-22*INT(Y)
1010 Z=PEEK(P)
1030 IFZ>131GOTO1050
1032 K=Z:Z=132+CO:CO=CO+1
1033 IFZ=131GOTO1050
1034 FORJ=0TO7
1035 POKE(5120+8*Z+J),PEEK
     (5120+8*K+J):NEXTJ
1050 E=INT((Y-INT(Y))*8)
1060 ZZ=5127+8*Z-E
1070 POKEZZ,PEEK(ZZ)ORF(D)
1080 POKEP,Z
1090 RETURN
```

Line drawing

Richard Matthews,
Harlow,
Essex.

TI-99/4

EXTENDED BASIC on the Texas T199/4A computer is easy to use and has many facilities, including sprites. However, one useful facility is lacking: the ability to draw high-resolution lines from point to point on the screen. The program described here allows high-resolution line drawing and is based on the computer's ability to redefine characters.

An important feature of Extended Basic is subroutines that can be called by name at any point in a program. The line-drawing program is written as one of these subroutines so that it can be attached to the end of other programs. The routine may be called at any time by the statement Call Plot RW,CL,RW1,CL1,CT. This would allow a line to be drawn from position RW, row, CL, column, to position RW1, row, CL1, column. The Texas screen has a resolution of 256 by 192 pixels and in this routine screen position 1,1 is in the top left-hand corner.

In simulating a line-drawing function it is necessary to redefine the character allocated to a screen position before each new pixel of a line is plotted. Each character consists of an eight-by-eight matrix of pixels and the character must be redefined to include the newly-plotted point while preserving the existing pattern of that character. Another limitation is the limited number of characters that are available for redefinition. In order to preserve the existing ASCII character set for text it is necessary to start at ASC-96, so this routine should only be used for certain plotting tasks. It is an excellent means of drawing line graphs.

The variable CT in the Call Plot statement is to indicate where within the character set you wish the characters to be redefined. In the example shown, the starting place is ASC-96 and thus CT has the value 96. When 48 characters have been used there are no more available characters to redefine, and so line 275 instructs the program to start again at ASC-96. If more characters are required then CT could be altered to 33, but then the standard ASCII character set will be overwritten. The variable CT need only be set once at the beginning of the program.

Lines 100 to 160 are not part of the line-drawing routine, but are included to show how a line can be plotted. In this example, a line would be drawn from screen position 2, 20 to position 7, 60. The line-drawing routine is called from line 130. Line 190 assigns values to array Bin.

The process for calculating the path to be taken by the line is shown in lines 210 and 240. Line 250 calculates the character position on the screen that contains the pixel which is being plotted. The Texas screen has a character size of 32 by 24.

Line 260 calculates the position within the character of the pixel that is being plotted. Call GChar in line 270 finds out which character already occupies this position on the screen. If that screen position has not yet been used then the ASC value of 32 is returned and this indicates that a new character must be assigned to this position and so CT is incremented by 1. Line 275 checks to see if all the available characters in the character set have been used.

The Call CharPat statement in line 280 — the CharPat sub-program is built into Extended Basic and returns a string that identifies the pattern of a character code — creates in variable x the pattern of the character code found at the screen position already identified.

Lines 290 to 330 modify the character code to allow for the new point that has been plotted. Line 290 identifies the position within the string identified in line 280 of the hexadecimal value that must be modified. Lines 300 to 320 convert this hexadecimal value to a decimal value and the logical operator Or is used in line 310 to redefine the plotted point while preserving the existing pattern of the character.

After conversion back into hexadecimal the string X in line 330 is updated to allow for the change and the new modified character is created and displayed in line 335. The For-Next loop continues until all the points making up a line have been plotted and then control passes back to the main program by way of line 340.

```
60 REM R.MATTHEWS
70 REM TX SOFTWARE
80 REM LINE PLOTTER  (TI99/4A EXTENDED BASIC)
85 REM  ***********
100 CT=96
110 CALL CLEAR
120 READ RW,CL,RW1,CL1
130 CALL PLOT(RW,CL,RW1,CL1,CT)
140 STOP
150 DATA 2,20,7,60
160 END
170 REM ***********
180 SUB PLOT(RW,CL,RW1,CL1,CT)
190 BIN(1),BIN(5)=8 :: BIN(2),BIN(6)=4 :: BIN(3),BIN(7)=2 :: BIN(4),BIN(8)=1
210 X1=RW1-RW :: Y1=CL1-CL :: Z1=MAX(ABS(X1),ABS(Y1)) :: G=RW :: H=CL
240 FOR I=1 TO Z1 :: G=G+X1/Z1 :: H=H+Y1/Z1 :: RW=INT(G) :: CL=INT(H)
```

```
 250 CHRW=INT(RW/8.01+1) :: CHCL=INT(CL/8.01+1)
 260 PIXRW=RW-((CHRW-1)*8) :: PIXCL=CL-((CHCL-1)*8)
 270 CALL GCHAR(CHRW,CHCL,CH) ::IF CH=32 THEN CH=CT ::CT=CT+1 ::CALL CHAR(CH,"")
 275 IF CT=144 THEN  CT=96
 280 CALL CHARPAT(CH,X$)
 290 PS=INT(((PIXRW-1)*8+PIXCL)/4.001)+1 ::CD=ASC(SEG$(X$,PS,1))
 300 IF CD<65 THEN DEC=CD-48 ELSE DEC=CD-55
 310 DEC=BIN(PIXCL) OR DEC
 320 IF DEC>9 THEN CD=DEC+55 ELSE CD=DEC+48
 330 X$=SEG$(X$,1,PS-1)&CHR$(CD)&SEG$(X$,PS+1,16)
 335 CALL CHAR(CH,X$) :: CALL HCHAR(CHRW,CHCL,CH) :: NEXT I
 340 SUBEND
 350 REM ***********
READY.
```

Chuff-chuff

G E Malpas,
Little Stoke,
Bristol.

BBC

THIS PROGRAM produces a piece of computer-generated animation for the BBC Micro and shows the use of both colour and block graphics in the teletext mode — as featured in June's *Your Computer.*

Lines 10-80 initialise the program and plot the background colour using CHR$(157) which produces a solid line of colour across the screen for the blue of the sky and green of the fields. Line 90 calls a routine to draw clouds in the sky, lines 480-520, and produces between one and eight clouds in random positions in the sky. This creates a different pictures each time the program is run. Line 100 calls a similar routine to draw a hut on the screen.

The main body of the program, lines 100-330, produces the sound effects for the train as it passes across the screen and also produces the control for the speed of the train, lines 140, 190, 270, 320. The position of the train is then plotted using the routine at lines 360-430. Lines 370 and 380 plot a solid line of colour across the screen producing the animated effect. Lines 390 and 400 plot the train itself in red, and then line 420 will produce puffs of smoke from the train at various positions across the screen using the routine ProcChuf.

The overall effect is a very colourful and amusing program. The reader could try adding further items to the scene.

```
5      REM ANIMATED TRAIN
10     MODE 7
20     C = 3
30     FOR X = 1 TO 10
40     PRINT CHR$(&84) CHR$(157)
50     NEXT X
60     FOR X = 11 TO 23
70     PRINT CHR$(&82) CHR$(157)
80     NEXT X
90     PROCCLOUDS
100    PROCHUT
110    FOR L = 20 TO 2 STEP -1
120    SOUND 0,-15,100,L
130    SOUND 0,0,100,L/2
140    C = C + 0.25:PROCTRAIN(C)
150    NEXT L
160    FOR L = 1 TO 40
170    SOUND 0,-15,100,2
180    SOUND 0,0,100,2
190    C = C + 0.25:PROCTRAIN(C)
200    NEXT L
210    SOUND 1,-15,150,20
220    SOUND 1,0,100,10
230    SOUND 1,-15,150,20
240    FOR L = 1 TO 40
250    SOUND 0,-15,100,2
260    SOUND 0,0,100,2
270    C = C + 0.25:PROCTRAIN(C)
280    NEXT L
290    FOR L = 2 TO 20
300    SOUND 0,-15,100,L
310    SOUND 0,0,100,L/2
320    C = C + 0.25:PROCTRAIN(C)
330    NEXT L
340    PRINT TAB(38,24);
350    END
360    DEFPROCTRAIN(C)
370    PRINT TAB(0,15) CHR$(&82) CHR$(157)
380    PRINT TAB(0,16) CHR$(&82) CHR$(157)
390    PRINT TAB(C,15) CHR$(&91)"kpt"
400    PRINT TAB(C,16) CHR$(&91)"o/?"
410    IC = INT(C)
420    IF IC = 5 OR IC = 10 OR IC = 15
       OR IC = 25 OR IC = 30 OR IC = 3
       OR IC = 32 THEN PROCCHUFF(C)
430    ENDPROC
440    DEFPROCCHUFF(C)
450    PRINT TAB(0,14) CHR$(&82) CHR$(157)
460    PRINT TAB(C+1,14) CHR$(&97)"e"
470    ENDPROC
480    DEFPROCCLOUDS
490    FOR Q = 1 TO RND(8)
500    PRINT TAB(RND(30) + 3,RND(8)) CHR$(&97)"N¾C"
510    NEXT Q
520    ENDPROC
530    PROCCHUT .
540    PRINT TAB(30,11) CHR$(&91)"xt"
550    PRINT TAB(30,12) CHR$(&93)"'/"
560    ENDPROC
```

Lissajous effect

Stephen K Wilson,
Oakes,
Huddersfield.

BBC

WHEN TWO sets of waves produce a geometrical shape a Lissajous figure is created. This program simulates this effect as produced on an oscilloscope screen. With the instrument's time-base off, one oscillating signal is connected to the X plate and one to the Y plate. If the frequencies of these signals are in a simple ratio a recognised symmetrical figure is formed. In physics these figures are used for determination of an unknown frequency through comparison with a known one. The nature of the figure depends on the path difference between the signals. With the simplest of all ratios — 1:1 — the figure is a sloping line with a path difference of 0 rads, a sloping ellipse with a path difference of one quarter of the rads, and a circle with a path difference of half of π.

In this simulation the user is asked to input the ratio of frequencies in lowest terms, and the path difference between the signals — X signal leading Y signal — as a fraction of π. The computer calculates and draws the figure.

The program will run on either BBC model, though those with model Bs would wish to alter line 15 to run it in mode zero for greater

(continued on next page)

(continued from previous page)

resolution. Those with greater patience and a greater desire for accuracy might wish to reduce the Step command at line 100.

With a view to converting to other Basic dialects it is worth mentioning that @% is a formatting feature which displays all figures to two decimal places. The VDU 28 call defines a text window at top-centre screen which is cleared by the VDU 12 call and cancelled with VDU 26, line 95. *FX 15,0 clears the keyboard buffer, line 25.

```
10    REM: LISSAJOUS FIGURES by S.WILSON
15    MODE4: @%=131594:PROCDISPLAY
20    PROCPLOT
25    *FX15,0
30    PRINT TAB(6,30)"Do you wish to re-run ";:INPUTA$
35    A$=LEFT$(A$,1):IFA$= "Y" THEN GOTO 15
40    @ = 2570: CLS: END
45    DEFPROCDISPLAY
50    PRINT TAB(8,1)"LISSAJOUS FIGURES":PRINT TAB(8,2)STRING$(18,"_")
55    VDU28,0,7,39,4:INPUT TAB(4)"X-plate signal frequency ",XF
60    INPUT TAB(4)"Y-plate signal frequency ",YF:INPUT TAB(2)"Path
      difference (fraction of PI) ",PD
65    VDU12
70    IF PD>=1 THEN PD = PD - INT(PD)
75    ENDPROC
80    DEFPROCPLOT
85    MOVE300,250: DRAW800,250:DRAW800,750:DRAW300,750:DRAW300,250
90    PRINT TAB(5)"Ratio of frequencies ";XF;":";YF:PRINT TAB(6)
      "Path difference ";PD*PI;" radians"
95    VDU26
100   FOR A = -PI TO PI STEP 0.01
105   XX = 250*SIN(A*XF + PD*PI) + 550
110   YY = 250*SIN(A*YF) + 500
115   IF A = -PI THEN MOVE XX,YY ELSE DRAW XX,YY
120   NEXT
125   ENDPROC
```

Program name

Alan Went,
Colchester,
Essex.

ZX-81

EVERYONE MUST at some time have recorded a program on tape and forgotten to label the cassette. To find out what the program is, it must be loaded, which on the ZX-81 with a full 16K program can take 10 minutes. This routine, which takes up about 90 bytes, will read the name that you gave the program, in a few seconds, without loading it, and without destroying the existing program.

The routine is a modified version of the ZX ROM Load routine, but whereas the ROM only uses the name to compare the program on tape against the program name given after Load. I have modified it to print the name on the screen.

Line 1 consists of a Rem line containing 74 characters into which Lines 10 to 70 Poke the machine-code routine. After running the program as listed Lines 10 to 70 should be deleted and Line 10 added:

10 RAND USR 16514

To use the routine start the tape-player then Run. The normal waiting-to-load pattern will appear on the screen. A few seconds after the program load patterns appear, the program will stop with the program name on the screen.

It is advisable to keep the name as short as possible but up to 90 characters can be used.

Note that Line 10 in machine-code loader is:

10 LET A$ = "CD230FCD8A4018FB0E0106003E7FDBFED3FF1FD2A2031717381110F1F1CD8A40CB7A792001D71730F4181DD51E94061A1DDBFE17CB7B7B38F510F5D12004FE5630C83FCB1130C3C9C9S"

After running the program as listed, replace Lines 10 to 70 with:

10 RAND USR 16514

```
   1 REM LN ??LN ▒RND/ CLS :▀▄ Y
▒<= RETURN PEEK COPY 3ABS ▒▀*#S)
( LET LET LN ▒RNDACS ??4▀NOT *K
POKE /1STR$ 2▄▀,1<= RETURN *ACS
??S PRINT ( PRINT SGN 4▄ RETURN
?KCOS ZACS )K?TAN TAN
  10 LET A$="CD230FCD8A4018FB0E0
106003E7FD8FED3FF1FD2A2031717381
110F1F1CD8A40CB7A792001D71730F41
81DD51E94061A1DD8FE17CB7B7B38F51
0F5D12004FE5630C83FCB1130C3C9C9S
"
  20 LET X=16514
  30 IF A$="S" THEN STOP
  40 POKE X,16*CODE A$+CODE A$(2
)-476
  50 LET X=X+1
  55 PRINT A$( TO 2);"  ";
  60 LET A$=A$(3 TO )
  70 GOTO 30
```

Spiral clear

Gary Nugent,
Churchtown,
Dublin, Eire.

ZX-81

SPIRAL CLS was written for a 16K ZX-81. It clears a 22 by 32 screen. The screen is first filled by a spiral of inverse spaces, and then by a spiral of spaces. The screen is then ready for output, the Print position having been reset to 0,0.

The routine is in machine code and is 91 bytes long. It should be entered into a line 1 Rem statement using any of the hexadecimal loaders that have been in previous issues of *Your Computer*. The code is not relocatable. Should you wish to move it, all the Call addresses will have to be changed.

This is a novel way to clear the screen and is faster than the system CLS when large amounts of memory and Scroll are in use.

Poking address 16599 with a value less than 192 increases the speed of the spirals. A larger value decreases the speed. To make the routine clear a 24 by 32 screen, do as direct commands:

POKE 16535,23 (21 for 22×32 screen)
POKE 16575,9 (11 for 22×32 screen)

The routine is called by Rand USR 16514.

```
3E 80                LD A,80
CD 93 40             CALL SPIRAL
3E 00                LD A,00
CD 93 40             CALL SPIRAL
01 00 00             LD BC,0000
CD F5 08             CALL PRINT AT
C9                   RET
2A 0C 40  SPIRAL     LD HL,(D-FILE)
0E 15                LD C,15
06 20                LD B,20
50        AGAIN      LD D,B
23        LOOP 1     INC HL
77                   LD (HL),A
CD D5 40             CALL PAUSE
15                   DEC D
20 F8                JR NZ,LOOP 1
05                   DEC B
59                   LD E,C
C5                   PUSH BC
01 21 00             LD BC,0021
09        LOOP 2     ADD HL,BC
77                   LD (HL),A
CD D5 40             CALL PAUSE
1D                   DEC E
20 F8                JR NZ,LOOP 2
C1                   POP BC
0D                   DEC C
50                   LD D,B
2B        LOOP 3     DEC HL
77                   LD (HL),A
CD D5 40             CALL PAUSE
15                   DEC D
20 F8                JR NZ,LOOP 3
5F                   LD E,A
78                   LD A,B
FE 0B                CP 0B
C8                   RET Z
7B                   LD A,E
05                   DEC B
59                   LD E,C
C5                   PUSH BC
01 21 00             LD BC,0021
ED 42     LOOP 4     SBC HL,BC
77                   LD (HL),A
CD D5 40             CALL PAUSE
1D                   DEC E
20 F7                JR NZ,LOOP 4
C1                   POP BC
0D                   DEC C
18 C5                JR AGAIN
F5        PAUSE      PUSH AF
3E C0                LD A,C0
3D        LOOP 5     DEC A
20 FD                JR NZ,LOOP 5
F1                   POP AF
C9                   RET
```

Double-height

Paul Evans, Clapton-in-Gordano, Avon.

SPECTRUM

THIS PROGRAM produces double-height characters from a 48K Spectrum.

Line 5 changes RAMtop to reserve memory for the new character sets. There are two new sets, one for the top half of each character, and one for the bottom half.

Lines 10 to 110 load the two character sets above RAMtop. This part of the program only needs to be run when the program is loaded: it does not have to be run each time a double-height character is printed.

Lines 9800 to 9920 print out text contained in a$ in double-height characters. Note that a$ should contain only ASCII characters, i.e., those with a value less than 128.

If you own a 16K Spectrum the following changes have to be made: 63830 in line 5 has to be altered to 31062; 63831 in lines 100 and 9820 changes to 31063; and 64599 in line 9830 changes to 31831. To print the text loaded into a$ type Gosub 9800.

I have discovered that the command Open# 2,"p" causes all text created by a Print statement or List command to be diverted from the TV screen to the printer. Sometimes this is more useful than keying LPrint to use the printer. The statement Close# 2 makes things revert to normal.

```
   1 REM *** Double height ***
   5 CLEAR 63830
  10 FOR x=0 TO 95
  20 FOR c=0 TO 3
  30 POKE FN a(0),FN b(0)
  40 POKE FN a(1),FN b(0)
  50 POKE FN a(768),FN b(4)
  60 POKE FN a(769),FN b(4)
  70 NEXT c
  80 NEXT x
  90 STOP
 100 DEF FN a(z)=z+2*c+x*8+63831
 110 DEF FN b(z)=PEEK (15616+x*8
+c+z)
9800 DIM p$(32)
9810 LET p$=a$
9820 LET chars=63831: GO SUB 990
0: PRINT p$
9830 LET chars=64599: GO SUB 990
0: PRINT p$
9840 IF LEN a$<=32 THEN LET char
s=15616: GO SUB 9900: RETURN
9850 LET a$=a$(33 TO )
9860 GO TO 9800
9900 POKE 23606,chars-256*INT (c
hars/256)
9910 POKE 23607,(INT (chars/256)
)-1
9920 RETURN
```

Magic circle

Stephen Skinner, Billingham, Cleveland.

DRAGON

THIS PROGRAM for the standard 32K Dragon demonstrates the use of the circle command. Four circles are drawn, each at a 90° displacement. In turn, each radius of the four circles decreases by a small amount until they form point. Sound is also included to add a bit of sparkle to the demonstration.

```
30 A=135:B=255:PMODE4,1
40 PCLS:SCREEN1,1:X=211
50 Y=96:R=443:X1=44
60 Y1=96:R1=43:X2=128
70 Y2=43:R2=43:X3=128
80 Y3=149:R3=43
90 CIRCLE (X,Y),R
100 CIRCLE (X1,Y1),R1
110 SOUND A,1:A=A+2
115 SOUND A+1,1
120 CIRCLE (X2,Y2),R2
130 CIRCLE (X3,Y3),R3
140 SOUND B,1:B=B-2
145 SOUND B-1,1
150 X=X-4:X1=X1+4:R=R-1
:R1=R1-1:Y2=Y2+3:R2=R2-1
:Y3=Y3-3:R3=R3-1
160 IF Y2>169 THEN 180
170 GOTO 90
180 FOR M=3 TO 4
190 FOR D=1 TO 700:NEXT
D:PMODE M,1:SCREEN 1,0
195 NEXTD
200 NEXT M
210 GOTO 180
```

Mystery

Allister Dann, Sleaford, Lincolnshire.

ZX-81

THESE PROGRAMS are for the 1K ZX-81 alone. Tempting as they might seem to 16K owners, the RAM pack must be removed.

Program 1 should be entered first and then Run. When the inverse L appears, enter 62,–166,237,71,201 where the commas represent Newline.

You will have to try it to see what this program does, because it is very hard to describe. Suffice to say it produces graphics never before seen on a ZX-81.

Enter program 2 very carefully, and use Run 100.Then,wait. The screen is filled with peculiar characters. Wait until three-quarters of the screen is filled, and then Wham!

To revert to the normal graphics mode, use New. Repeat this procedure, changing the –166 to –122 for even more spectacular results.

The cleverer ones amongst you will have realised that program 1 can be entered as a series of direct Poke commands. The format I have used is simply the one I like best. For fun, trying changing the –122 to another number.

Program 3 was discovered by accident. The Poke command gives you 34 columns as opposed to the standard 32. Use line 1 with other programs to increase screen size.

```
10 FOR A=17000 to 17004
20 INPUT I
30 POKE A,I
40 NEXT A
50 LET C=USR 17000
Enter 62,–166,237,71,201.
```

Program 1.

```
100 LET A=INT(RND*255)+1
200 PRINT CHR$ A;
300 GOTO 100
```

Program 2.

```
10 POKE 16441,20
20 PRINT "AB"
30 GOTO 10
```

Program 3.

Scroll clear

Ian Bland, Northampton.

ZX-81

WHILE MESSING AROUND with my 16K ZX-81 I found a way to make the screen Clear quickly after Scrolling. Normally, a CLS command or a return to non-Scrolled Printing takes a long time because the display has to be padded out with spaces on the expanded machines. This program will illustrate this:

```
10 FOR N=1 TO 22
20 SCROLL
30 PRINT"TEST"
40 NEXT N
50 CLS
```

See how long the CLS command takes. The trick is to artifically pad the display file on each scroll, by using a Tab to move the Print position to the end of the line. To show this, change line 30 in the program to:

```
30 PRINT"TEST"; TAB 31;
```

and Run the program again. By forcing the ZX-81 to print a full line of 32 spaces each time, the display file remains intact. ■

COMPETITION CORNER

CAT-FIGHTER

BY ANTHONY ROBERTS

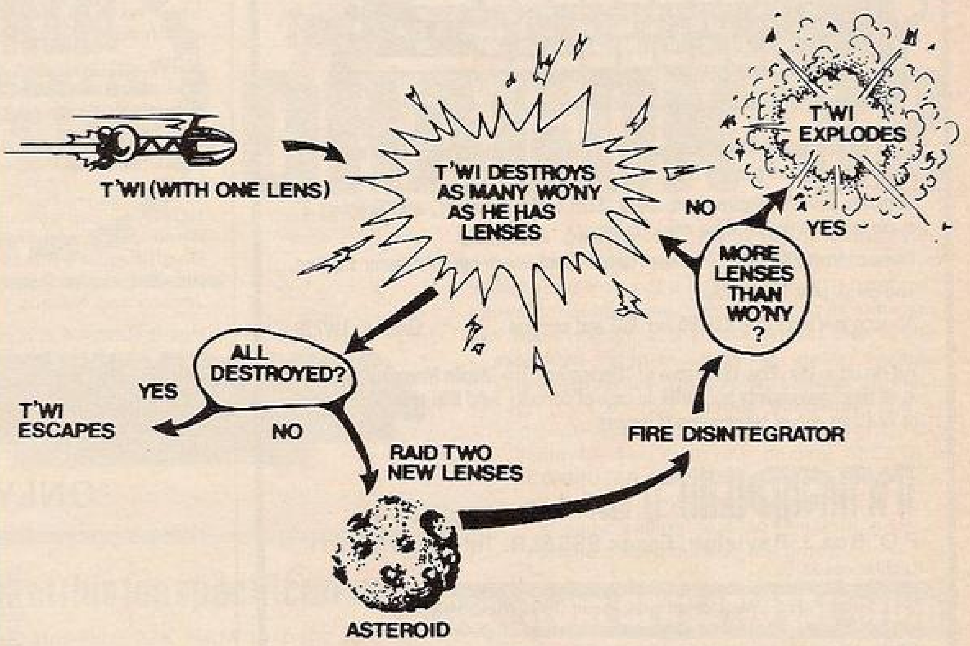
CAPTAIN T'WI is on a suicide mission inside the automated Wo'ny defence zone, with the entire force of between 2,000 and 2,100 homing cat-fighters after him.

T'wi has only a single-lensed F'lix disintegrator to start with, but fortunately every time it is used to destroy a cat-fighter the resultant sub-etheral interference disables the rest of the force just long enough for T'wi to raid the Wo'ny supply asteroid and pick up two more lenses and fix them to his disintegrator. The weapon will destroy as many cat-fighters as it has lenses. Unfortunately, any lens not aimed at a cat-fighter, but which hits one, automatically self-destructs — taking everything within 100 square AUs with it. Two lenses aimed at the same cat-fighter have the same effect.

Of course, T'wi makes it out after totally destroying the cat-fighter force; and gets the maximum number of precious F'lix lenses: how many cat-fighters, and lenses? Here's a chart of the action.

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 November. The name of the winner, the solution, and a competition report will be published in the January, 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

WE RECEIVED more than 100 correct entries for September's Jailbreak problem — considerably more than in previous months. There were in fact three solutions: entry at 00.03 hours for an escape with one prisoner, entry at 00.21 hours for two prisoners, entry at 15.40 for three prisoners. Most people reasonably assumed that the preferred solution was the one in which the most prisoners were released.

Some entries took a mathematical approach, based on the fact that the number of beads must be the sum of an arithmetical progression. But most programs simply searched for those times that fulfilled all the conditions.

We considered programs that contained two loops, for hours and minutes, neater than programs that used a single loop, Time = 0 to 23.59, since the latter tests non-existent times like 12.70.

From the handful of entries which took the first line we awarded the £15 book token to S Beadle, 44 Mendip Avenue, Hillcroft Park, Stafford ST17 0PG. He noted that his ZX-81 took just over eight minutes to solve the problem in Fast mode.

Our September competition for a NewBrain computer asked entrants to complete the sentence "I need a Newbrain because . . ." and large number of entries complained that their old brains were worn out with the effort of solving the crossword. Other pleas were that their brains were too small, unable to cope, storm-damaged, jaded, bug-ridden, out of memory, over-taxed and crashed.

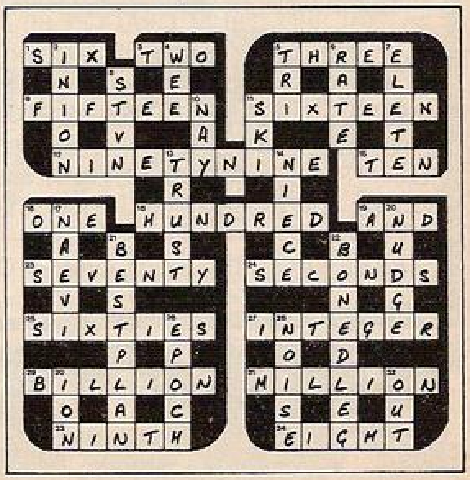
A Morgan put it this way: "My old brain can't take the strain of failing again"; while C Shires reported with disarming candour "My present one cannot think up witty slogans to win competitions". Moved by such plaintive cries, we gave the prize to M White, 41 Monville Road, Fazakerley, Liverpool L9 9DE, who wrote "It's probably my last chance to get a head in computing".

Several people needed a NewBrain because as P Marfell said "This is the age of the Brain"; D Lewis confessed "I have a mania for such crania" and D Bull revealed that "Igor dropped the last one on the laboratory floor".

```
5    REM JAILBREAK SOLUTION BY S.BEADLE
10   FOR H = 1 TO 24
20   FOR M = 0 TO 59
30   LET P = 1
40   LET G = 0
50   LET B = M + 100*H
60   LET B = B - G
70   IF B > 0 THEN GOTO 200
80   IF B = 0 THEN GOTO 100
90   LET G = G + 1
95   GOTO 60
100  LET P = P + 1
110  IF P = G THEN GOTO 150
120  LET B = G
130  LET G = 0
140  GOTO 60
150  PRINT H;"HRS.";M;"MINS.";P;"PRISONERS"
160  STOP
200  NEXT M
210  NEXT H
VARIABLES: M = MINUTES    H = HOURS  G = GOLD COINS
           B = BEADS      P = PRISONERS
```

S Beadle's program to solve the Jailbreak problem.

Solution to the September crossword.



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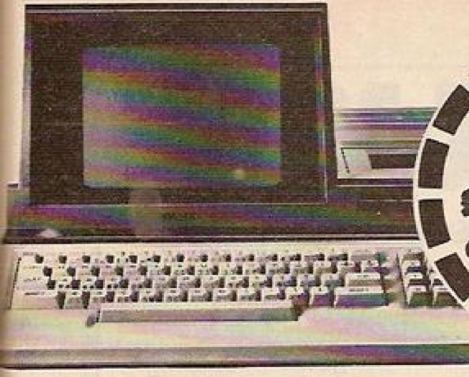

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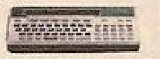

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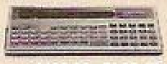

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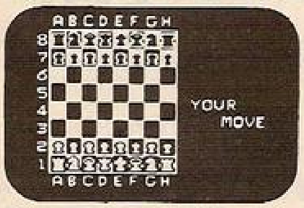

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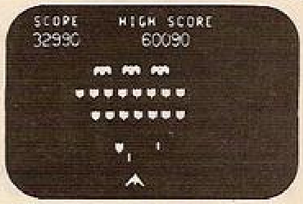

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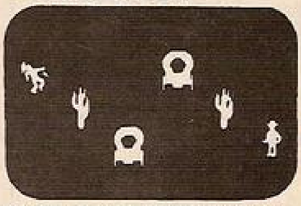

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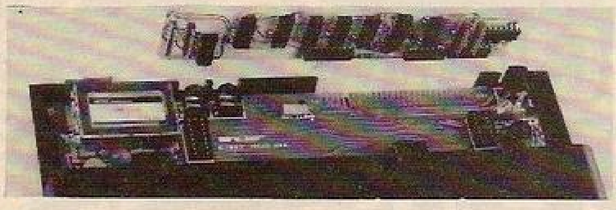

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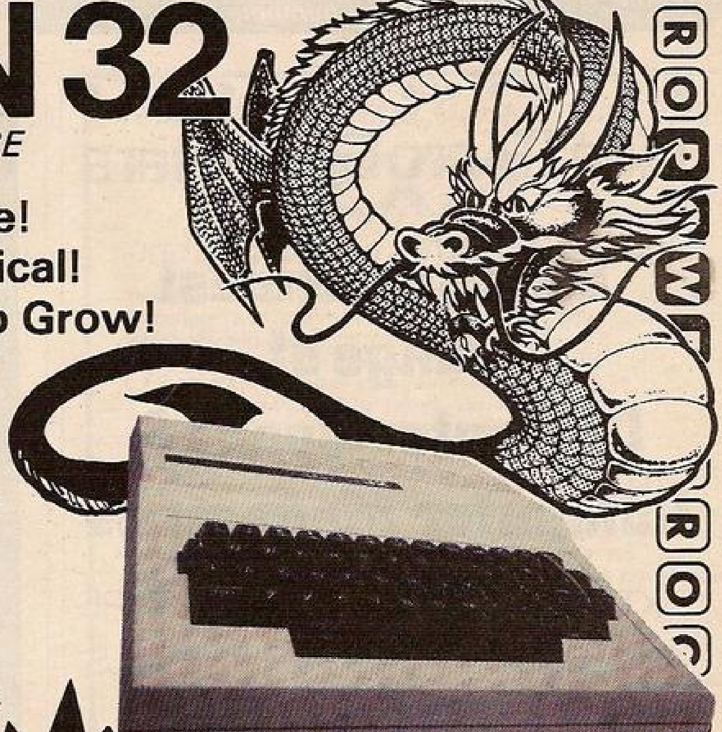

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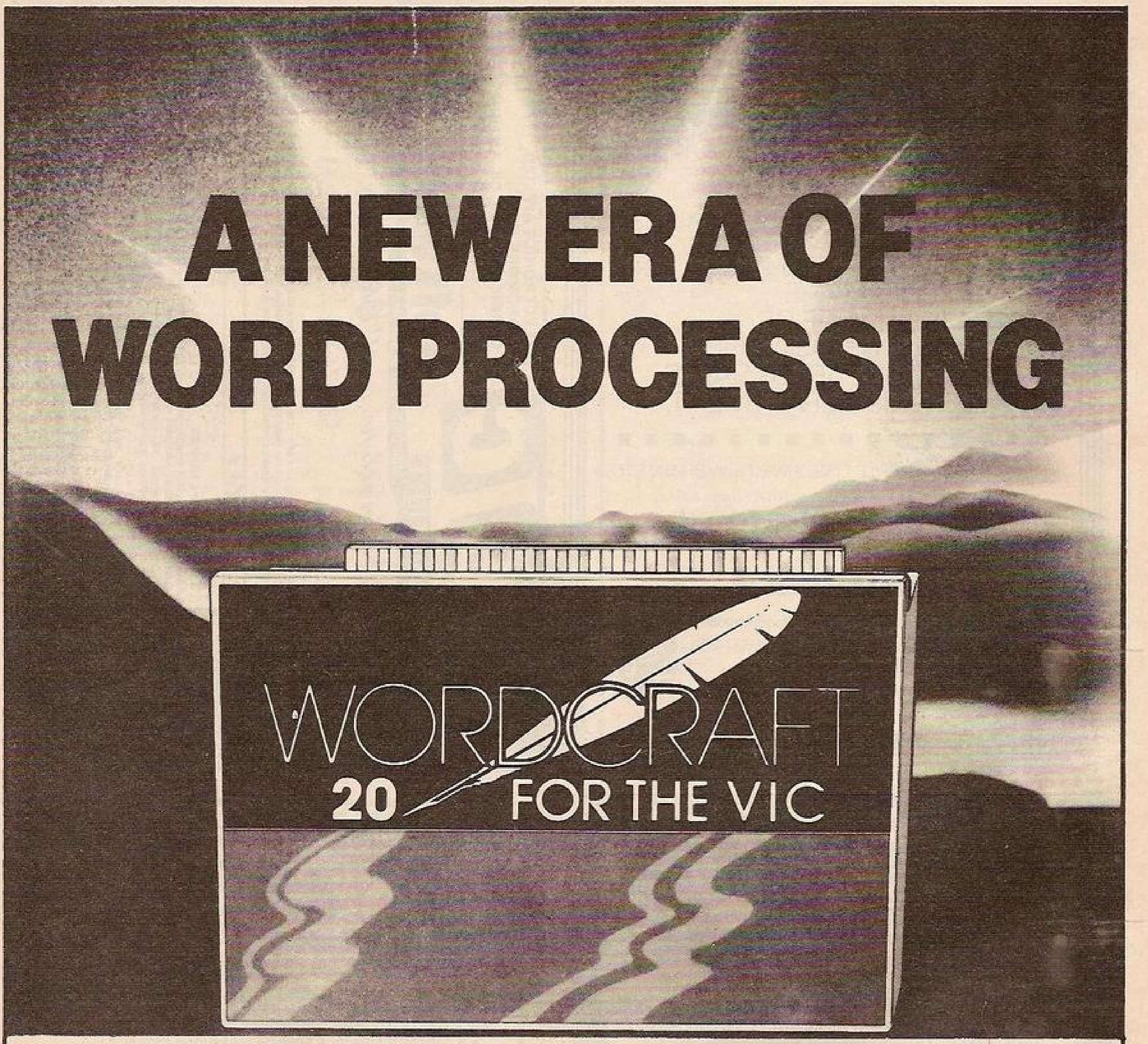

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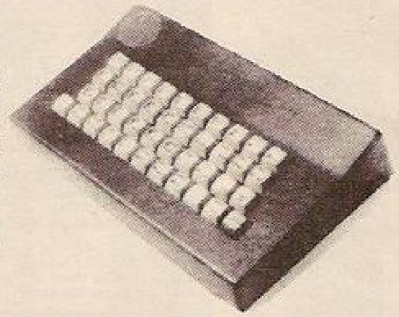

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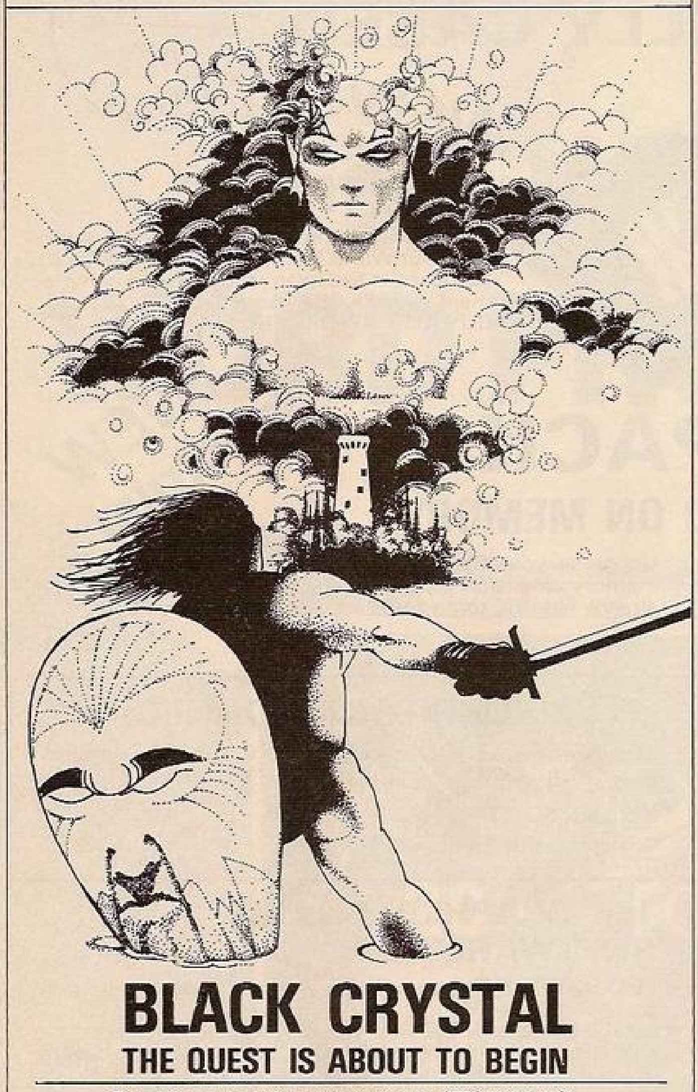

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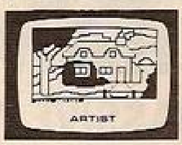

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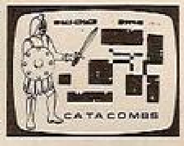

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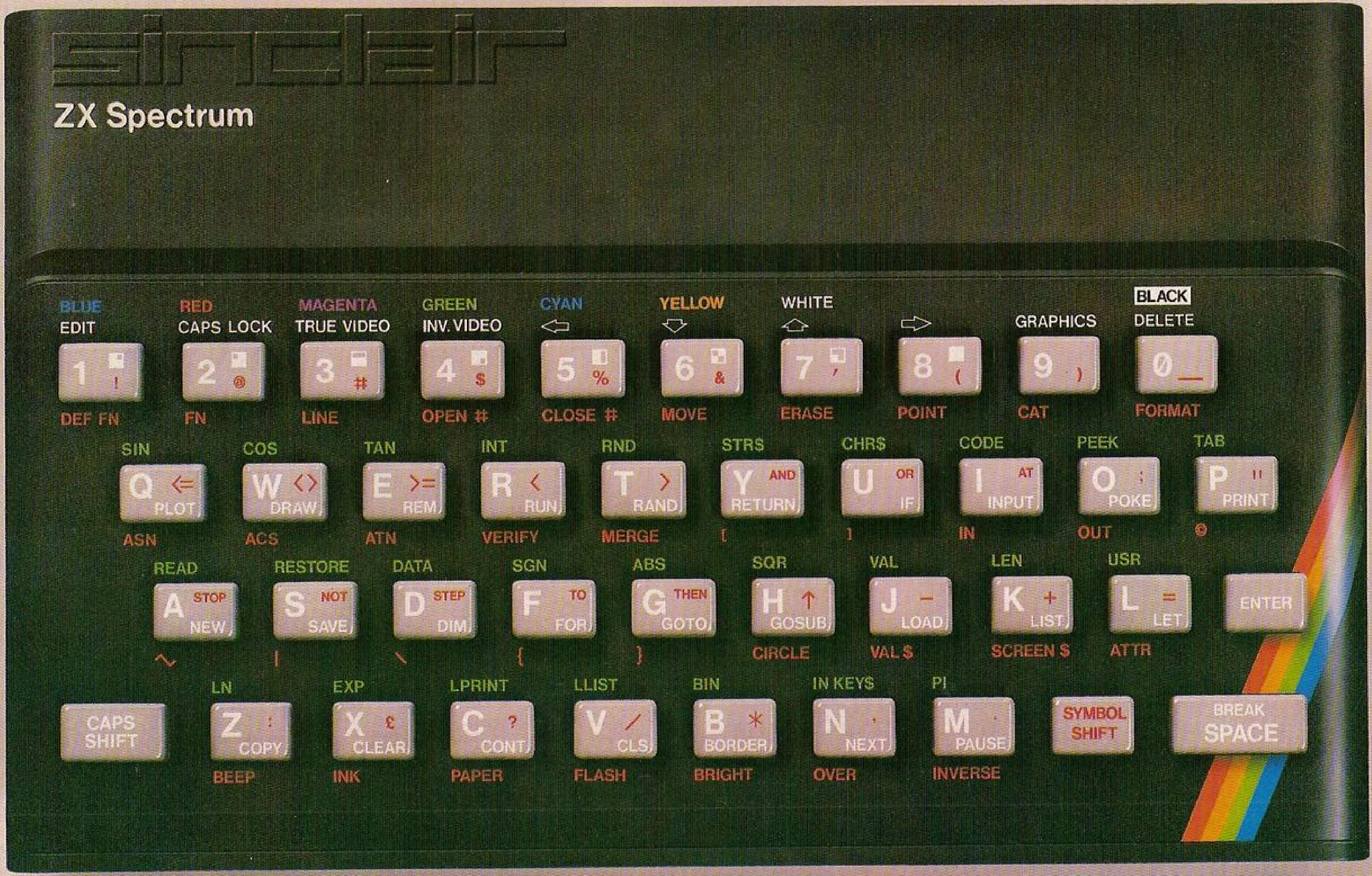
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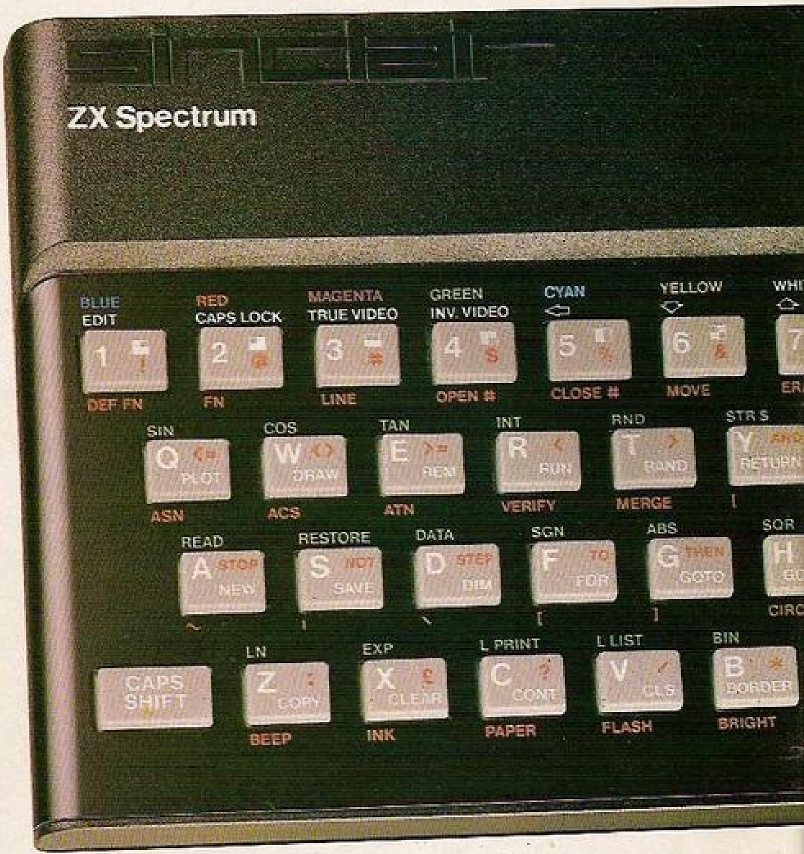

First, there was the world-beating Sinclair ZX80. The first personal computer for under £100.

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Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

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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.
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- Massive RAM – 16K or 48K.
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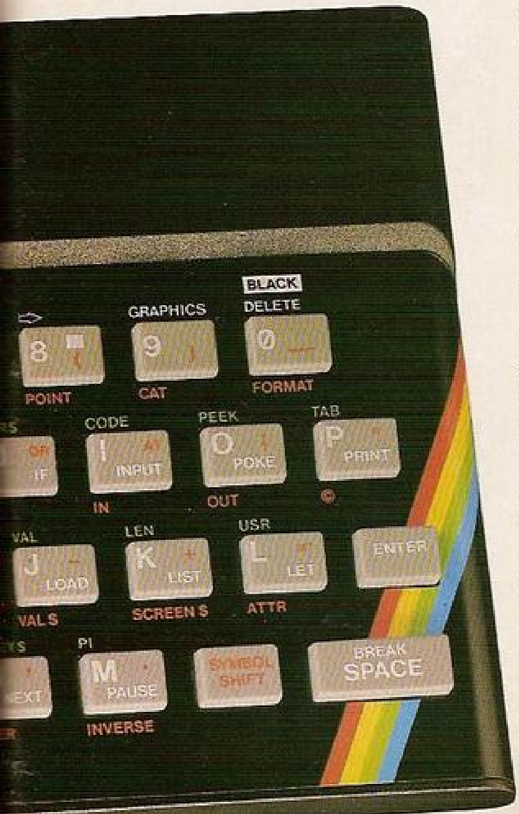

The ZX Printer – available now

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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A remarkable breakthrough at a remarkable price. The Microdrives are available later this year, for around £50.

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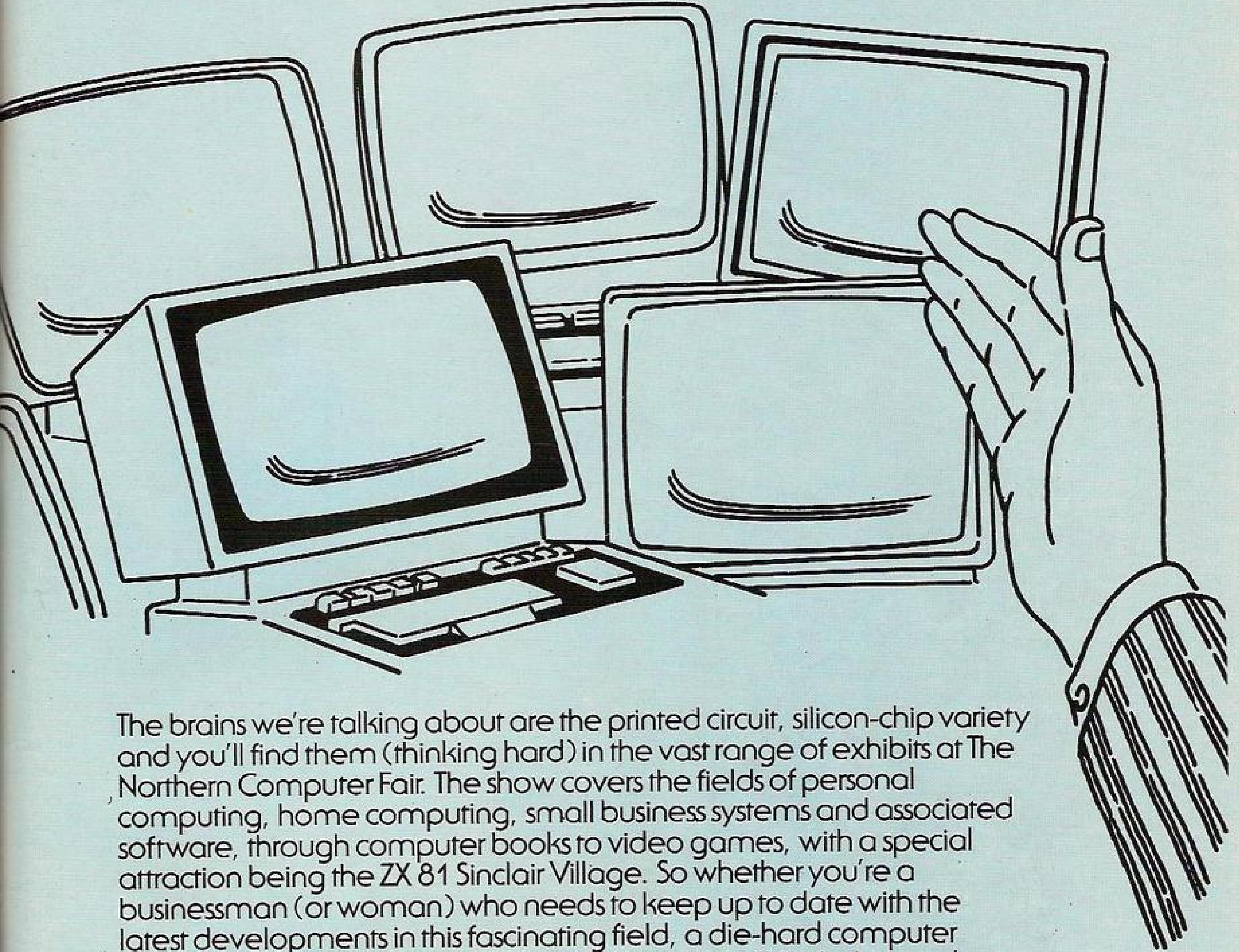

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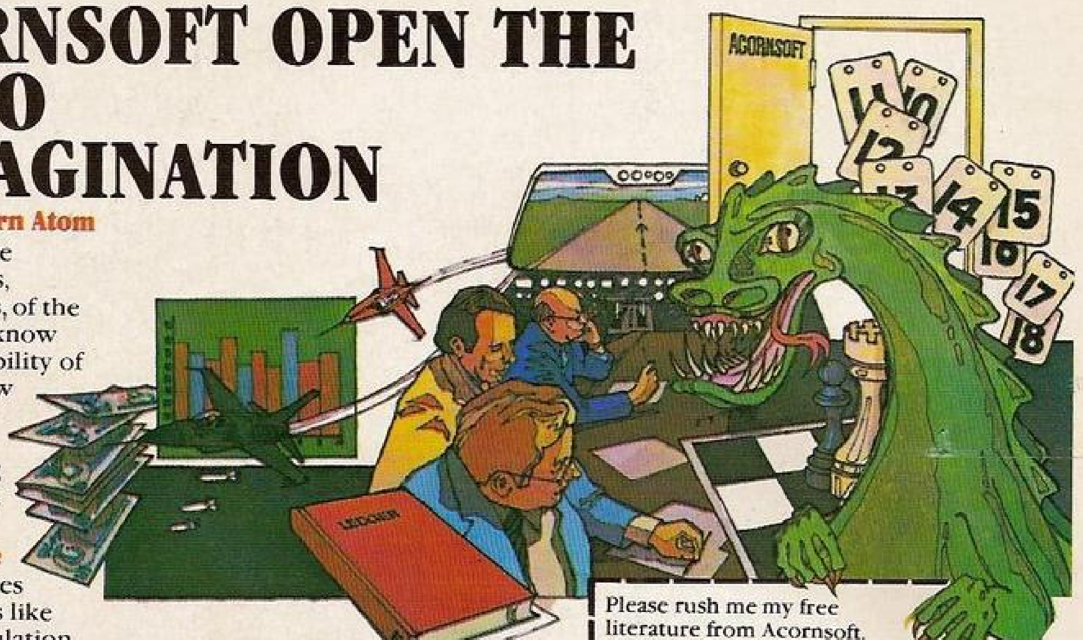

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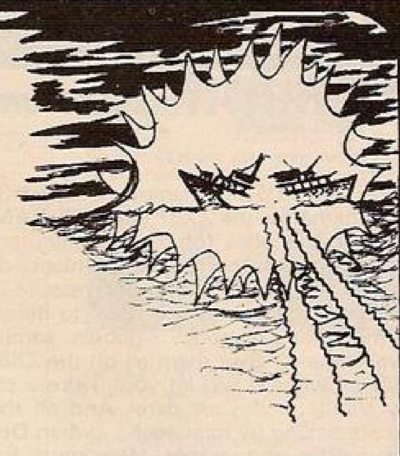

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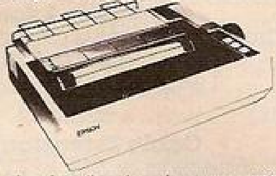

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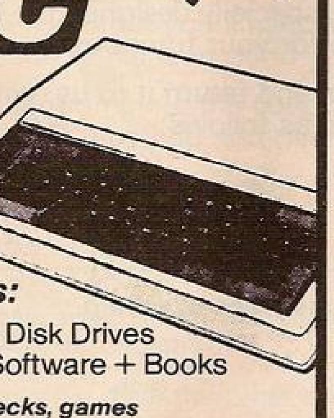

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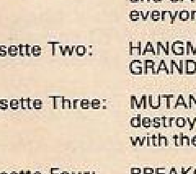

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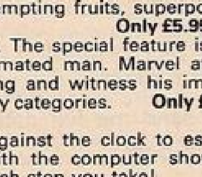

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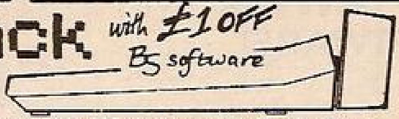

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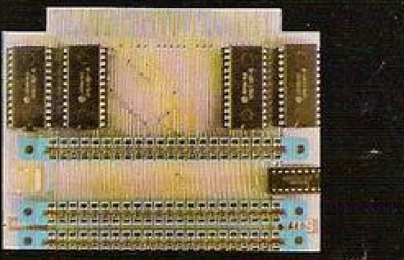

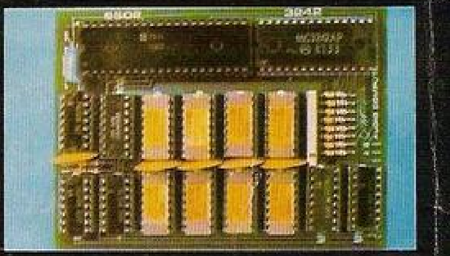

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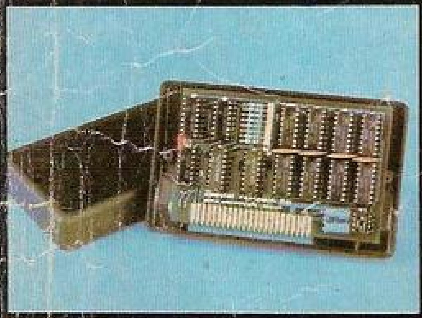

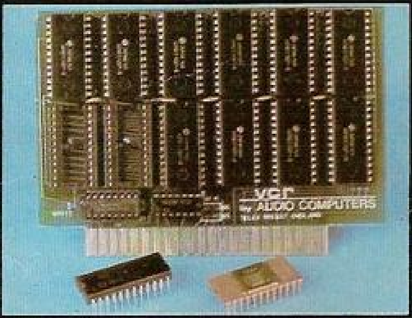

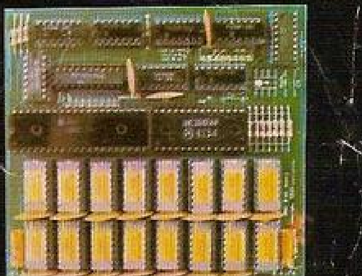

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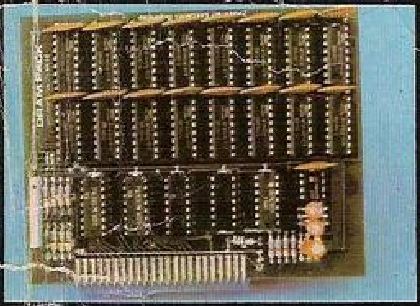

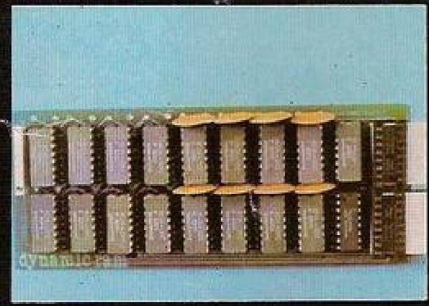

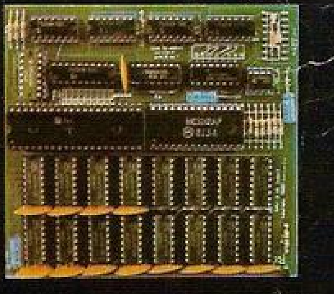

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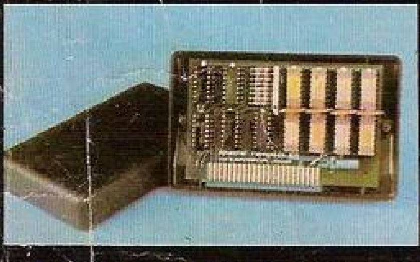

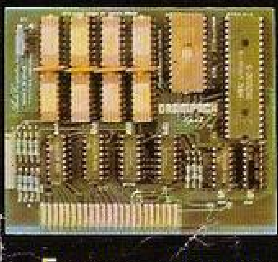

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