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Vol. 3 No. 4

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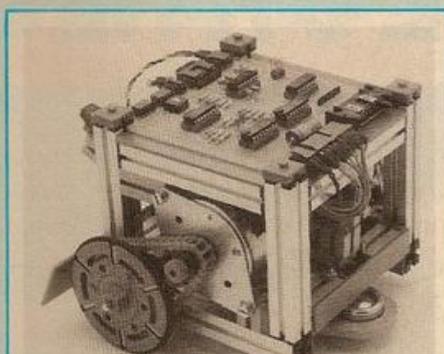
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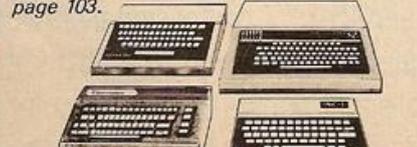
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MACHINE CODE

Cover photograph by Stephen Oliver

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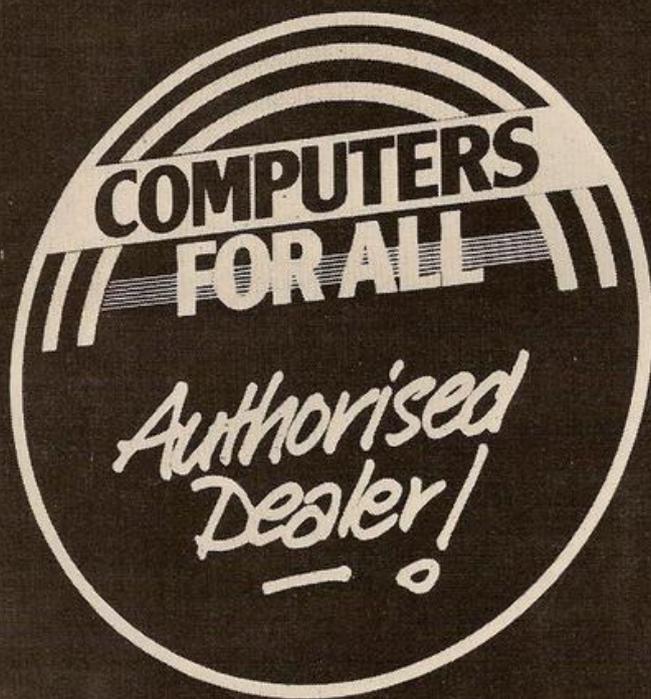
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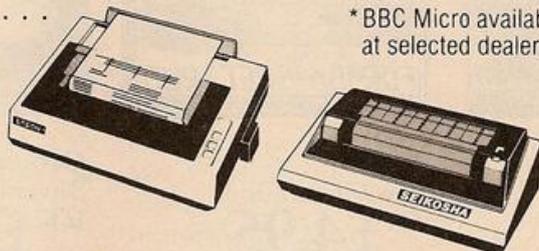
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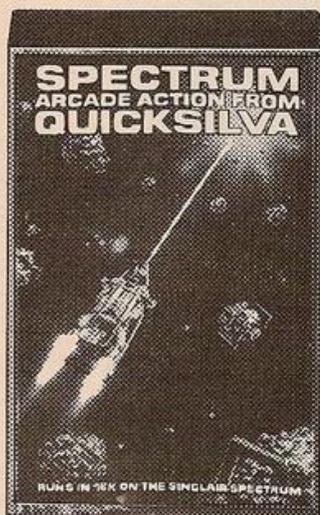
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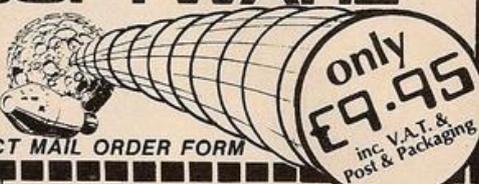
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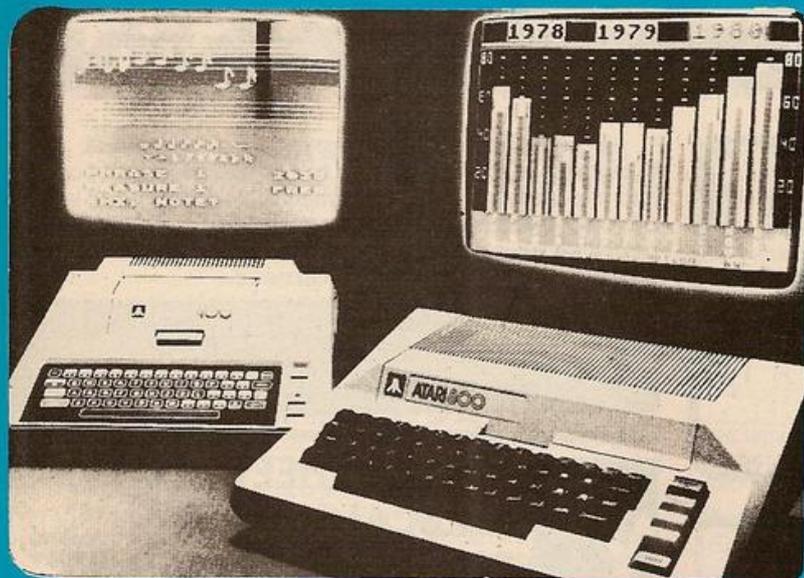
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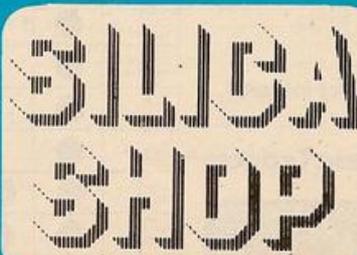
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Compatible with most micros. See table. Runs a complete home finance package for you with every facility necessary for keeping a track of regular and other expenses, bank account mortgage, H.P. etc. This program also allows you to plot graphically by Histograms your monthly outgoings.



WORD PROCESSOR . . . £19.95

Compatible with most micros. See table. This program features routines found in much larger and more expensive packages with a typical word length of 5-6 letters it allows for around 1000 words in memory at one time. Ideal for the user who requires a simple program to write letters on his computer. Features include, block delete, block insert, search and replace, edit text, display text and more.

Dealer/Trade enquiries invited — generous trade discounts for quantity
Special ACCESS card instant sales hotline Tel: 03952-5165
 for **GUARANTEED** despatch within 24 hours . . .
 24 hr Ansaphone Service.

All enquiries other than credit card sales to 03952-5832

Gemini. Functional Software Specialists. 9, Salterton Road, Exmouth, Devon.

Tick the box for Program you require. Prices include V.A.T. and Package and Postage.
 Please supply the following cassette software.

Database	£19.95	<input type="checkbox"/>	ZX81 16K Database	£9.95	<input type="checkbox"/>
Stock Control	£19.95	<input type="checkbox"/>	BBC Cash BOOK disk or tape	£95.00	<input type="checkbox"/>
Mailing List	£19.95	<input type="checkbox"/>	BBC Disks — other titles	£23.95	<input type="checkbox"/>
Invoices and Statements	£19.95	<input type="checkbox"/>	Osborne Disk Database	£23.95	<input type="checkbox"/>
Commercial Accounts	£19.95	<input type="checkbox"/>	Word processor	£19.95	<input type="checkbox"/>
Home Accounts	£19.95	<input type="checkbox"/>	Beebcalc	£19.95	<input type="checkbox"/>
			Dragoncalc	£19.95	<input type="checkbox"/>

Name _____

Address _____

Machine Type _____

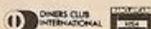
Memory Size _____

I enclose _____

Make cheques and postal orders payable to Gemini Marketing Ltd.

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Signature _____

Gemini. Functional Software Specialists, 9 Salterton Road, Exmouth, Devon.



Push your Sinclair to the limit

ZX81/SPECTRUM ARCADE GAMES

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ZX INVASION FORCE (ZX81)

Use your skill to fire through the energy band to destroy the menacing alien ship — **£3.95**

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SPEC INVADERS SPEC GOBBLEMAN

These exciting high-speed classic games incorporate hi-resolution graphics and sound to bring you the best in arcade action at only **£4.95** each (16/48K)

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Hop across the dangerous road avoiding the lethal cars, then lorries. Go back to the wild west for a gunfight battle amongst cacti and wagons. Features include western music. **£4.95**

NEW

NAMTIR RAIDERS (ZX81)

High speed, quick action arcade game with four separate groups of attackers. **£3.95**

Gobbleman also available for ZX81 at **£3.95**

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Nine powerful new functions for your ZX81 (including re-number lines (goto, gosub), program merge, string finding and replacement). **£5.95**

SPEC BUG

A 30 in 1 machine code tool and disassembler for your ZX Spectrum. **£6.95**

ZX BUG

A 30 in 1 machine code tool and disassembler for your ZX81. **£6.95**

Improve your machine code programs with this new 48K Spectrum Assembler

Just released by Artic, this new professional quality assembler is also available for 16K ZX81 and features:—

- * Word-processor-like text editor. * High-speed, versatile two-pass mnemonic assembler with labels and detailed error-trapping. Will assemble to any address.
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ONLY £9.95

ZX81 & SPECTRUM

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ADVENTURE GAMES

ONLY £5.95 for ZX81 and £6.95 for SPECTRUM

INCA CURSE (Adventure B)

In a jungle clearing you come across an ancient Inca temple. Your mission to enter, collect the treasure and escape alive. But beware! Includes a cassette save routine.

SHIP OF DOOM (Adventure C)

You are unavoidably drawn to an alien cruiser. Can you reach the control room and free yourself? Or will they get you first? Includes a cassette save routine.

ESPIONAGE ISLAND (Adventure D)

While on a reconnaissance mission your plane loses control and you are forced to land. Can you survive and escape with the island's hidden secret?

PLANET OF DEATH (Adventure A) 16/48K

You find yourself stranded on an inhabited alien planet. Can you reach your ship and escape?

also available for SPECTRUM

ZX FORTH

Supplied on cassette with editor cassette, user manuals and keyboard overlay. ZX Forth combines the simplicity of basic with the speed of machine code **now £14.95**

THE ULTIMATE ADVENTURE FOR THE SPECTRUM/ZX81 for only **£9.95**

AND THE CHANCE TO WIN **£10,000 or more** IF YOU **KRAKIT™**

RULES AVAILABLE FROM ARTIC



Your eccentric father has left you £10,000 in his will. In order to claim your windfall you must solve twelve clues and gain access to a bank account in which the money has actually been deposited. Be the first to crack the puzzle and the prize is yours! Plus you will win two tickets to the city of the secret KRAKIT™ vault location. The Prize money is increased weekly. A telephone number will be supplied so you have the opportunity to find out just how much you could win.

DON'T MISS YOUR CHANCE TO WIN A FORTUNE!

SPECTRUM MICRO CHESS

The only Chess program for a 16K or 48K Spectrum. Allows all legal moves, castling; en-passant and pawn promotion. Options to play black/white. Sets board in any position. Full colour and graphics display.

ONLY **£6.95**

new releases for 16K & 48K SPECTRUM

SPECTRUM INVASION FORCE

A popular arcade game for 16K or 48K Spectrum. Fires through the force field to destroy the menacing alien ship. Sounds easy?? Two levels of play — normal or suicidal. Full colour. Sound and hi-res. graphics.

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A GREAT CHESS GAME FOR YOUR ZX81 OR SPECTRUM™



*SPECTRUM CHESS 48K

ZX CHESS I

Very popular machine code program, with six levels of play and an analysis option. Available for ZX81. **£6.50**

ZX CHESS II

A new improved version, with a faster response time, seven levels of play, analysis option and in addition a recommended move option. **£9.95**

ZX 1K CHESS

An incredible game in 1K for only **£2.95**

As featured on ITV



SPECTRUM VOICE CHESS

This incredible program talks you through your game.

It tells you its move, recommends a move, and contains a range of facetious comments. The game is based on the highly successful ZX Chess II and is offered at the Christmas offer price of **£9.95**.

SPECTRUM CHESS now only £9.45

ALWAYS AHEAD WITH ZX81/SPECTRUM SOFTWARE

Cheques & P.O. made payable to: Artic Computing Limited. Dealer enquiries welcome.

Please state whether your order is for ZX81 or Spectrum. Send S.A.E. (6in x 9in) for catalogue.



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TELEWRITERTM

the DRAGON 32 Word Processor

TELEWRITER

Telewriter is the powerful word processor designed specifically for the DRAGON 32 Computer. It can handle almost any serious writing job and is extremely easy to use. It has all the advanced features you need to create, edit, store, format and print any kind of text. With Telewriter you can quickly produce perfect, finished copy for letters, reports, term papers, articles, technical documentation, stories, novels, screenplays, newsletters. It is also a flexible and efficient way to take notes or organize ideas and plans.

51 x 24 DISPLAY

The DRAGON 32 is an incredibly powerful and versatile computer, but for text editing it has some major drawbacks. The small 32 character by 16 line screen format shows you too little of the text and, combined with its lack of lower case letters, bears little resemblance to the way text really looks on the page. Reverse video in place of lower case just adds confusion.

Telewriter eliminates these shortcomings with **no hardware modifications required**. By using software alone, Telewriter creates a new character set that has **real lower case letters**, and puts 24 lines of 51 characters on the screen. That's more on-screen characters than Apple II, Atari or TRS-80 Model III. That's more than double the DRAGON 32's standard display.

FULL SCREEN EDITOR

The Telewriter editor is designed for maximum ease of use. The commands are single key (or single key plus control key), fast, and easy to remember. There is no need to switch between insert modes and delete modes and cursor movement modes. You simply type. What you type is inserted into the text at the cursor, on the screen. What you see on the screen is always the current state of your text. You can move quickly through the text with one key cursor movement in all 4 directions, or press the shift key simultaneously for fast, auto-repeat. You can jump to the top or bottom of the text, and beginning or end of a line, move forward or backward a page at a time, or scroll quickly up or down. When you type past the end of the line, the wordwrap feature moves you cleanly to the next.

You can copy, move or delete any size block of text, search repeatedly for any pattern of characters, then instantly delete it or replace it with another. Telewriter gives you a tab

... truly a state of the art word processor ... outstanding in every respect

- The RAINBOW, Jan. 1982

The only one with all these features for your DRAGON 32

51 column x 24 line screen display
Sophisticated full-screen editor

Real lower case characters

Powerful text formatter

Works with any printer

Special MX-80 driver

Requires absolutely

no hardware modifications

★ Tandy colour version

also available

key, tells you how much space you have left in memory, and warns you when the buffer is full.

FORMAT FEATURES

When it comes time to print out the finished manuscript, Telewriter lets you specify: left, right, top, and bottom margins, line spacing and lines per page. These parameters can be set before printing or they can be dynamically modified during printing with simple format codes in text.

Telewriter will automatically number A4 pages (if you want) and centre lines. It can chain print any number of text files from cassette without user intervention. You can tell it to start a new page anywhere in the text or pause at the bottom of the page.

You can print all or any part of the text buffer, abort the printing at any point, and there is a "Typewriter" feature which allows you to type straight to your printer. Because Telewriter lets you output numeric control codes directly (either from the menu or during printing), it works with any printer (Tandy, Seikosha, MX-80, Okidata, NEC 8023, C. Itoh 8510, Centronics, GE Terminus, Smith Corona TP-1, etc.).

There's even a special driver for the Epson MX-80 that lets you simply select any of its 12 fonts and do underlining with a single underline character.

CASSETTE INPUT/OUTPUT

Because the Telewriter makes using cassette almost painless, you can still have a powerful word processor without the major additional cost of a disk. The advanced cassette handler will search in the forward direction till it finds the first valid file, so there's no need to keep retyping a load command when you are lost in your tape. The Verify command checks your cassette save to make sure they're good. You can save all or any part of the text buffer to cassette and you can append pre-existing files from those you have in the buffer already.

ASCII COMPATIBLE

Telewriter turns your DRAGON 32 into the most powerful, lowest cost, word processor in the world today. But that's not all. The simple ASCII conversion program provided with Telewriter means you can use the full power of the Telewriter editor for creating and editing BASIC and assembly language programs. It means you can use Telewriter to prepare or edit text files used with any data communications program.

Telewriter costs £49.95 on cassette and is

**AVAILABLE FROM
DRAGON 32
DEALERS
NATIONWIDE
OR DIRECT FROM
MICRODEAL**

**41 TRURO ROAD, ST. AUSTELL,
CORNWALL PL25 5JE
24 HOUR ORDERLINE 0726 67676**



**SEND FOR OUR FREE
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DRAGON 32 & TANDY
RANGE OF COMPUTERS.
PLEASE STATE WHICH
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Name _____

Address _____

Make / type of computer _____

Please include a 1st Class Stamp

*... one of the best programs for the Color
Computer I have seen ...*

- Color Computer News, Jan. 1982

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SPECTRUM

NEWS from SPECTRUM

ATARI 800

This proven and tested micro is now **UPGRADED** to 48K RAM and there's **no increase in price** either which must make it **about the best value around**. See our ad. for further details.

ATARI 400

Now **REDUCED** by a **MASSIVE £39** to an **incredible price of only £159.95** from Spectrum.

SINCLAIR ZX SPECTRUM

We have now added the super **SINCLAIR ZX SPECTRUM 16K** and **48K** Models to our range - check our ad. for further details.

NEW SPECTRUM MEMBERS

Check our address page! - there are many new **SPECTRUM** dealers throughout the UK so there's a good chance there'll be a **SPECTRUM** centre very near you.

STOCKS

The general stock situation has now improved and you'll find that most **SPECTRUM** centres will be able to supply you **immediately** and at **super LOW** prices too!

INTRODUCING SPECTRUM FACTS!

Next to many of our offers, you'll find a few lines tagged **SPECTRUM FACTS**. We pride ourselves on providing you, the customer, with a **genuine service** as well as **super LOW** prices, and we want you to know that when you buy from a **SPECTRUM** dealer, you'll get **exactly the right Micro** for your needs. **SO LOOK OUT FOR YOUR SPECTRUM FACTS!**

After Sales care

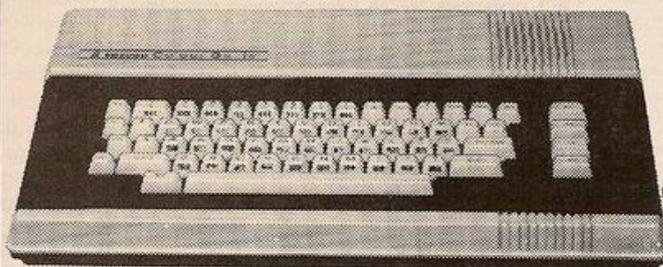
SPECTRUM service centres will ensure that should your machine 'go-down' we will get it running again as quickly as possible. We also offer **extended warranties** at reasonable prices too! - ask your **SPECTRUM HOME COMPUTER CENTRE** for full details.

COMPUTER DEALERS!

(or prospective Computer Dealers!) If you would like to know more about becoming a **SPECTRUM APPOINTED DEALER** on an exclusive area basis, please write to **MIKE STERN, Spectrum (U.K.) Ltd., Burrowfield, Welwyn Garden City, Herts.**

COLOUR GENIE

A truly reliable micro and highly recommended by Spectrum.



The new **COLOUR GENIE** features powerful and sophisticated **COLOUR GRAPHICS**, allowing you to create full 8-colour Games, Diagrams and Charts quickly and simply.

At its low **SPECTRUM** price, the Colour Genie is amazingly versatile - its **Powerful 16K RAM** memory (expandable internally to 32K) means **FULL COLOUR** video games and **POWERFUL COMPUTING** with a full range of inexpensive accessories: **16K RAM** pack, Joysticks for TV games, Light Pen, Disk Drive and a Printer.

But that's not all - the Colour Genie also features a **16K ROM** Memory with **128 Upper and Lower case Colour Graphics Characters** already stored, plus sound, a professional typewriter keyboard. In use, it's as straightforward as any, thanks to the use of **BASIC** language and direct keyboard accessed colour commands.

The superb Colour Genie is at **SPECTRUM** now - check it out and see the Genius at work!

Spectrum **LOW** Price
£224.48
Inc. VAT

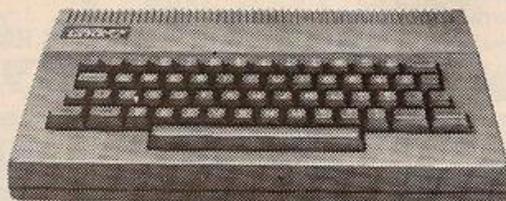
COLOUR GENIE ACCESSORIES

Joysticks	£49.49
16K RAM	£38.50
Printer Interface	£39.95
VISCOUNT Teach yourself Colour Genie BASIC	£6.95

SPECTRUM FACTS

Maximum user RAM	14,200 Bytes (approx)
Text Screen	24 x 40
High Resolution	160 x 96
Cassette Lead	Included

LYNX



Just look at this super new **LYNX** Micro - an incredible **16K+ 32K** video ram and that's expandable up to or beyond **96K**. For just **£225.00 INCLUDING VAT** the **LYNX** is exceptionally versatile. All **LYNX**'s 'add-on' connections are standard types. The high definition colour graphics make it a **top-value** choice for the home or office (with expansion, the **LYNX** can become an 80 characters-per-line word processor!) Take a look at the **LYNX** - a memorable bargain from **SPECTRUM**. But please phone to check stock position before making a journey as this new machine is bound to be in **great demand**.

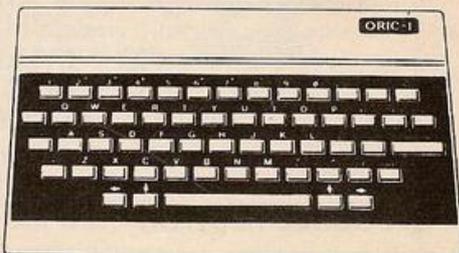
Spectrum **LOW** Price **£225.00**

VISCOUNT - Teach yourself **LYNX** BASIC £6.95

SPECTRUM FACTS

Maximum user RAM	13,700 Bytes (approx)
Text Screen	24 x 40
High Resolution	265 x 248
Cassette Lead	Included

ORIC-1

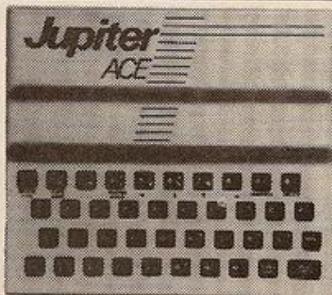


A superbly designed and engineered micro and great value-for-money from **SPECTRUM**. Offering **48K RAM** Colour - (8 foreground and 8 background can be displayed at same time) **High resolution graphics** User definable Graphics. Full sound (6 octaves of controllable sound.) Easy to use keyboard with moving keys. Standard Centronics parallel interface allows easy connection to a wide range of printers etc.

Spectrum **LOW** Price **£169.95**
Inc. VAT

SPECTRUM FACTS

Maximum user RAM	47,870 Bytes
Text Screen	28 x 40
High Resolution	240 x 200
Cassette Lead	Included



JUPITER ACE

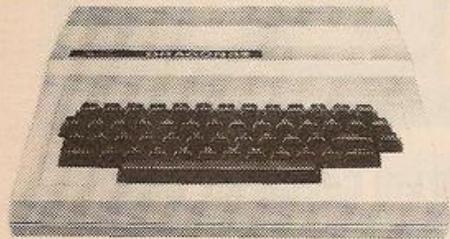
Outstanding value-for-money! The **JUPITER ACE** uses easy to understand **FORTH** language. Connects to your own TV. **3K** RAM expandable to **19K**. Full moving keyboard with auto repeat and caps lock. Full sound and chunky graphics. If you've wanted to learn an impressive Language then this is the machine for you.

Spectrum **LOW** price **£89.95** Inc VAT
£76.22 ex vat

SPECTRUM FACTS

Maximum user RAM	1,000 Bytes approx.
------------------	---------------------

HURRY! Limited stocks only- DRAGON



Unbelievable value at only £199.95 from SPECTRUM! British built and designed it's one of the most impressive micros to appear for quite some time. Extensive facilities include highly advanced colour graphics. Just look at this top specification: Powerful standard 32K RAM (expandable to 64K Bytes). ■ 9 Colour, 5 resolution Display. ■ Extended Microsoft colour BASIC (as standard). ■ Advanced sound with 5 octaves - 255 tones. ■ Professional style editing, e.g. extract line, auto find reinsert. ■ Professional quality keyboard. ■ Centronics Paralled printer interface. ■ Serious programmer/user - the BASIC on this machine is similar to that found on machines costing 3 times the price! ■ Uses almost any cassette recorder. ■ Standard file handling ON TAPE.

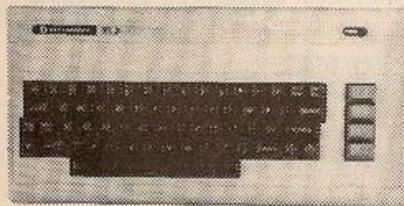
Spectrum LOW price
£199.95 INC. VAT

SPECTRUM FACTS

Maximum user RAM 29,679 Bytes
Text Screen 16 x 32
High Resolution 256 x 192
Cassette Lead Included

	EX VAT	INC VAT		EX VAT	INC VAT
ACCESSORIES					
Joysticks (pair)	£17.35	£19.95	Madness and the Minotaur	£6.91	£7.95
Cassette Lead	£2.35	£2.70	Examples from:		
CARTRIDGES					
Beserk	£17.35	£19.95	Dragon Manual	£6.91	£7.95
Cosmic Invaders	£17.35	£19.95	Personal Finance	£6.91	£7.95
Meteroids	£17.35	£19.95	Dragon Mountain	£6.91	£7.95
Ghost Attack	£21.70	£24.95	Typing Tutor	£6.91	£7.95
Cave Hunter	£17.35	£19.95	Black Sanctum	£6.91	£7.95
Starship					
Chameleon	£17.35	£19.95	VISCOUNT Software for DRAGON		
CASSETTES					
Calixto Island	£6.91	£7.95	Teach yourself Dragon Basic . . . £6.95		
Graphic Animator	£6.91	£7.95			
Quest	£6.91	£7.95			

Commodore VIC-20



Now a top quality home/business micro for the price of a games machine.
■ Memory expandable to 32K ■ High resolution (full PET type) graphics ■ 16 Screen colours and 8 border colours ■ Plugs in to your TV, or monitor ■ Add Disk Drive & Printer for impressive 170K Byte system ■ Can act as an intelligent terminal for a larger computer.

£129.90 INCLUDING VAT

SPECTRUM FACTS

Maximum user RAM 3,853
Text Screen 22 x 23
High Resolution 176 x 158
Cassette Lead Needs own Recorder

COMMODORE 64

Very limited supplies of this new micro now available - please check with your local SPECTRUM dealer before making a journey.

Spectrum LOW Price £345.00

VISCOUNT SUPER X2 64K DYNAMIC RAM PACK for VIC-20 EXCLUSIVE TO SPECTRUM!

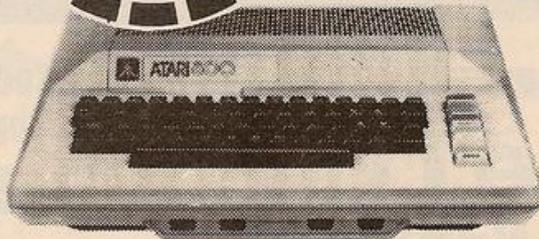
Unbelievable-but-true, now you can upgrade your VIC-20 from 3.5K to a massive 67½ RAM. Enables you to load up to 8 games or programs at a time & still select which one you wish to use. Can be used in conjunction with other expansions to increase total memory up to 152K-using the VIC memory expansion board. The SUPER X-2 will make your VIC-20 the biggest little micro in town!

Spectrum LOW price £114.94 INC. VAT

Now with
48K
RAM
and still at the same
LOW price!

ATARI 800

Now this proven and tested machine has been upgraded to a massive 48K RAM and it's still at the amazing LOW price of £399.99 from SPECTRUM. It's an ideal Home Micro for graphics, educational and personal finance etc, use and it will take you from learning up to small business use. You can add printers, program recorders, disk drives and more, to expand your micro as and when you want, to suit your needs. So if you're looking for a top-of-the-line micro you must see the ATARI 800 with 48K at SPECTRUM - NOW!



Spectrum LOW Price

£399.99 INC. V.A.T.

SPECTRUM FACTS Maximum user RAM 37,899 Bytes
Text Screen 24 x 40
High Resolution 320 x 192
Cassette Lead Needs own Recorder

ATARI 400 16K RAM



NOW ONLY £159.95 INC. VAT

BASIC cartridge extra
£39.99 inc. VAT
(£34.77 ex. VAT)

SPECTRUM FACTS

Maximum user RAM 13,323 Bytes (with basic Cartridge)
Text Screen 24 x 40
High Resolution 320 x 192
Cassette Lead Needs own Recorder

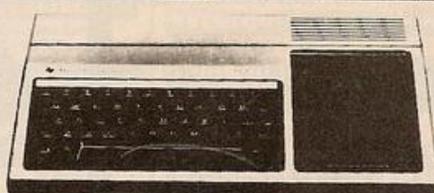
ATARI DISK DRIVE
£299.00 INC. VAT

ACCESSORIES, BOOK & GAMES for ATARI

	INC VAT		INC VAT
Accessories			
Thermal Printer	£198.95	European Countries & Caps	£14.99
16K RAM Pack	£65.00	Hangman	£14.99
400 Keyboard	£59.95	Kingdom	£14.99
32K RAM board (400/800)	£75.00	States & Capitals	£14.99
48K RAM board (400/800)	£99.00	Touch Typing	£19.99
Paddles (Pair)	£13.99	Music Composer (Cartridge)	£35.99
Joysticks (Pair)	£13.99	Home Entertainment (Cartridge except where stated)	
I/O Cable	£12.99	Galaxian	£29.99
Printer Cable	£28.50	Defender	£29.99
Monitor Cable	£25.00	Asteroids	£29.99
Thermal Paper	£4.00	Basketball	£24.99
Pointmaster Joysticks	£14.95	Blackjack (Cassette)	£14.99
Quickshot Joysticks	£14.95	Caverns of Mars (Disk)	£29.99
Keyboard for Atari 400	£00.00	Centipede	£29.99
Books & Manuals			
Wiley Manual	No VAT	Computer Chess	£24.99
Basic Reference Manual	No VAT	Missile Command	£29.99
DDS. 2 Manual	No VAT	PAC Man	£29.99
Operating System Listing	No VAT	Space Invaders	£29.99
DDS. Utilities Listing	No VAT	Star Raiders	£29.99
Home Computer Programs - Home/Office			
Word Processor (Disk)	£99.99	Cribbage & Domino	£19.95
Mortgage & Loan	£14.99	European Scenic Jig-saw	£19.99
Microsoft Basic (Diskette)	£59.99	Programming Languages & Aids	
Home Study (Cassette except where stated)			
INV. to programming 1	£19.99	Assembler Editor	£39.99
INV. to programming 2	£22.99	Atari Basic Cartridge	£39.99
INV. to programming 3	£22.99	Macro Assembler (Disk)	£59.99
Conversational French	£39.99	Pilot (Consumer)	£59.99
Conversational German	£39.99	Pilot (Educator)	£89.99
Conversational Italian	£39.99	Entertainer Kit (Star Raiders Missile Command & Pair Joysticks)	£69.99
Conversational Spanish	£39.99	Programmer Kit (Basic Cartridge & Manuals)	£39.99

Commodore VIC-20

TEXAS T199/4A



■ 16K RAM (expandable to 48K) ■ Built-in 14K Byte BASIC interpreter ■ 16 Bit Micro-processor ■ 16 Colour High Resolution graphics ■ Extensive range of solid state software command modules available from games to architectural aids.

Spectrum LOW Price £154.95 INC VAT
(£134.74 ex. VAT)

SPECTRUM FACTS

Maximum user RAM 14,500 Bytes (approx.)
Text Screen High Resolution 256 x 192
Cassette Lead Extra £10.95

	EX. VAT	INC. VAT		EX. VAT	INC. VAT
TEXAS PERIPHERALS					
Speech Synthesizer	£40.50	£46.58	Parsel	£23.45	£26.96
Peripheral Exp. System	£122.00	£14.30	Car Wars	£23.43	£26.95
Disc Cont. Card	£124.30	£142.95	Munchman	£23.43	£26.95
Disc. Drive	£234.74	£269.95	Adventure & Pirate	£31.26	£35.95
RAM Exp. Card	£179.57	£206.50	Education		
Matrix printer	£347.78	£399.95	Number Magic	£12.13	£13.95
Software Entertainment					
TI Invaders	£16.48	£18.95	Add/Subt. 1	£23.43	£26.95
Tombstone City	£19.96	£22.95	Teach yourself beginners		
Attack	£19.96	£22.95	BASIC	£8.26	£9.50
			Home Budget Management	£19.96	£22.95
			... and many more		

MORE SPECTRUM LOW PRICES

SPECTRUM

A few examples from our Software SELECTION from independent software houses

THORN EMI

Software for Atari	Inc. VAT
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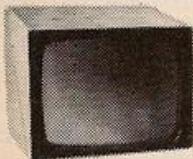
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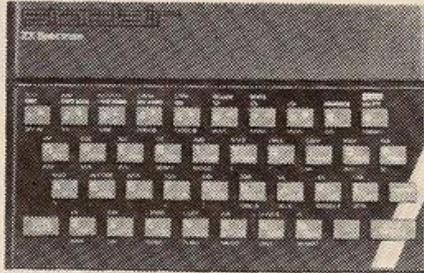
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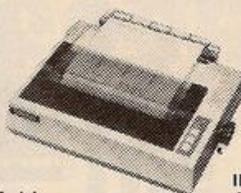
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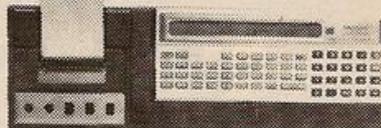
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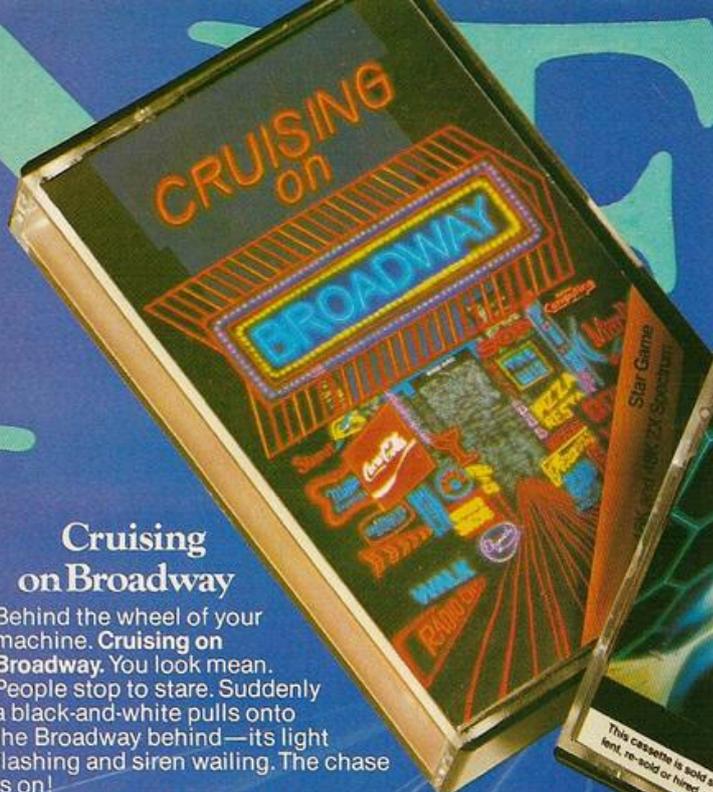
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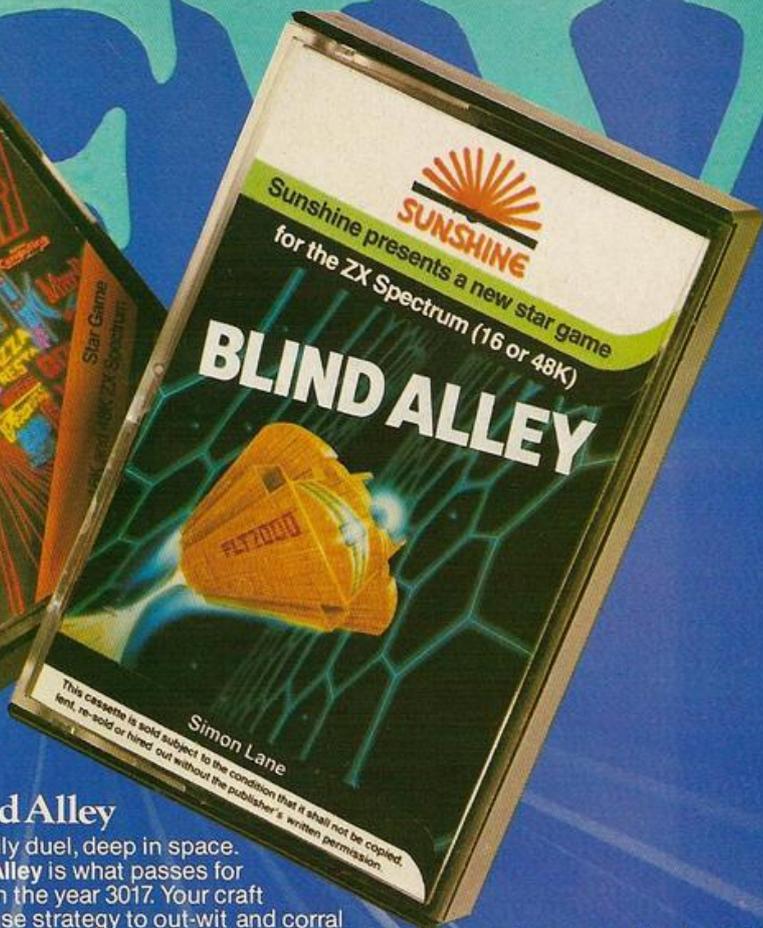


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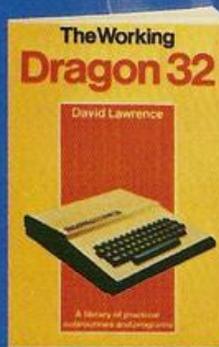
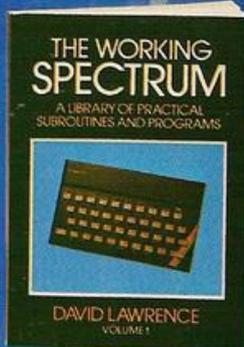
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 me, at me. And I'm alone.
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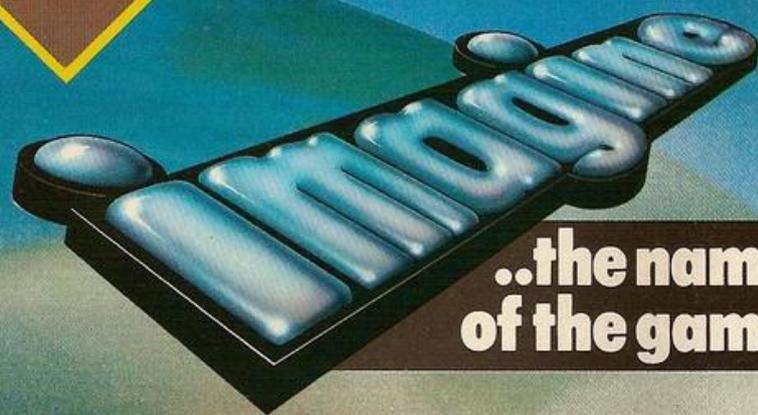
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catcha snatcha



Barney
boothace
had never had
it so bad, demoted
from ace detective of
the aristocracy to the
level of a mere store
detective he wanders his
now well worn beat around the
jewellery and watch counters
considering his predicament
life for the hardened criminal
he has to look after lost
valuable umbrellas and
lost property officers
expect the occasional
or a planted
excitement
CATCH
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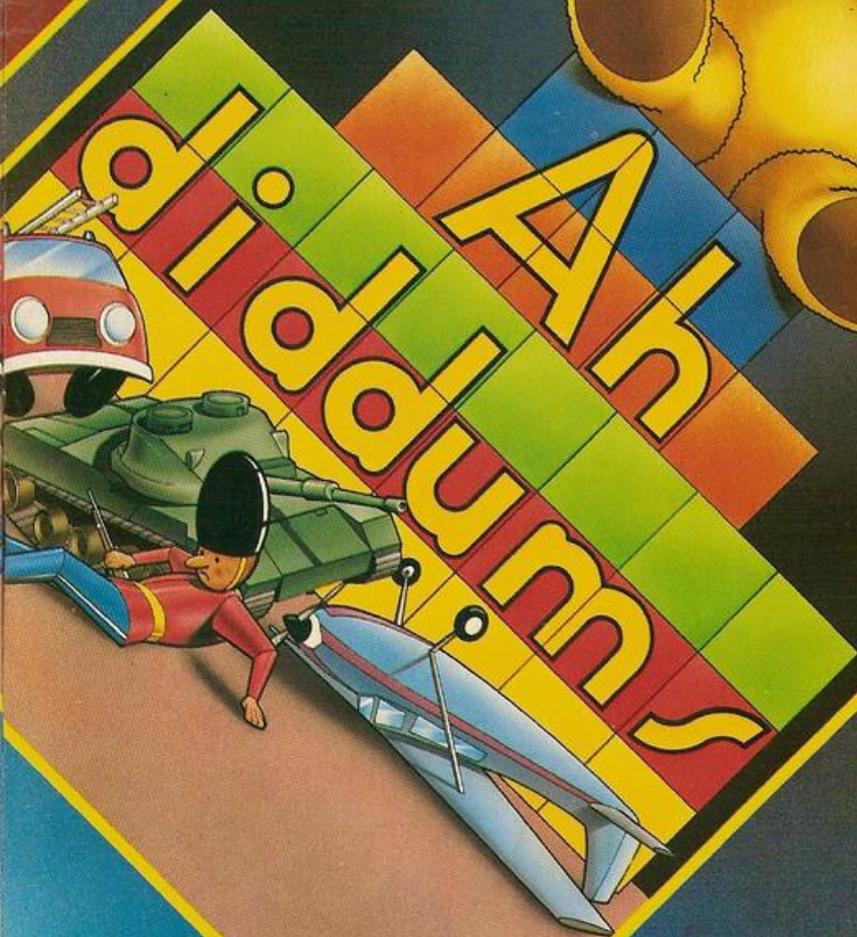
..the name
of the game

...a hectic
...nighter when
...children and return
...handbags to the
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...bungling shoplifters
...to add to the fun and

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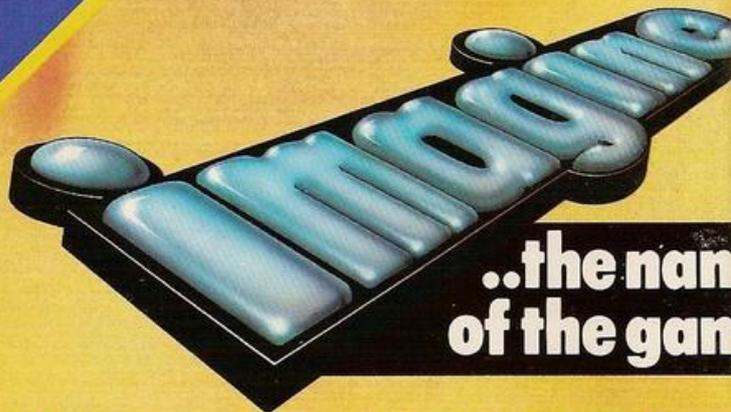
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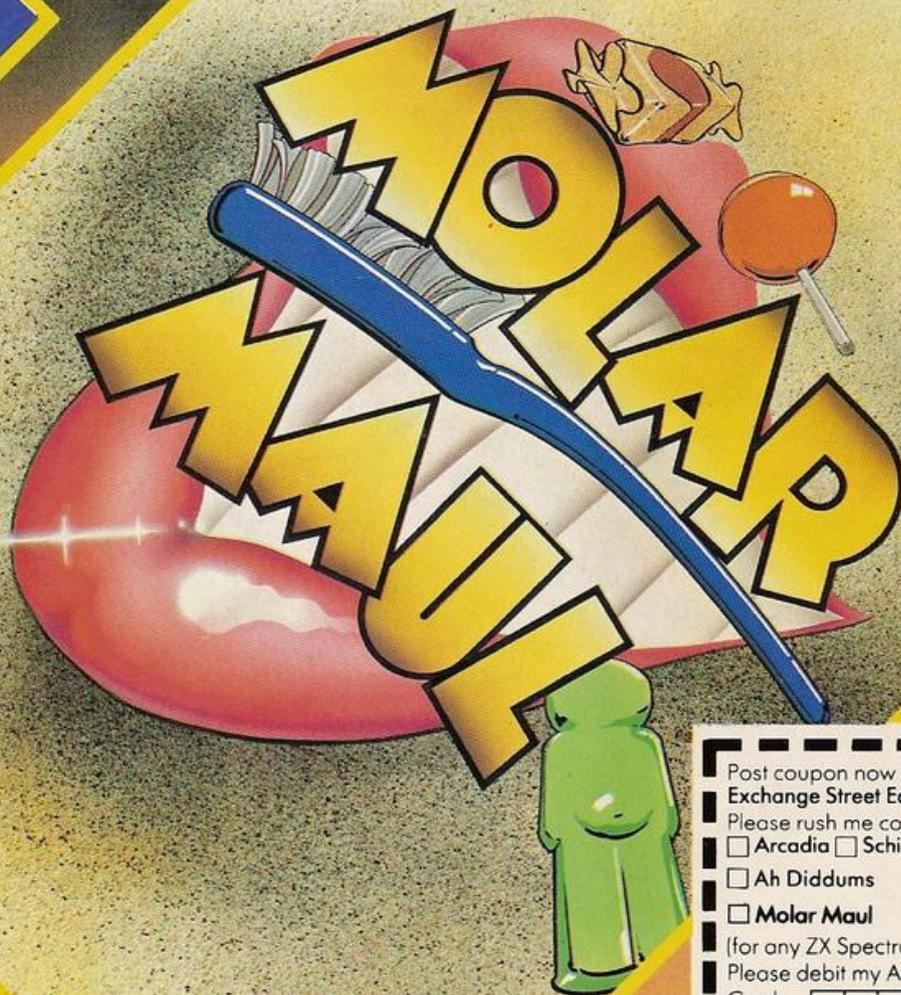
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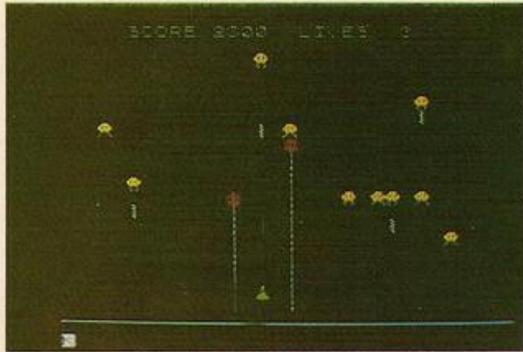
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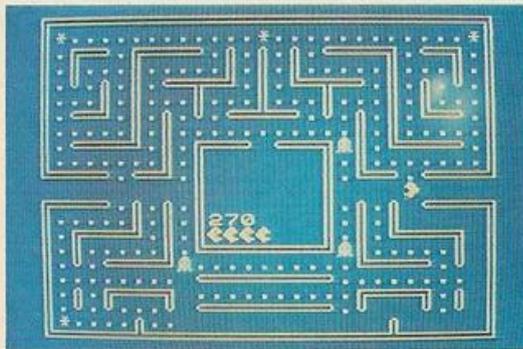


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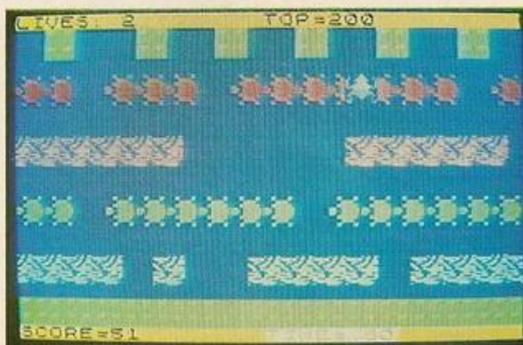
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CENTIPEDE AND PAINTER

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YOUR LETTERS

THE CASTLE OF RIDDLES

At last the task is finished — Castle of Riddles is solved! Although it undoubtedly took me longer than many others, I posted my competition form earlier this morning. I also felt the need to make a few comments.

I am not an adventure game expert by any means, Castle of Riddles was the first I have ever completed, but what a marvellous five days' enjoyment I have had. A thoroughly well-planned and written program with only one exception which I will come to in a moment.

I would never have believed the incredible emotional ups and downs a game like that could produce. From Saturday morning to evening, passing the Shooting Gallery or the Awesome Creature was proving absolutely impossible. That was a low low. My wife encouraged me to take a break and relax. A few hours later the thought of exploding the case and scaring the Giants seemed a possibility. Sure enough that was a high. Later in bed, amid a turmoil of thoughts, the association between the red paint and the creature occurred.

On Sunday morning with trembling fingers, I threw the can of paint and observed with undisguised joy the dying of the beast. That was a high high.

The one odd thing about the program was the Black Rod. I just could not believe that losing the rod before moving through the Black Passage was correct. I tried for a long time making the trip from the Pit through the tunnel the final move, but that of course proved impossible.

Although the right answer is achieved by not carrying the rod through the passages, surely there must be a way of retrieving it first? I would very much like to know.

However, congratulations to *Your Computer* and Acornsoft for mounting a brilliant exercise, I sincerely hope that it will not be the last.

P Croft, County Down, Ireland.

SCROLL TRICK

A feature lacking on the Sinclair Spectrum is the Scroll command. Although substitutions have been published for this, involving Poking and Printing, I believe that my solution is much neater. Simply, place the line, LET A=USR 3280 in your program, and the entire screen will be scrolled up by one line.

*Peter Bernstein,
Northwood,
Middlesex.*

POLYGON BUG

The Sinclair Spectrum has a versatile bug in the one-liner PLOT x,y: DRAW a,b,n*PI

There is a pentagon at x=y=a=b=50, n=100.8. Odd-sided polygons are usually larger than the circle whose diameter is defined by the line joining x,y and x+a, y+b. Thus they go off the screen, with an Integer Out of Range message. Good examples are the near-perfect triangle spooking about at x=220, y=210, a=b=50, n=168.24, and the heptagon lurking somewhere between n=71.5 and 72.5.

The bug crawls in at n=17 and is cyclic. As odd values of n go up, the circle turns into an apparently rotating polygon. As n rises, the number of sides decrease and the speed of rotation increases, program running time stays constant at eight or nine seconds.

At some point it collapses into a rotating line. I think most of these collapsed polygons are at non-integer values of n. As n increases further the polygon "opens out" and the number of sides increases. The cycle then repeats. For polygons and stars, the trick is to find values of n that visually "locks" the rotation and gives a static shape.

I recommend trying small values for a and b in studying the odd-sided polygons, so that they stay on-screen even if they are very large relative to the circle diameter. I cannot: my Spectrum recently went into terminal coma and is back at Chateau Sinclair for a rebore!

*John Brazier,
Stanford in the Vale,
Oxfordshire.*

LYNX FAN

Your review of the Lynx in your February issue prompts me to reply to some of Bill Bennett's comments: He opens his review with the assumption that the consumer wants gimmicks or a computer with some outstanding feature. Any prospective Lynx buyer should bear in mind that some machines with outstanding features have then at the expense of some graphics. If anyone wants gimmicks, I suggest that they compare the Spectrum dead-flesh keyboard with that of the Lynx.

As a ZX-81 owner I know that Sinclair's manual provides one chapter of two pages on machine-

code. The Lynx manual's machine-code chapter is nine pages long. I do not think any purchasers can expect a great deal more.

Your reviewer seemed to be disappointed by the Beep command — perhaps he is jaded after all the machines he has reviewed. Anyone wishing to try out Beep need only walk into a branch of Laskys and type in the following ditty:

```
90 RANDOM
100 LET W=RAND(200)
110 LET C=RAND(200)
120 BEEP W,C,63
130 IF W C THEN LET W=W/2
140 IF W=C THEN GOTO 90
150 GOTO 100
```

Our 15-month-old daughter thinks that this beats Beethoven.

I agree that the manual could be improved by the addition of an index — I am sure it will be.

Why was there no mention of the Lynx's ability to accept abbreviated commands? For example, Auto to A. Also, why no mention of single key entries? I think that indeed the Lynx does indeed offer something new — it is consistently good. It is soundly engineered and it does not overheat. It has a well-designed, professional quality keyboard, and it is British and available.

No doubt by now you have guessed that previously I had been using a ZX-81 and now am the proud owner of a Lynx. Before buying it I looked at the BBC machines. You have to pay another £195 to implement CP/M on the BBC. I personally did not like the Dragon as it was not Z-80 based. Following my bad experiences with mail order from Sinclair, imagine the trepidation with which I ordered my Lynx on November 22, 1982. I had hoped to receive it before Christmas but did anticipate some delay with a brand new machine. Imagine my

surprise when I received a letter of apology in the New year apologising for the delay and promising it by mid-January. Sure enough it arrived on January 20. Considering the Christmas holiday I do not think that is a bad record.

I wanted CP/M because I had used WordStar at work and appreciated what a vast range of software would be available to me given that disc-operating system.

*R D Hughes, Worthing,
West Sussex.*

NO STRINGS

Mr Excell seems to think BBC Basic is more standard than Sinclair Basic because BBC Basic supports string arrays — Letters, January issue, p27. In fact, those funny Mid\$, Left\$, Right\$ and similar commands are an aberration of Microsoft-type Basics, and not "standard" at all.

The proposed American National Standards Institute — ANSI — committee X3J2 is currently finalising Standard Basic. It does not include string arrays, and it does make Let mandatory. The original co-author of Dartmouth Basic, and Chairman of the ANSI committee, noted last year that string arrays had gone and cried "Good riddance!" I agree.

Anything that can be done with string arrays can be done with long strings, but not vice versa. Also, string arrays are not a feature, in the Microsoft form, of any more advanced language I can think of. If you want to progress from Basic, it is not a good idea to come to depend on them.

Mind you, I would rather use BBC Basic than Sinclair Basic. BBC Basic is good, but look at the size of it! A better Basic is the Cromemco Struc-

DUTCH DRAGON BOOSTER

With reference to Stephen Mummery's letter — February 1983 — regarding the increase of the Dragon 32's user-available memory, I can add that with the following statement:

```
POKE25,6:POKE27,6:
POKE29,6:POKE31,6
```

you have 31015 bytes at your disposal. You have also cleared the first high-resolution page, which could not be done with the PClear statement. With Clear0 you can add another 200 bytes.

Another useful feature, which you can achieve by changing pointers, is to Merge programs. First you have to Cload the first program. Then you ask the contents of memory locations 25,26,27 and 28 with the command:

```
?PEEK(25),PEEK(26),
PEEK(27),PEEK(28)
```

Next you have to Poke the value of location 27 in location 25 and the value of location 28 minus 2 in location 26 — suppose the value is 137, then you have to Poke value 135 in location 26. If the value of location 28 is 0 or 1 then you have to subtract one from the value to Poke in location 25 and the value to poke in location 26 would be 254 or 255. Now you can Cload the second program. Make sure that all the line numbers are greater than those in the first program. That can be done by the Renum command. The last thing to do is to Poke the original values back to location 25 and 26, which will be in most cases 30 and 1. If you enter the List command you see you have both programs together.

T A Bik, Amstelveen, Netherlands.

tured Basic, which also lacks string arrays, but that's 32K. We should all have so much spare memory.

I own an Atari 800. Atari Basic is a stripped-down version of the Cromemco Basic, written by the same people. It takes up only about 8K, and has long strings instead of string arrays. As it is supplied on a plug-in ROM, however, you can remove it and load an enhanced Microsoft Basic — that is more than twice the size — from disc without running out of memory. Alternatively there is an enhanced version of Atari Basic called Basic A+, available from Optimized Systems Software. Again it was written by the people who wrote Atari Basic, is upward-compatible, and includes the things that had to be left out of the 8K ROM such as Print Using, While — Endwhile, and If — Else — Endif.

The moral is simple. The most powerful feature to look for in a Basic is that you can remove it, or switch it out, freeing the address space either for another Basic or another language.

Jack Schofield
London W3

SPECTRUM TIPS

Here are a few tips for increasing execution speed when writing programs in Basic on the Spectrum. A program's memory may be divided into three parts: the top, the middle and the bottom, each one being more appropriate for the storage of a specific functional part of the program.

The top part, which always has the lowest line numbers, is suitable for frequently-used loops and subroutines — the most-used ones have the lowest line numbers. It is useful to make a subroutine with any frequently-used loop — having taken all unnecessary computations out of the loop — and then put it at the top of the program's memory. It is still better to pack each subroutine within one line only, keeping in mind however that For-Next loops are better at the beginning of a line instead of in the middle. The middle part is used to store the main body of the program.

The bottom part is convenient for functions that are performed only one time per execution, like initialising variables, dimensioning arrays, reading Data statements and so on. It is better to declare variables beginning with those most frequently-referenced first.

The reason for all that is that jumps are always performed by processing through line numbers, starting at line 1, and skipping over to the next line until match is found; thus, the fewer lines away from line 1 you are, the quicker the jump. Do not forget that this gain is multiplied by the number of jumps performed: in French, we say: "Les petits ruisseaux font les grandes rivières!"

André Didelot,
Geneva,
Switzerland. ■

AFTER THE RAVAGES of glue sniffing and teenage alcoholism, the nation's youth are now in the grip of computer addiction. Recent shock reports tell how children sneak back after four o'clock to use their school's computer laboratories, or meet in derelict buildings to program pocket calculators. Parents are warned of the tell-tale signs: the inability to converse in anything but machine code; the complexion horribly coarsened by hours at the keyboard; the eyes vacant except for the cursor flashing in the corner.

Clearly all this makes for good, scare-mongering newspaper stories which are, of course, totally misinformed. Every computer fan knows that you are just as likely to observe this kind of behaviour in adults as in children. A recent survey by Gowling revealed that the father and son partnership makes up 80 percent of home computer owners. Micros are bought for sons by fathers who believe that understanding computing will help their child in school. Presumably as soon as the micro arrives at home some children become users very quickly. In other cases, the father feels he has to get to know the machine if he is to help his son — and becomes hooked in the process. So, what seems to distinguish this addiction from other vices is that parents and children are equally responsible for introducing each other to it. But what is it about computers that makes them so habit-forming?

Some will claim it is the element of problem-solving involved in programming. Others will answer that it is the fact that micros promise mastery of a finite and logical universe contained in a small plastic box. A place where — unlike the real world — if you have the knowledge, what you want to happen surprisingly often does. In other words a

kind of hi-tech escapism. Others, still under the influence of a dose of Space Invaders, will be unable to answer at all.

In the old days lecturers complained that all-night drinking and debauchery disrupted students' studies. Now a new villain has emerged. Tutors at London University claim that many undergraduates are spending five hours a night intoxicating themselves with the pleasures of home computing. Students arrive for their lectures fit only for another game of Pac-Man.

So much for the vices but what about the virtues of computer addiction? A physical dependence on micros could make you highly productive — if only in terms of computing. Jobs that can only be regarded as chores by the ordinary owner are fun for the addicts, who see in every new operating system the chance of a kind of electronic nature ramble.

The computer-dependent form an unpaid army of software engineers ready to engage themselves in any national programming cause that appears on their screens. It is exactly because there is this level of obsessional commitment to home computing that such a profusion of software exists in the U.K.

Kids have been addicted to arcade games for 30 years. But whereas the teenage pinball wizards of the past only profited the pier manager, today's silicon whizz-kids are learning skills which could stand them in good stead for their future careers. Some already have careers, programming for the big software houses.

And although critics view the addiction as dangerous, the bank managers of the child prodigies may well be content to see them continue living dangerously. ■

How to write for Your Computer

We called this magazine *Your Computer* precisely because we welcome your views, tips and hints and even your criticism of machines and software in general. If you would like to see your name in print, whether on a Software File program or a full-blooded article, here is how to go about it. Ideally, all articles should be typed double-spaced on one side only of uniform sheets of paper. If listings can be dumped directly from a printer — you can always use a friend's or user group's — this minimises the risk of error. In a perfect world a cassette would accompany the article. That considerably speeds up the checking process. Not only do you get to air your own discoveries and opinions, but we will even pay you for the privilege. We pay £35 per published page — that's as it appears in the magazine and includes illustrations.

Why not give it a try? You have nothing to lose but your postage.

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Happy birthday Microdrive — and now a big hand for the ZX-83, ZX-84 and Microvision

YOU WILL be able to order the Microdrive on or about April 23 — the anniversary of its official announcement. Sinclair also has a ZX-83 in store for us this year, but the revolutionary all-in-one computer exclusively revealed in last November's *Your Computer* is now dubbed the ZX-84 and may not be released until next year.

Sinclair's long awaited Microdrive is a compromise between cassette storage and floppy-disc storage. A high speed tape loop — or stringy floppy — will store over 100K of data or programs. Sinclair is confident that the access time will be less than the 3.5s. advertised.

The £40 price is less than originally expected but a £30 drive controller containing an RS-232 interface is necessary to connect the Microdrive to a Spectrum.

Initially Microdrives will not be able to run on any other computers, although one controller will allow you to run up to 40 Microdrives off one Spectrum.

The Microdrives will accept interchangeable tape-loop cassettes. Initially Sinclair will sell games and adaptations of existing Spectrum



software on these cassettes. Blank cassettes will be made available to other software manufacturers.

Priority will be given to satisfying the Microdrive orders of those who

ordered Spectrums last summer, so it could be late this summer before the microdrive goes on general release.

Sinclair's Microvision flat-screen

pocket television should be launched this July, opening the way for the 9in. flat-screen to be incorporated in the ZX-84, which will also have twin Microdrives and a Modem.

Nigel Searle, Sinclair Research's Managing Director is playing his cards close to the ZX-83, but he has confirmed that there will be one — "It is fairly natural if you follow the sequence: ZX-80, ZX-81, Spectrum — alias ZX-82".

Your Computer spies have observed several projects which could be the ZX-83 under wraps at Sinclair's new Cambridge headquarters. One of the favourites is a Spectrum with improved sound capabilities and a Modem which could be rushed into production if the Oric begins to threaten Sinclair's hold on the market.

The situation is further confused by the low-cost desktop business computer which Sinclair has developed for ICL to launch this year.

The difference between an Apple and a Peanut is just £300

THE APPLE II costs £675. From mid-April Peanut Computers will be selling an Apple look-alike with virtually the same specifications at just over half the price.

Like the MPF-II, another Apple copy, the Peanut is imported from the Far East. It is designed to run Apple software and to take many of the large range of Apple II accessories. These include RAM expansion boards, Z-80 interface to allow the computer to run CP/M software, language cards and an 80-column display card.

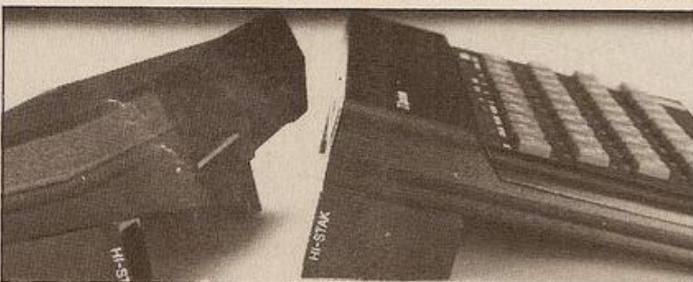
The standard machine comes with 48K RAM and is expected to sell for around £345. Two graphic modes are offered, giving a resolution in black and white of 280 by 192 and colour resolution of 140 by 192. The



The Apple II E — Apple's latest attempt to stave off Apple II copies.

text format provides 40 columns by 48 rows. It will be sold by mail order from Peanut Computers, Unit 20, Low Mill, Dewsbury, West Yorkshire.

Just propping up the back of your home micro can save it from overheating and certainly makes it easier to type on. While most computerniks lean their slices of 1980s high technology on cassette cases, door wedges or stale sandwiches, Hi Stak plastic legs are the latest spring fashion. Warp Factor Eight sells them at an appropriately astronomical £3.95 for two. If you use something really obscure to prop up your micro, write in and tell us and we will send you a pair of Hi Staks.



Check your power packs

SINCLAIR RESEARCH has been obliged to recall some 28,000 power packs after discovering that they could be dangerous.

The power packs are recognisable by a white stripe on the power supply's output to the Spectrum.

What makes them unsafe is that the 240V input track inside the power supply is too close to the 6V output — it is possible that a power-spikes during very humid weather could result in a user receiving an electric shock.

Sinclair Research Managing Director Nigel Searle admitted that the power packs — just one batch from one supplier — were not checked in detail for safety.

YOUR COMPUTER TOP 20

Game	Company	Machine
■ Arcadia	Imagine	Spectrum
■ Chop	Creative	Vic-20
■ Liter	Software	
■ Defender	Atari	Atari
■ Dragon	Salaman-	Dragon
■ Trek	der	
■ Flight	Psion	ZX-81
■ Simulation		
■ Football	Addictive	ZX-81
■ Manager	Games	
■ Gorf	Commo	Vic-20
■ The	dore	
■ Hobbit	Melbourne	Spectrum
■ Hungry	House	
■ Horace	Psion	Spectrum
■ Intro to	Commo	Vic-20
■ Programm-	dore	
■ ing		
■ King Kong	T D	ZX-81
■ Miner	Software	
■ 2049er	Big 5	Atari
■ Monsters	Software	
■ Pimania	Acornsoft	BBC
■ Planet	Automata	Dragon
■ Invasion	Microdeal	Dragon
■ Planetoids	Acornsoft	BBC
■ Rocket	Acornsoft	BBC
■ Raid		
■ 3D	J K Greye	ZX-81
■ Defender		
■ 3D Tunnel	New	Spectrum
■ Timegate	Generation	
	Quicksilva	Spectrum

BBC Micros for the blind

A GRANT worth £18,000 from the Department of Industry will help the Open University to open up microcomputing to the blind and partially-sighted. Eight schools will be supplied with "touch and hear" systems based on BBC Micros equipped with speech synthesisers.

The system reads lines of Basic aloud as they are entered using a Votrax-based Type and Talk synthesiser instead of displaying them on the screen. So instead of, say:

10 PRINT CHR\$(23)

appearing on the tube you would hear

TEN PRINT CHARACTER
TWENTY-THREE

Many blind people cannot use a conventional typewriter keyboard but are familiar with a manual Braille typewriter, the Perkins Brailler. So Dr Thomas Vincent and his Manchester Open University team which has been developing the system over the last year has adapted the Perkins machine as an alternative keyboard for the BBC Micro by fitting microswitches to sense key depression and an interface to the BBC Micro.

Vincent hopes that the micros will stop the blind children from being left behind as computer skills become more widespread. It should also make it easier and more enjoyable to learn Braille.

Double Dragon will answer the 64,000 byte question

WATCH OUT Commodore and BBC, Dragon Data plans to launch a new 64K RAM machine late this summer. The £180 Dragon 32 which has now sold 35,000 units will not be discontinued when the £300 64K machine goes into production.

Commodore at least will be well able to drop the price of the



Versatile new portable from Texas completes the TI family

THE STRUGGLE to win a place in the nation's briefcase becomes even more heated with the launch of the Compact Computer 40, the first in a series of Texas Instruments portable computers. Texas clearly intends it to compete with the Epson HX-20.

Like the Epson computer it has an liquid-crystal display, a QWERTY keyboard and a numeric keypad. The display has 31 characters, can

be scrolled left and right and adjusted for different contrasts.

Measuring 9in by 6in, by 1in, the CC-40 weighs 22oz. and takes four AA alkaline batteries which provide power for up to 200 hours. Programs are retained in memory when the machine is switched off.

Memory capacity is 6K of RAM expandable to 18K, and 34K ROM. Plug-in cartridges can expand the ROM by a further 128K. The Basic is compatible with the TI Basic used in the TI-99/4A and the new TI-99/2 announced last month.

The CC-40 will also take the same low-cost peripherals as the TI-99/4A. These include a £150 four-colour printer and the £120 Wafertape digital tape drive which takes 40K tape cartridges and has a data-transfer rate of 8,000 bits per second.

A RS-232 interface will also be available and at later date Texas will

release other peripherals such as a Modem, a bar-code reader and a TV interface.

The CC-40 is expected to sell for around £170. Texas claims that it has more capabilities than the Epson portable computer and that it will be considerably cheaper — even with the additional cost of the printer and tape drive.

Not some new video-game monster but a face which may be just as frightening for some of the big names in micro games. It belongs to Richard Branson who made millions from Virgin records and is now turning his evil eye to home computers. Nick Alexander will run Virgin Games which will bring record-company style razzmatazz to computer games. Nick Alexander reckons that computer games will soon become even more popular than video films.

Cut-price rail tickets offer for first Midland Computer Fair

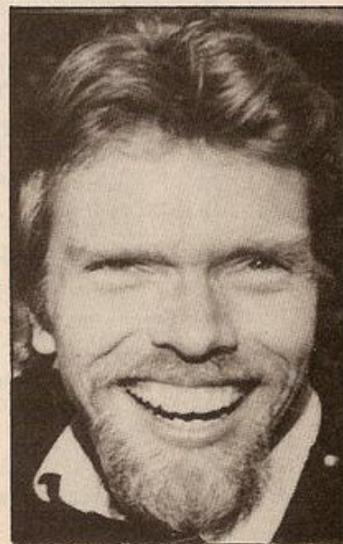
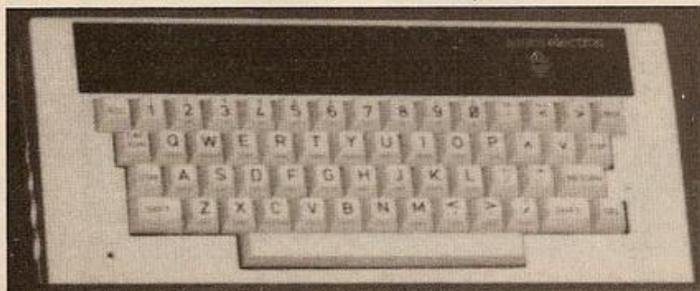
WHISPER IT softly but Acorn's Electron may receive its first public showing at the Midland Computer Fair — and combined rail fare and

admission tickets will cut the cost of getting there.

Tens of thousands of home computer enthusiasts are expected to turn up to the Fair at Bingley Hall Birmingham which will be open from 10am to 6pm on Thursday and Friday April 28 and 29, and 10am until 5pm, Saturday April 30.

Admission will be £2 — half price for children and pensioners — but British Rail and IPC Exhibitions are offering cut-price all-in fares; such as £12 from any station in London, £9.50 from Manchester, £4 from Coventry and £4.50 from Hereford.

Acorn's Electron should be out by the end of April.



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Full Upgrade	£75.00
Joysticks (pair)	£13.00
Single Disk Drive	£265.00
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20 inch Colour Monitor	£343.85

ACORN SOFTWARE PROGRAMS (phone for availability)

ACORN ATOM

Single Disk Drive (incl. FREE buffer kit)	£343.85
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BOOKS

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Basic Programming on the BBC Micro	£5.95
Let Your BBC Micro Teach You to Program	£6.45
NEC '30 Hour BASIC'	£5.95
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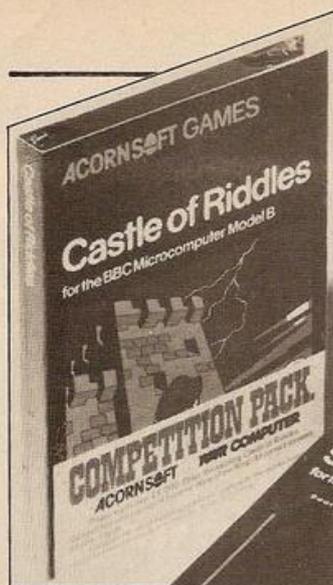
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£3,000 Riddle — the winners

NOW IT CAN be told — the names of the winners of the *Your Computer* and Acornsoft *Castle of Riddles* competition. Peter Voke from Aylesbury, Buckinghamshire was the first to deliver the right answer, in person.

Second was C P Bignell of Littlehampton, West Sussex and, in third place, P K Colbert of Heath, Cardiff. Next month, we will publish fuller details for those of you still stuck in the Pit or over-awed by the Awesome Creature.

Down with the Atari 400

ATARI IS LAUNCHING a three-pronged attack on micro users. Prices of the 400 series home computers have been slashed by £40 to £160 for the bare 16K RAM machine or £200 if you want Basic and the manuals. Meanwhile the £400 Atari 800 has been upgraded from 16K to 48K RAM without a price increase and a conversion kit will soon be available to turn the Atari video games machine into a home computer.

Now you can plug your Spectrum straight into a professional printer using the new Euroelectronics ZX Lprint Centronics interface. This parallel interface will free Spectrum owners from dependence on Sinclair peripherals and will be tough competition for Sinclair's serial RS-232 interface which should be launched this month. Both the ZX Lprint and Sinclair's RS-232 should cost around £30.



Maestro and Renault II pop talking micros under the bonnet

AT LAST motor manufacturers are waking up to the possibilities of on-board microcomputers. Computers have been creeping into luxury cars like BMWs for the last couple of years but only with the announcement of the Renault 11 and the Austin Maestro last month has the micro appeared in volume production.

The Austin and Renault systems are a similar size to the average home computer with the addition of a voice synthesis unit which again is similar to some of the plug-in peripherals available for home computers. The Maestro's unit is based around a 6805 microprocessor running at 4MHz. 32K ROM is used to store 15 phrases such as "Fasten your seat belt" including

Austin's Maestro — below — and the Renault 11 — above.



Computer garages to fix micros on the spot

HIGH STREET computer garages where you can take in an ailing micro and have it fixed on the spot



warnings of high engine temperature or low fuel.

In Britain the voice is female but a further 128K ROM on export models incorporates German, French and Italian voices. The French have also opted for a female

voice but the Germans and Italians will be warned by male voices. The Germans will be confronted by a barking "Achtung, achtung", every time they step out of line.

Renault has opted for a similar voice unit on the Renault 11 — a fastback version of the top-selling Renault 9. A female voice will regale the driver with advice while a male voice will shout warnings.

The Maestro's voice unit will only be available on the top of the line Vanden Plas and MG models but the microcomputer will control speed and temperature sensors on all models and will power a digital display board. Smiths Industries who makes the unit claims that the vacuum fluorescent display of speed and fuel consumption is 20 times brighter than a television screen.

Bob Dickens of RD Labs has had to head for the hills because of Your Computer. Sales of the Digital Tracer — a device which allows you to copy drawings straight to the screen with a Spectrum or ZX-81 — have proved so successful since we reviewed it in January that RD Labs has had to move to a new factory in Cwmbran, South Wales.

for a fixed fee of £10 are the latest idea from Liverpool software house Imagine.

Sending your home computer back to the manufacturer after it gives up the ghost in the middle of a game of Pac-Man can be a frustrating business. With horror stories of people waiting up to a year for repaired machines to be returned, Imagine's Mark Butler is confident of the demand for a simple High Street repair service.

The first computer garages will appear in Liverpool but Mark Butler is already negotiating with an Oxford Street store and hopes to set up branches all over the country. The garages will deal with Spectrums, ZX-81s, BBC Micros, Dragons, Vic-20s and Atoms.

Previously Imagine was better known for games like Wacky Waiters and Ah Diddums but although Butler claims that 70 per cent of Spectrum owners now have Imagine's Arcadia, it has not starred in *Your Computer's* retail Top 20 because most of the sales have been by mail order.



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Volcanic Dungeon is available on the 16K ZX-81, 48K Spectrum and Dragon 32. An entry form is supplied with every game. (Anyone who already owns the original ZX version can enter by sending a SAE for an entry form.) **Order your copy NOW from CARNELL SOFTWARE, 4 Staunton Road, Slough, Berks. Only £5.00 including P&P. Also available from good microcomputer stores.**

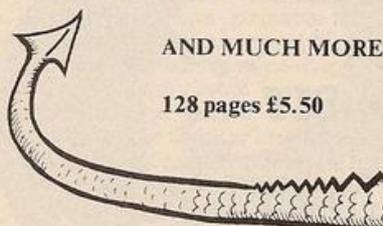
The 'Judges' decision is final and no correspondence will be entered into. All business associates of Carnell Software, and their relatives, are disqualified from entry. A copy of the rules of the Volcanic Dungeon championship will be supplied with the entry form.



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Trevor Toms, best selling author of the ZX81 Pocket Book and the Sinclair Learning Lab, turns his attention to the ZX Spectrum — the book you have been waiting for! All the material in the book is totally new.

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Discover new ways of using PRINT; INSTR functions, VAL, PRINT USING, hexadecimal conversion, upper case conversion, load and save arrays. BEEP with sliding tones, automatic scroll and how to use all the machine features within machine code.

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All the tools you need to write machine code effectively. Graphics tool kit — debug monitor — symbol assembler (with labels, all ED commands, ORG statements, forward and relative jumps) — disassembler (with label assignment); now you can really dig into the Sinclair ROM! This section alone would be stupendous value for money!

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COMPUTER CLUB

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.

Camden keys in at Queen's Crescent

Meirion Jones takes a look at what's happening down in North London at the burgeoning new club based at Queen's Crescent library in Camden.

WHILE ANNA FORD, David Frost and the rest of TV-am's megastars were launching themselves from Camden Lock on to the nation's breakfast tables with a "Hello, good morning and welcome" a quieter but perhaps more effective launch was being prepared down the road at Queen's Crescent library.

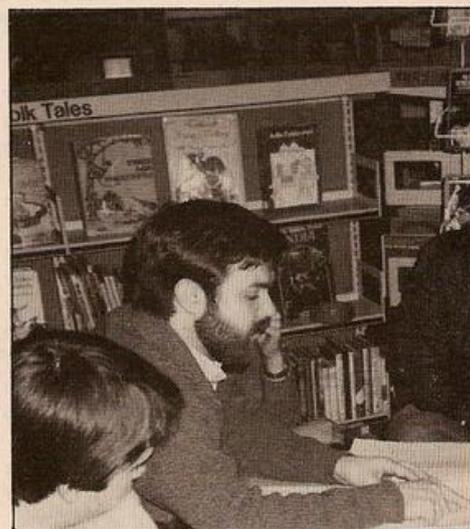
It all started with a chance enquiry by Wil Jackson at his local library. Why, he wanted to know, did they have so few books about new technology? "You would be surprised how many people who come in here have their own computers," he told Branch Librarian Jean Walton. She made him her computer books adviser, and by February there were 50 computer titles on the shelves and it was time to set up a computer club. Camden Council



gave free use of the library where the club has met every Tuesday at 7pm since.

The club concentrates its efforts on newcomers to computing with two beginners' groups and a more advanced programming section. Many of the 30 members who attend each week are still at school.

When we visited, one group was huddled around a Spectrum in the hands of Simon Warren — a radio engineer. They had mastered the essentials of Basic and he was showing them how to debug a program — in this case an error-prone version of Nim.



Simon showed how to trace problems in a program but the final error proved elusive and so the group learnt an unexpected lesson — knowing when to give up.

Wil Jackson, who is now the chairman, was explaining the rudiments of computing to newcomers using another Spectrum. In another corner Lucas Fowler the club secretary was demonstrating a ZX-81 input/output board which he had made for an O-level electronics project.

Robert Martin — a professional programs analyst — was explaining structures to the more advanced programmers and advocating flowcharts. He also warned against becoming so obsessed with the program that you forget what you want it to do. "If you proceed from the output you cannot go wrong. If you find a bit of the program interesting and start there you can lose sight of the overall objective — and end up with spaghetti programming."

The club is increasing its links with other groups. While we were there a missionary from Worcester Park preached the benefits of joining the Association of London Computer Clubs.

Camden Council is hoping the Queen's Crescent project will be a success so it can be spread to other libraries in the area. Wil Jackson hopes the effect will be "like ripples on a pond. From Kentish Town to Primrose Hill — and from there you never know where we will get to."

You can find out more about Queen's Crescent Computer Club by calling in at the library or ringing Jean Walton on 01-485 4551.

Local society news

Amateurs in Spennymoor

SPENNYMOOR AMATEUR Computer Club in Country Durham meets every Thursday evening at the Spennymoor Recreation Centre. Members own a wide range of home computers, and new members plus their micros are always welcome. More details from Anthony Vincent on 0388-817304.

Stevenage Sinclairs

A COMPUTER CLUB for owners of Sinclair machines has been formed in Stevenage. It meets on the first Wednesday of each month at the Stevenage Library. Telephone John Pearce on 0438-50587 or Bill Googe on 0438-54758 for details.

South Trafford computes

SOUTH TRAFFORD Microcomputer club meets once every two weeks and puts out a monthly newsletter which contains courses in Basic and machine code. The club is open to all serious users with an interest in learning or exchanging ideas. For further details write to

Ian White at 16 Leicester Avenue, Timperley, Altrincham, WA15 6AR or phone him on 061-969 2080.

Yate and Sodbury

YATE AND SODBURY Computer Club formed only recently but 80 people attended its second meeting. The club meets on the third Monday of the month in the canteen at Newmans, Station Road, Yate. You can telephone the secretary, Kay Crowe, on 0454-517461.

Brentwood buffs

MEETINGS of the Brentwood Microcomputer Club are held every two months on the third Monday of the month at the Methodist Hall, Warley Hill. The next meeting is on May 16, starting at 7.15pm. The club regularly organises talks and demonstrations. Future meetings will include a visit from a Commodore representative and a talk on network programming. Contact Allan Holland on 0277-221620 for further information.

FIRST BYTES

Starting out in home computing? First Bytes is for you. Just write to *Your Computer* with any hardware or software problems, no matter how small or simple.

QUESTIONS

What are the arrows?

'Tell me more about the cursor control keys. How are they used to control movement?'

LURKING SOMEWHERE on every computer keyboard are the four cursor control or arrow keys which are of particular importance in editing programs, and other text, and in controlling on-screen movement in games.

When you are entering program lines you will find that the left arrow — backspace — often acts as a delete key and will erase the last character which you typed. If your particular implementation of Basic has only a line editor then only the left and right arrows are of use to move back and forth along a single line, but if you are fortunate enough to have a full-screen editor then the up and down arrows will also move you from line to line.

Often the cursor symbols are not displayable on the screen and must be dealt with as their ASCII character codes which are as follows:

	shift not pressed	shift pressed
left arrow	8	21
right arrow	9	93
up arrow	94	95
down arrow	10	91

Organising movement around the screen must take into account how the screen is mapped. The following routine sorts out the four movements in both upper and lower case for a screen addressed as X,Y coordinates.

```
10 X=0, Y=0
```

```
20 A$=INKEY$:IF A$="" THEN 20 ELSE
A=ASC(A$)
```

I could do that...

Most microcomputers only store integers to eight or nine-figure accuracy. We will award £15 to the shortest program which multiplies two 12-digit numbers and gives the answer to 24-digit accuracy. Entries must be in by the last day in April. Contestants had no trouble in answering March's programming challenge. The winning program was sent in by D Waring, Staddle Stones, Stock Green, Redditch. His solution is simplicity itself:

```
10 INPUT A$
20 LET A$="" + A$ + ""
30 FOR N=0-20
40 FOR M=0-31
50 PRINT AT N, M; A$
60 NEXT M : NEXT N
70 FOR N=20-0 STEP-1
80 FOR M=31-0 STEP-1
90 PRINT AT N, M; A$
100 NEXT M : NEXT N
```

CHARACTERS PRINTING

ONE OF THE FIRST Basic commands everyone learns is Print which puts characters onto the screen. In its simplest form:

```
10 PRINT "HELLO"
```

The message Hello will appear at the left side of the screen and the print position will then move to the next line below, so that if 20 Print "First Bytes" is added the screen display will be:

```
HELLO
FIRST BYTERS
```

Punctuation is very important in controlling print position as can be seen by placing a comma at the end of line 10, which changes the display to:

```
HELLO FIRST BYTERS
```

as a comma only moves the next print position some way to the right and not onto the next line.

If the comma is now replaced by a semi-

colon the new print position is directly behind the old one giving HELLOFIRST BYTERS which is not very helpful. To stop the two strings running together place a space at the end of the first one to give

```
"HELLO "
```

Note that spaces are often automatically left either side of numeric variables to keep things tidy without effort.

When you want to put material in columns a Tab — for tabulator — command is useful. This moves the print position to a particular column of the display on the current line and is most useful for tables. Note the careful punctuation which stops your carefully-chosen print position jumping straight to the next line.

```
10 PRINT "DATE"
20 INPUT DA$
30 PRINT TAB(6);DA$
```

```
30 IF A=8 OR A=21 THEN X=X-1
40 IF A=9 OR A=93 THEN X=X+1
50 IF A=94 OR A=95 THEN Y=Y-1
60 IF A=10 OR A=91 THEN Y=Y+1
90 GOTO 20
```

If you want to ensure that movement does not exceed particular boundaries add:

```
70 IF X<XM THEN X=XM ELSE IF X>XS
THEN X=XS
80 IF Y<YM THEN Y=YM ELSE IF Y>YS
THEN Y=YS
```

where XM = minimum value and XS the maximum value of X, and YM = minimum value and YS the maximum value of Y.

Where the screen is mapped sequentially — starting from the top left and returning to the left at the start of each new line — the appropriate lines for modifying the print position (P) are:

```
30 ..... P=P-1
40 ..... P=P+1
50 ..... P=P-LL
60 ..... P=P+LL
```

where LL is the number of characters a line.

BEATING STOP

DEBUGGING A PROGRAM can be both frustrating and enjoyable. Some people seem to have a gift for homing in at once on the source of a problem. Obviously the more experience you have the more likely you are to develop an intuition for the sort of bugs that cause particular types of error.

But most of us have to adopt a rather more systematic approach and there are several straightforward techniques that can be usefully adopted.

Beginners are often unaware that although a program has crashed, its variables still hold numbers and characters. To find out the value

```
40 PRINT TAB(15);"CREDIT"
50 INPUT CR$
60 PRINT TAB(24);CR$
```

Even more exact control of print position is available through Print @ — or Print At — commands which specify not only the column but also the line of the display, allowing you to jump easily to any point on the screen.

Their exact operation depends on the dialect of Basic and the way the screen display is mapped. Screen mapping is usually one of two types. In the first the print positions are numbered consecutively from the top left hand corner, jumping back to the left hand side of the screen at the start of each new line.

In the second, print positions are defined on an X,Y grid. Thus

```
PRINT AT 10,10;"HERE"
```

on a ZX-81 and

```
PRINT @ 330;"HERE"
```

Decisions, decisions: branching programs



THE BUGS AND TRACE

of the variables simply type as a direct command

```
PRINT A,B,C
```

or whatever variables you want to look at. You can then work out what values they should have at that stage in the program, and set about finding the point at which they have been corrupted.

Programs that run but do not do what you want them to are even more worrying. The problem may occur because the program is not following the path you intend it to. It may be branching to the wrong subroutine or perhaps may not be returning to the right place.

PRETTYLY

on a Dragon both Print 10 lines down and 10 columns across.

For really fancy printing the Print Using facility, which allows you to specify the print format, is invaluable. The structure of this is Print Using format — image of print structure required; output list — what you want to print — and the most common use of this option is in printing columns of cash in a form where only two decimal places are displayed and all decimal points are aligned.

```
10 INPUT C$
20 PRINT USING "###.##";C$
30 GOTO 10
```

If the following values are input, 123.456: 987.54: 6.4; 4.3211 this is the display:

```
123.46
987.54
  6.40
  4.32
```

Whatever the cause, the first step here is to track down the point at which things are going wrong. A good procedure is to insert Stop commands at different stages of the program and check whether the program runs correctly up to those points. In this way you can eliminate the sections that appear to be working properly and narrow down the trouble spot to a single routine.

One of the most useful debugging aids is a Trace facility. This is built into BBC Basic but some toolkit packages, such as Commodore's Programmers Aid, supply it for other machines.

Trace gives a printout of the line number of each program line before it is executed. A proper Trace facility should also allow you to control the speed at which the program is executed and should print the line numbers in a window in one part of the screen. If these features are not present — as they are not on the BBC Trace — then the line numbers come too fast to follow and overwrite the rest of the display.

If you do not have a Trace facility you can write a simple version yourself: insert a print statement in the routine you want to check telling the computer to print the variables or line number at the top of the screen.

These techniques will not help you if the screen goes haywire or blank and the computer does not respond when you press the escape or break keys.

Almost certainly, in this case, the program has either Poked the wrong location or contains a machine code routine which it cannot break out of program. The only solution is to turn the computer off and start again, right from the very beginning.

MOST COMPUTER PROGRAMS involve decisions and have branches in their structure. Although it may appear that the computer has a mind of its own you must always remember that it is only carrying out your instructions to the letter. The simplest type of branch involves testing a variable against another variable — or perhaps an absolute value — and taking some particular action in consequence.

The general form is If condition is true Then take action, for example:

```
10 IF A=B THEN GOTO 100
10 IF A=B THEN B=B+1
10 IF A=10 THEN STOP
```

The full form of this type of conditional branch is If condition is true, Then take action 1, Else take action 2, although the latter part is often omitted as, if the first part is untrue, the program will fall through to the next line anyway. Let us consider a situation often found at the start of a program:

```
10 PRINT "DO YOU WANT
  INSTRUCTIONS? (Y/N)"
20 INPUT Q$
30 IF Q$="Y" THEN 1000
40 .....rest of program
1000 .....instructions
```

As you presumably want to return to the main part of the program after reading the instructions Then Gosub 1000 may be better than Then 1000. The test as it stands is OK as long as some clown does not reply with Yes instead of just Y, but if we change 30 to:

```
30 IF Q$="Y" THEN 1000 ELSE IF
  Q$<>"N" THEN 20
```

then only Y and N are acceptable, any other key producing a request for another input.

If you have a complex decision point in a program, such as selection from a menu, then you can use several If-Then tests but things can soon start to look very messy and complicated:

```
100 IF A=1 THEN 1000 ELSE IF A=2 THEN
  2000 ELSE IF A=3 THEN 3000 ELSE IF
  A=4 THEN 4000 ELSE IF A=5 THEN
  5000 ELSE PRINT "TOO BIG"
```

In such situations On Goto or On Gosub can usefully be used instead. The form of this is On expression Goto line number list, where the line number which control passes to is determined by the value of the expression.

If numbers are used in the menu then these can be evaluated directly:

```
100 ON A GOTO 1000,2000,3000,4000,5000
  ELSE PRINT "TOO BIG"
```

To use the letters A to E instead of numbers 1 to 5 you can input A\$, determine the ASCII value of this, and then subtract 64 and continue with line 100:

```
80 INPUT A$
90 A=ASC(A$)-64
```

NO HOME COMPUTER will succeed without quality software and plenty of it. The Dragon 32 has been both praised and criticised for shying away from state-of-the-art technology in favour of the tried and tested. In spite of the unfashionable 6809 CPU quantity of Dragon software is not a problem, but how does the quality stand up?

Presentation varies widely from cheap cassettes with hand-written labels to custom-made book-type cases with program notes or separate detailed instruction manuals. Most of the programs were easy to load.

Since the Dragon and the Tandy Colour Computer use pretty much the same version of Microsoft Colour Basic, interconversion of programs was an obvious idea, although there are significant differences between the two machines.

As the cassette-operating systems differ, most Tandy tapes will not load on the Dragon, and only some Tandy cartridges operate correctly, as certain ROM routines are not identical. Only one software house — Microdeal — seems to have followed this route, via licensing deals, for some of the best Colour Computer machine-code software from the U.S.A. We found some of the original author credit lines intriguing as we thought Tom Mix was a pre-war western hero — although as the author of Donkey King and Katerpillar he is certainly no cowboy.

Assessing programs is always difficult as we all appreciate different things. An arcade-game freak looks for close similarity to the original but many people want originality rather than a re-hash of tired old ideas.

Most adventures were traditional text-only types which scarcely exploited the Dragon's capabilities, but they were quite cheap. Taipan is a trading game set in the China Sea, where you travel from port to port buying and buccaneering on the briny. Other adventure games take place in mazes where you roam around collecting valuable objects and weapons, and facing many perils. Scenarios range from seeking treasure in Egypt, questing for the Holy Grail, rescuing stranded potholers in the Mendips, and finding the Orb — whatever that is — we have not found it yet. Pharaoh's Curse from Apex Trading did not seem too powerful and we thought rescue from Death's Head Hole — by Words and Pictures — the most original and interesting.

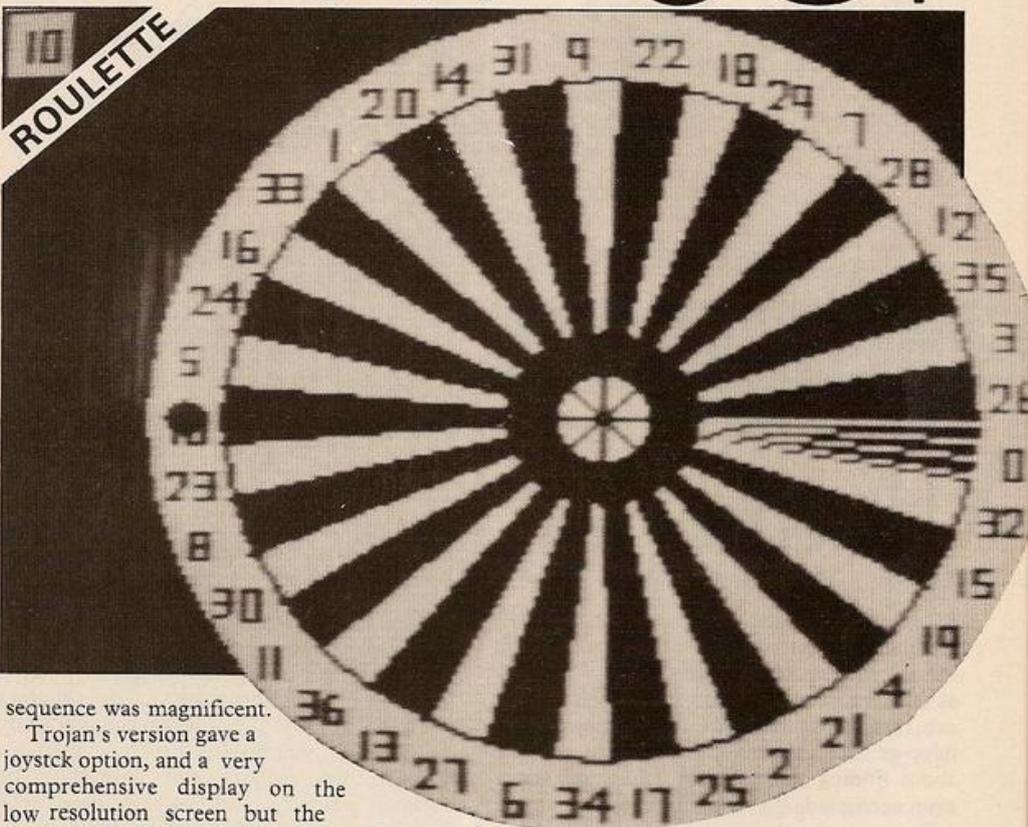
3-D Maze by Impact Software is graphics only and rather simple. It involves collecting treasure and finding your way out. On the other hand Phantom Slayer, written in machine code, is very fast. It is difficult to zap those hooded phantoms before they get you. If the first shot does not kill it, then run.

Starship troopers

Dragon Trek from Salamander, and Dragon Trek from S W Winter both featured mixed text and graphics on the high-resolution screen and were in real time. This means you cannot wait for ever to make your move. The Salamander version had the largest visual position display, an excellent damage control centre, nice messages from the crew and allowed you to steer photon torpedoes with a joystick, but we must say that the Winter version was also excellent value for money and the picture of the Enterprise in the title

DRAGON SOFTWARE

Once upon a time the Dragon was a fine machine with no software — but now the Brains have picked the best from 100 good programs.



sequence was magnificent.

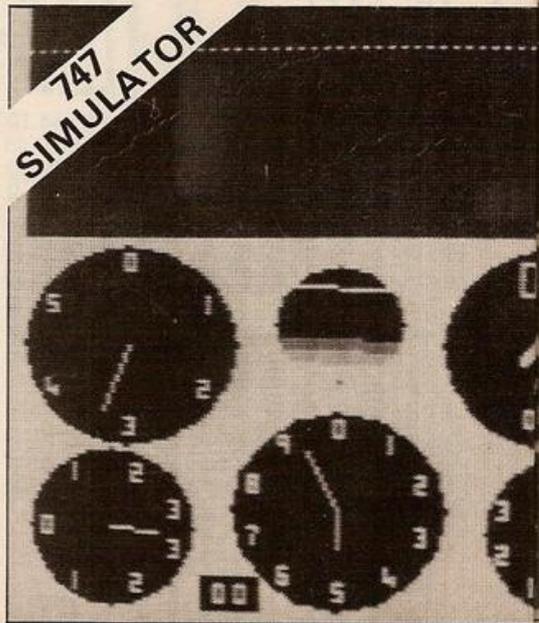
Trojan's version gave a joystick option, and a very comprehensive display on the low resolution screen but the commands were tricky to master. Impact's Star Trek was cheap, hence there are some limitations, but it is worth considering if your Pockets are feeling the strain.

Star Trek III finds it somewhat hard to compete at its price and the Barnsoft version, only using high-resolution in the introductory sequence — which seemed interminable — had very slow response to commands, and fighting Klingons seemed a pretty random process.

The most impressive adventure tested was S W Winter's The Ring of Darkness, which really flexes the Dragon's muscles. A series of sub-programs, each of which is loaded separately, under program control and each constituting a good game in its own right make up the fabric of this game. Having decided what sort of character you want to be, and what particular skills you need, you find yourself on a complex high-resolution map and set out on your search for four rings.

Do you visit a town or buy provisions, weapons or spells and perhaps do a little job on the side for the king, or do you explore deep dark 3-D dungeons infested with giant bats, rats and skeletons? How can you reach those islands, and can you cope with the constant attacks of various foes? A very complex adventure which could take a lifetime to solve. This soon displaced breakfast television in our house.

Many compendia of games, of varying quality, are on offer but all reviewed here offer a reasonable range of programs at a fair price and can be recommended, particularly to new users. The best buy must now be the recent Games Tape 1 from a new source — Active



SURVEY WARE

Software — which has taken some established ideas and implemented them beautifully using all of the Dragon's facilities cleverly. There are eight games, several of them as good as those offered elsewhere as individual cassettes.

In Interplanetary Trader you voyage the galaxy for blatant personal gain, dealing with the bank, and avoiding various perils, whilst keeping you ship in one piece.

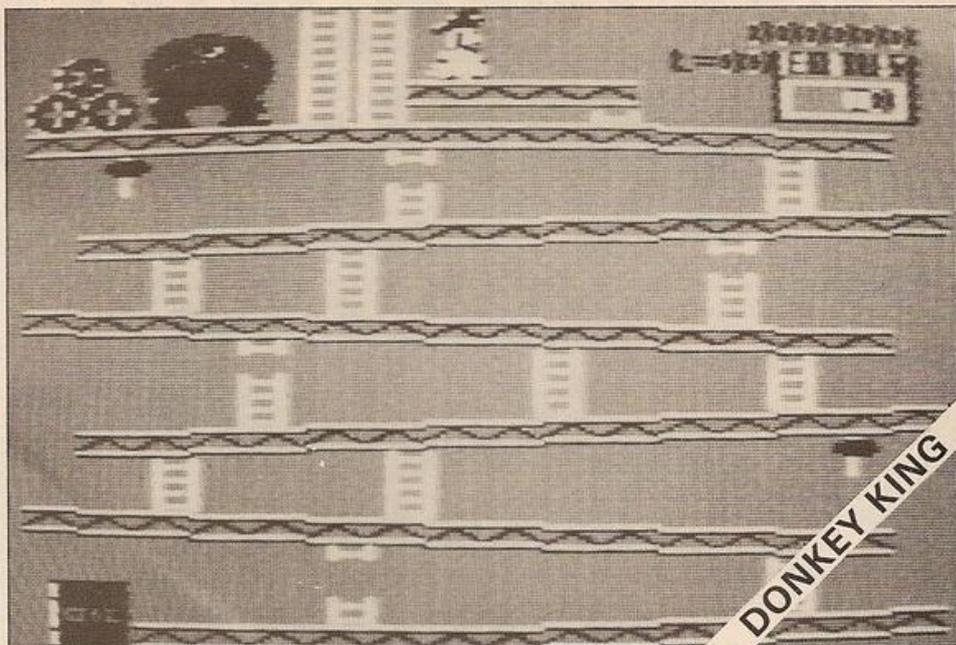
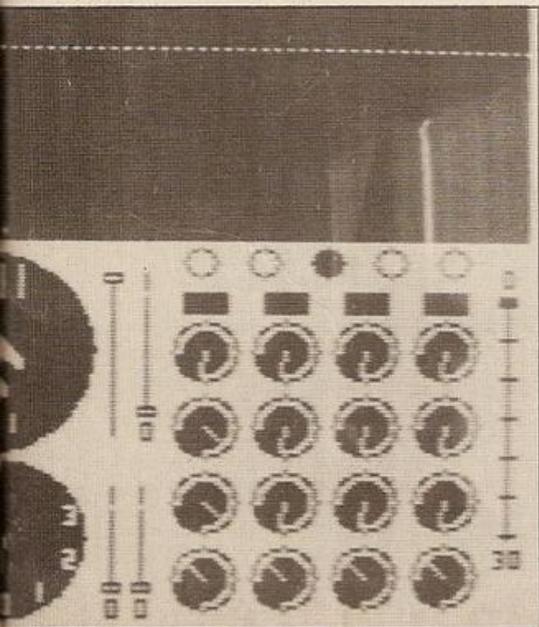
Execution is a colourful re-interpretation of Hangman with a first-class moving high-resolution display of a firing squad in place of the scaffold, and a tuneful rendering of the Mexican Hat Dance. Wumpus Mansion is a game with two mazes, you travel the first seeking treasure and avoiding Wumpi — revolting things — and race through the second if you have the misfortune to trigger a time-bomb.

Wipeout is a variant of the old snake idea. You slither around the screen collecting items, but not crossing or going back on your track.

Hi-Lo is rather like "Play Your Cards Right" but has the advantage of doing without Bruce Forsyth. Snail's Pace makes a change from horse-racing, and Atom Hunt requires some brainwork, but Air Assault is just good old-fashioned aggression as you bomb the city to make enough room to land your helicopter.

A series of innovative family-orientated multi-player games come from Shards Software. Dragon Fun and Games is excellent for children's parties.

The first Gem Pack, from Gem Software, offers four games of skill, the second Gem Pack offers two skill games plus two strategy games, and the third complex versions of Reversi and Pontoon.



J C Morrison's tapes are excellent for your arcade games fans as they each contain three diverse and very fast machine-code programs. DGT2 contains Snakes, Lander and Invaders and DGT4 feature Pterodactyl, Torpedo Run and Hornet.

Garland Software has released physics and biology programs, which are particularly useful to schools. All programs use both text and graphics, repeatedly question the user on his knowledge, and allow any section to be repeated.

Useful animation is included in Action of the Heart — showing blood flow and electrical activity — and Principles of the DC Motor — especially the perspective view of a moving motor at the end — and the Ohm's Law program features a useful simulation of an experiment which requires you to take readings from the screen, checks your accuracy and plots a graph of your results.

The educational value of these programs is high and our only real criticism is the jump-back from the high-resolution pictures to the text screen when user input is required, which makes it more difficult to consider your answer.

Skill may mean different things but arcade games are the highest test of reaction and co-ordination. Microdeal has an extensive range of first-class machine-code look-alikes of all the favourites. Planet Invasion is very hard and if you are fed up with zapping and being zapped then try Donkey King: rescue the fair maiden from that maniac gorilla with the endless supply of barrels by jumping and hammering at the right moment.

The popularity of golf programs was a surprise — surely people play golf to get out in the fresh air, or is the 19th hole merely a substitute for the one-armed bandits?

The best — for the true golfer — is Salamander's. It closely approximates the actual game procedure, includes wind, sloping greens and an obvious thud when your trajectory ends in a bunker. The use of a movable aiming point rather than compass directions is particularly good. Apex offer a much cheaper and quite reasonable high-resolution alternative. For the non-golfer who

just wants another game, or for youngsters, the low-resolution Handicap Golf from Computer Rentals is perhaps your cup of tea.

Grand Prix, from Salamander, allows one or two players to try their driving skill with the joystick on versions of all the major motor-racing circuits of the world, or if that is too easy what about flying a Jumbo Jet? 747 Simulator — from DACC — lets you try cold-start, warm-start and landing approach and has a very complex and realistic flight-deck display. Keeping control of the 747 is hard even without the occasional systems failures which were generated — I wonder what Boeing would have to say about this — and flying this program is a real simulation, rather than just another game.

Dragon slaying

Tenpin, by G Newman, was a reasonable simulation of bowling, including an accurate update of your score card on screen, but the ball was rather small and difficult to see. If you are stuck on the space theme UFO — Computer Rentals — allows you to pit your wits against 10 different types of alien ship and Luna Lander — St George Software — was quite difficult.

We nominated St George and the Dragon from Computer Rentals as the most original and amusing game. This is an animated graphics program in which you kill — or avoid — the fire-breathing dragon, cross a river, and smite a magic rock asunder with your sword to release the princess. Two versions were included, for joystick and cursor keys, the former being extremely difficult and the latter merely impossible. Killing the dragon is a cinch compared with balancing on the bridge and swimming with armour on.

If brainpower is your forte then consider the games of strategy. St George Software's Checkers was simple — and cheap — but still beat us, so what hope did we have against Salamander's three-dimensional Vulcan Noughts and Crosses. No wonder the latter has a zero player option where the machine tries to out-think itself as you sit back and watch in amazement. In MC Lothlorien's

(continued on next page)

(continued from previous page)

Samurai Warrior you have to weigh up which of your colleagues to fight to the death, but the graphics are rather slow and predictable. Tyrant of Athens, also by Lothlorien, is a better idea, representing the Hellenic Wars.

For those planning World War III there is the more complex Strategic Command from Romik where you build up and deploy your land and sea forces against the enemy. Keeping track of the entire disposition of your forces, and selecting targets, becomes difficult and we deplore the absence of an arms limitation conference option.

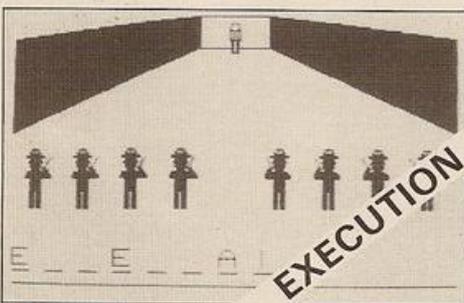
If money, rather than military might, takes your fancy then invite your friends in for a flutter at Charm Computer Software's Roulette, where the wheel stands still and the ball goes round, but the bank still wins. An alternative multi-player money game in Space Monopoly from Microdeal. You must select your outposts and make your investments with due regard to the possibilities of expansion and takeovers.

Wizard Wars from Salamander is a clever technological development of the old "Paper-stone-scissors" schoolyard game, in which teams of wizards select diabolical and protective spells as they battle to destroy each other. There is a whole book of complex spells with differing potencies, energy requirements, and possibilities of backfiring, to be learnt if you are to triumph.

An increasing range of Dragon utilities is appearing. Artist's Designer from S W Winter allows you to construct high-resolution

drawings with ease and also to write text on the high-resolution screen. Character Generator — Gem Software — allows you to define your own high-resolution character set on a nine by seven matrix, and Save this for use elsewhere. It makes character definition easy and detailed written instructions are supplied, but in use text appears rather slowly as PSet rather than Draw is used. An interesting 3-D demonstration of the manipulation of an image in three-dimensions is included.

Micro Music Map, from Cotswold Computers, is a chart giving conversions from



sheet music to Dragon Play format, particularly useful to non-musicians who want to include tunes in the program.

Compusense's Demon — cartridge — and PSS's Dragbug — cassette — both provide monitors which allow you to inspect and modify memory and register contents so that you can create your own machine-code programs. As the main part of Demon resides in the cartridge area, little user memory is taken up and, whilst Dragbug includes a dis-

assembler and a printer driver, Demon allows you to inspect memory in ASCII format, and include various monitor subroutines in your own programs. Demon also comes with clearer instructions, and is compatible with other software to be released by Compusense — including an editor-assembler. The disassembler from Rampage gives output of selected memory contents to screen and printer in standard 6809 mnemonics.

The two text-processors Telewriter from Microdeal, and Textstar from PSS, could both be used as word processors and indirectly, to produce and edit Basic programs with the benefit of a full-feature editor. In this application the value of the Dragon's "real" keyboard becomes particularly apparent. Both programs provide a useful range of text-handling facilities including full-screen editing, moves, search and replace, formatting, cassette saving and merging. Textstar also includes alphabetical and numerical sort, line and column display, and right justification, and is relatively inexpensive, but it uses the normal limited Dragon text screen and character set. As a real word processor Telewriter — U.S. transplant via Microdeal — is much more practical as it provides true upper and lower case characters on a black-on-white, 51 columns by 23 lines screen display. This accepts a wide range of printer control functions, block copy and delete, selective search and replace, word and line count, page-numbering, Verify, auto-retry during file search, partial Save and Print, queueing of

(continued on page 45)

Type	Supplier	Players	Price	Originality	Accuracy	Type	Supplier	Players	Price	Originality	Accuracy	
Adventures						Dragon Space Mission		10	1	£7.95	—	***
Text only						Dragon Monster Mine		10	1	£7.95	—	***
Orb	11	1	£5.00	**	—	Katerpillar		14	1 J	£8.00	—	****
Pharaoh's Curse	2	1	£4.95	**	—	Invaders Revenge		14	1-2 O	£8.00	—	****
Rescue from Death's						Planet Invasion		14	1 J	£8.00	—	****
Head Hole	25	1	£4.45	***	***	Scarfman		14	1 O	£8.00	—	****
Taipan	12	1	£5.00	***	**	Dragon Gold		10	1-2	£7.95	*	**
The Quest	11	1	£5.00	**	—	Golf		20	1-2	£7.95	****	*****
Graphics only						Golf		2	1-2	£4.95	**	***
Phantom Slayer	14	1	£8.00	****	—	Handicap Golf		6	1-2	£6.95	**	***
3D Maze	11	1	£5.00	**	—	Grand Prix		20	1-2 J	£7.95	—	****
Text and Graphics						Luna Lander		22	1	£4.00	—	***
Ring of Darkness	24	1	£10.00	*****	—	St George and the						
Star-Trek						Dragon		6	1 O	£6.95	*****	—
Dragon Trek	24	1	£6.99	—	****	Tenpin		16	1	£7.00	—	****
Dragon Trek	20	1 J	£9.95	—	*****	UFO		6	1 J	£6.95	—	***
Space Trek	23	1 O	£7.50	—	****	747 Simulator		8	1 2J	£9.95	—	****
Star Trek	3	1	£6.50	—	**	Strategy						
Star Trek	11	1	£5.00	—	***	Checkers		22	1	£3.50	*	****
Star Trek III	22	1	£8.00	—	***	Roulette		4	1-9	£4.95	***	****
Compendia						Samurai Warrior		13	1	£6.95	**	**
Dragon Family Programs	21	V	£6.00	****	—	Space Monopoly		14	2-4	£8.00	****	***
Dragon Fun and Games	21	V	£6.00	****	—	Strategic Command		19	2 2J	£9.99	****	***
Games Compendium	20	V	£7.95	***	—	Tyrant of Athens		13	1	£6.95	**	***
Games Pack 1	10	V	£7.95	**	—	Vulcan Noughts and						
Games Pack 2	10	V	£7.95	**	—	Crosses		20	0-2	£7.95	***	—
Games Pack 3	10	V	£7.95	—	****	Wizard War		20	2-9 2J	£7.95	—	—
Games Tape 1	1	V	£5.75	*****	—	Utilities						
Dragon Games 2	15	1	£6.95	—	****	Artist's Designer		24	O	£6.99	**	—
Dragon Games 4	15	1	£6.95	—	****	Character Generator		10		£9.95	**	—
Educational						Demon		5		£18.40	****	—
Action of the heart	9	—	£11.00	***	****	Disassembler		18		£5.00	*	—
Digestive system	9	—	£9.90	***	****	Dragbug		17		£9.95	**	—
Ohm's Law	9	—	£9.00	****	****	Micro Music Map		7		£3.50	***	—
Principles of the						Telewriter		14		£50.00	*****	—
DC motor	9	—		****	****	Textstar		17		£11.95	***	—
Skill						Threedee		22		£5.00	***	—
Defence	14	1 H	£8.00	—	****							
Donkey King	14	1-2 J	£8.00	—	****							

Table of games reviewed. J means joysticks required; O means joysticks are optional, and V means the number of players varies.

PLAY YOUR CARDS RIGHT

THE INTEGRAL EXPANSION SYSTEM FOR VIC-20



Congratulations for choosing one of the best home computers around. Unlike Commodore, we still think that the VIC 20 is great, and doesn't need replacing by a big brother. Here is the result of careful design, bearing in mind many similar products from Commodore, Stack and Arfon: an integral expansion system which is practical, reasonably priced and compatible with Commodore products and many others. The system features many exclusive qualities in addition to those of its competitors. It consists of 4 items, each of which may be purchased separately and used independently.

● **3 SLOT MOTHERBOARD:** This is a simple box plugging straight into the VIC 20, providing support for various cartridges. It comes with a switch to isolate the Super Expander Cartridge from Commodore, a switch to simulate games cartridges, a battery back up connector* and there is also room for 8K of extra Ram if required*.

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● TECHNICAL SPECIFICATIONS

MOTHERBOARD: 3 x 22 way gold plated connectors. Accepts all Commodore cartridges. Accepts Toshiba 2016 or Hitachi 6116 CMOS Ram (qty: 4). Write protect switch fitted. Mode switch and battery connector fitted only when supplied with 8K Hitachi Ram.

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(Continued from page 42)

cassette files for Print, and repeat headers. Cassette files are saved as very compact machine-code dumps rather than the extremely slow ASCII format used by Textstar.

Four different versions, optimised for different printers, are included, together with a conversion program for work on Basic programs. First-class documentation comprising a step by step tutorial and a reference manual are included and Telewriter represents excellent value as a word processor for the serious Dragon user which, at £50, looks very good in comparison with Wordcraft for the Vic-20.

CONCLUSIONS

- An excellent range of games software for the Dragon has emerged, at prices which compare well with material for competitive machines, and substantial offerings on the serious side are now appearing, all of which augurs well for the future of Dragon Data.
- Various rumours are circulating about hardware modifications, ROM bugs and RAM reconfiguration which can cause problems on some machine-code programs, so if you have a program that runs into difficulties consult your supplier.
- One point to watch when using programs one after the other is the last

Software suppliers. Numbers correspond with those given in the table of games reviewed.

- | | |
|--|---|
| 1 Active Software, 32 Moors Lane, Northfield, Birmingham B31 1DH. | 14 Microdeal, Deal House, Luxylan, Bodmin, Cornwall PL30 5EF. |
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| 4 Charm Computer Software, 243 Shirley Road, Acocks Green, Birmingham B27. | 17 PSS, 452 Stoney Stanton Road, Coventry CV6 5DG. |
| 5 Compusense, PO Box 169, London N13 4HT. | 18 Rampage, 32 Birchwood Drive, Wilmington, Dartford, Kent DA2 7NE. |
| 6 Computer Rentals, 140 Whitechapel Road, London E1. | 19 Romik Software, 24 Church Street, Slough SL1 1PT. |
| 7 Cotswold Computers, Park Hill, Hook Norton, Oxfordshire. | 20 Salamander Software, 27 Ditchling Rise, Brighton, East Sussex BN1 4QI. |
| 8 DACC, 23 Waverley Road, Hinderley, Greater Manchester WN2 3BM. | 21 Shards Software, 10 Park Vale Court, Vine Way, Brentwood, Essex, CM14 4UR. |
| 9 Garland Computing, 35 Dean Hill, Plymouth PL9 9AF. | 22 St George Software, 6 Storrsdale Road, Liverpool L18 7JZ. |
| 10 Gem Software, 22 Prestwick Drive, Bishop's Stortford, Hertfordshire CM23 5ES. | 23 Trojan Products, 166 Derlwyn, Dunvant, Swansea SA2 7PF. |
| 11 Impact Software, 70 Redford Avenue, Edinburgh EH13 0BW. | 24 S W Winter & Co, 101 Westminster Bridge Road, London SE1. |
| 12 Jaysoft, 6 Wentworth Drive, Bishop's Stortford, Hertfordshire. | 25 Words and Pictures, 7 Hawthorn Crescent, Burton-on-Trent DE15 9QP. |
| 13 M C Lothlorien, 4 Granby Road, | |

state of the reserved graphics pages. These can easily cause out-of-memory errors on the next program if you do not turn off between programs.

■ A final word to small suppliers —

please remember multiple copies are really no substitute for a decent recording. There is nothing so frustrating as a program that will not load.

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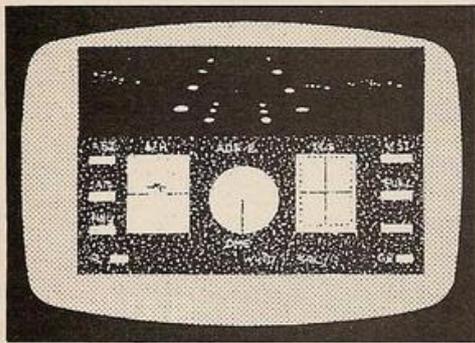
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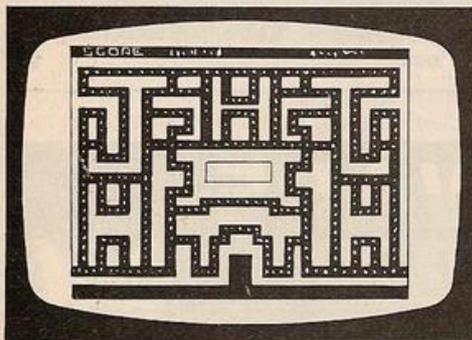
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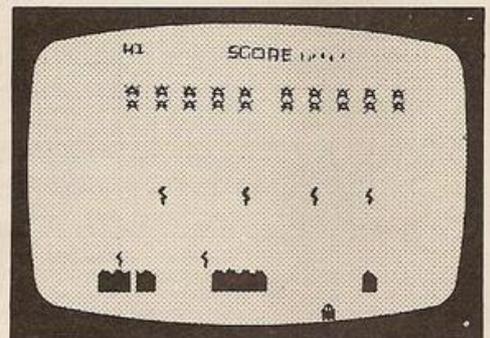
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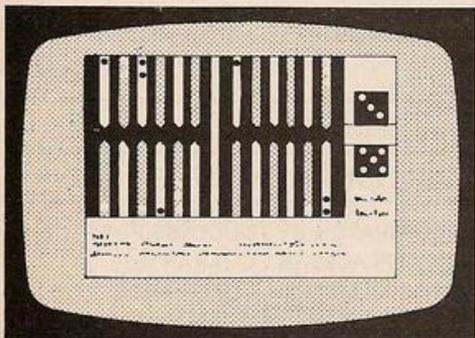
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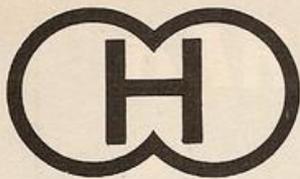
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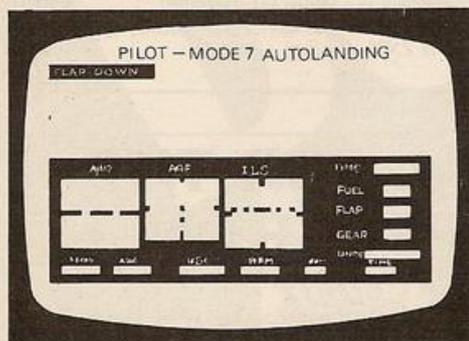
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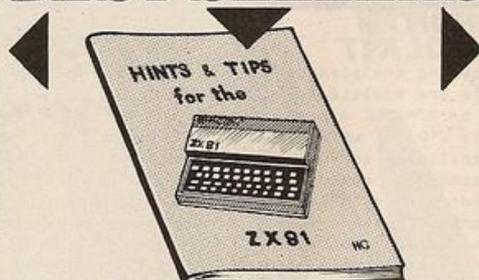
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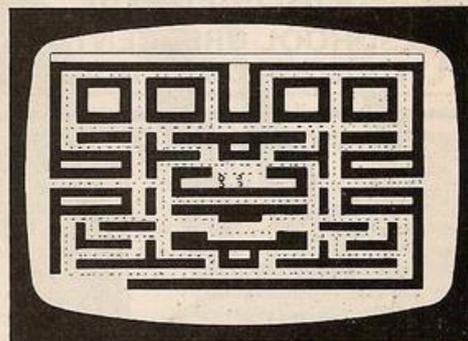
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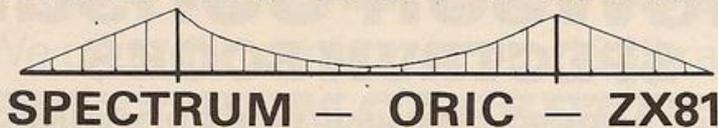
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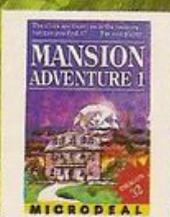
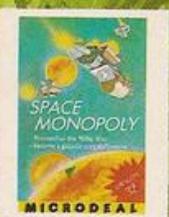
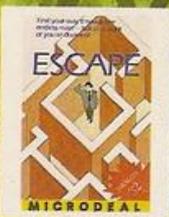
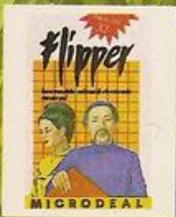
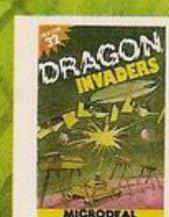
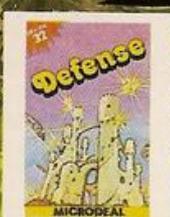
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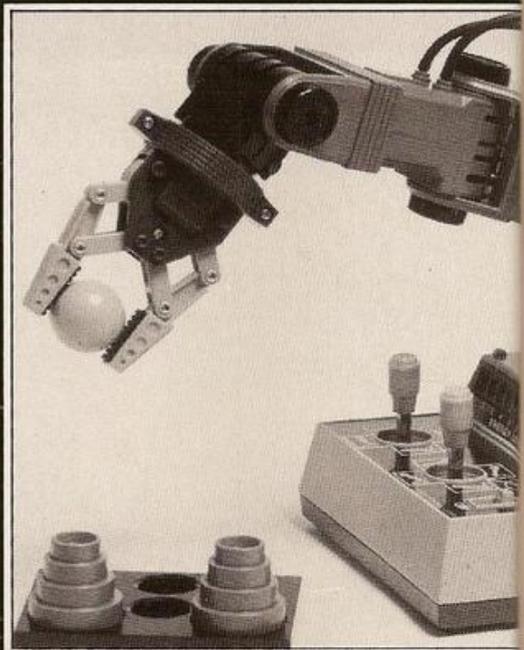
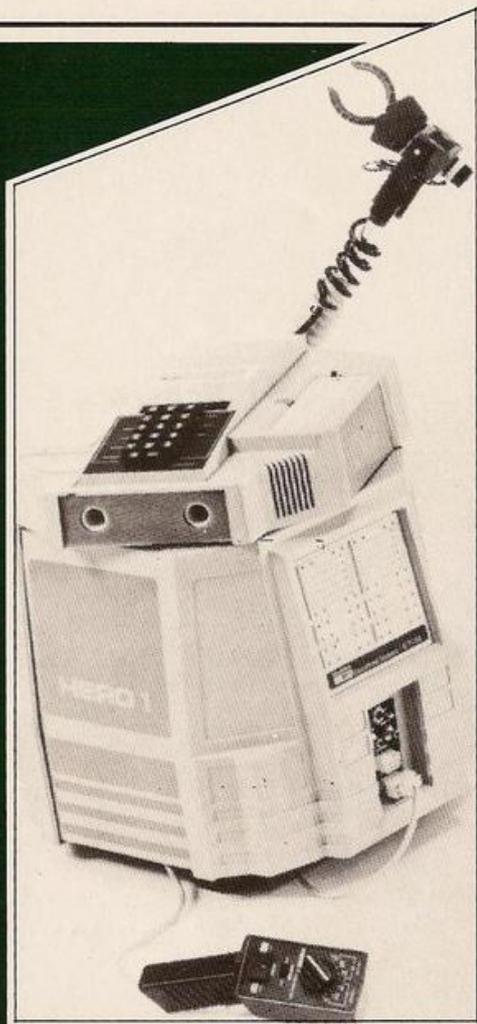
The Buggy's only competition comes from the Japanese toy industry and infant American domestic robot industry.

Tomy's Robo 1 was the star of the British Toy Fair at Earl's Court. A toy version of an industrial robot arm, it is battery run and controlled by two joysticks at the base. The arm itself can be swung up and down through 180 degrees and turn 360 degrees horizontally. Further dexterity is provided by the wrist which can swivel in almost any direction. By controlling the Robo 1's claw hand the operator can grip, pick up, rotate, move and release objects with remarkable precision. This is a well constructed and absorbing toy which sells for just £30.

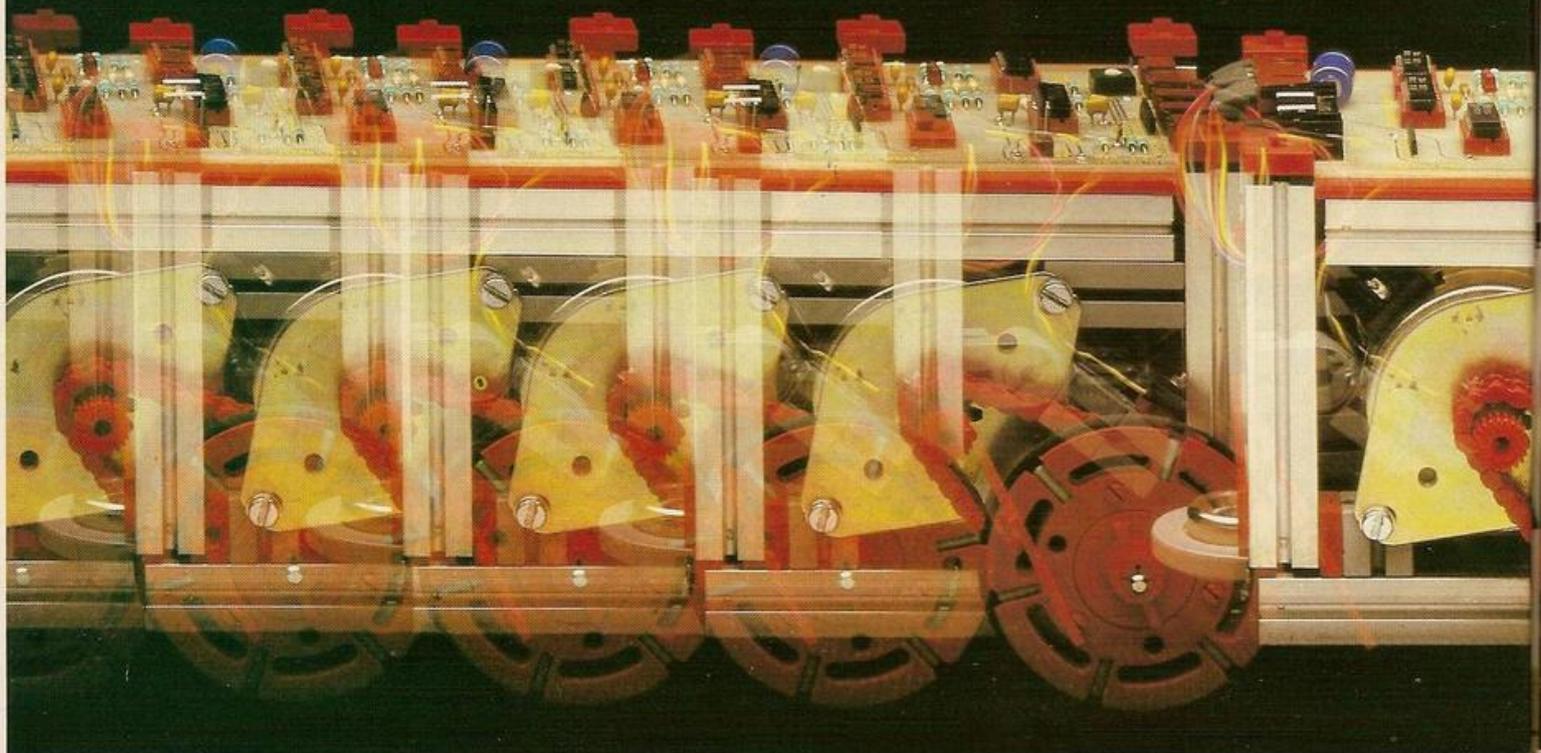
Like the Buggy the Hero-1 is a programmable three-wheeled vehicle driven by two stepper motors and sold in kit form. Looking like a cross between Dr Who's K9 and Star Wars R2D2 it more closely conforms to the popular idea of a robot. Unlike the Buggy the Hero-1 is self-contained with an on-board microprocessor and its own battery power supply. It uses a 6808 processor with 4K RAM and 8K ROM. Instructions are entered via a hexadecimal keypad.

The Hero-1's range of sensors is far more extensive than the Buggy's. As well as a light detector it has detectors which can sense sound, motion and distance. It uses a sonar system to work out the distance of objects within a range of eight feet. There is also a built-in clock and options for a speech synthesiser and gripper arm.

This is obviously a more sophisticated package than the Buggy and a much more expensive one. In the U.S.A. the Hero-1 robot kit sells for \$1,000 without the arm and speech synthesiser. Heath Electronics U.K. will be launching a fully-assembled version including the arm and synthesiser for £2,455



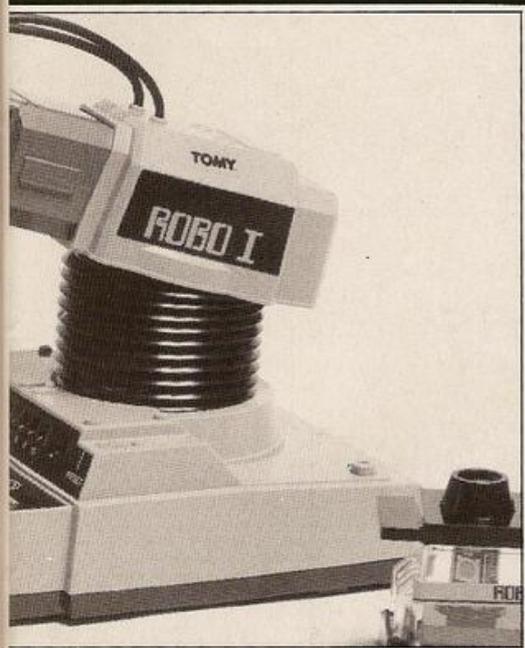
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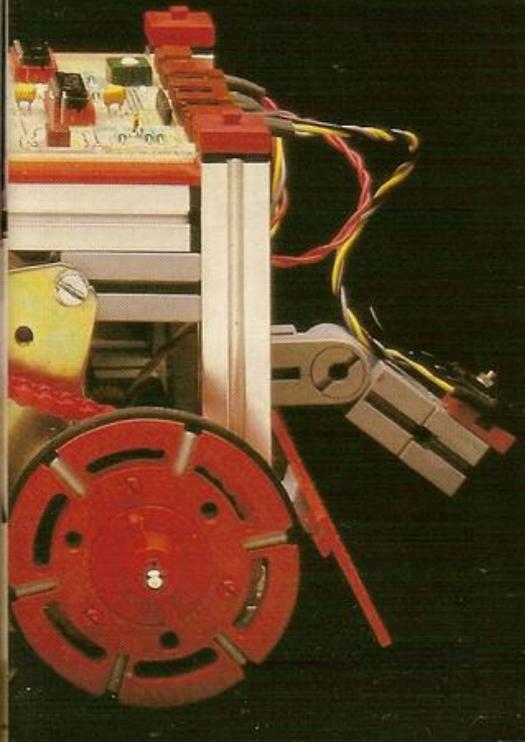
REVIEW

which will be available later this month.

But in some ways the Buggy offers the user greater scope for exploring robotics. It is easier to program and the BBC Microcomputer allows for more versatile software applications than the Hero-1's on-board computer.



ROBOTS



Designed for the home.
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Tested by Simon Beesley.
Buggy — the world's first
affordable robot.

BBC

BUGGY

IF YOU HAVE grown tired of all those video games and have exhausted your machine's programming potential you can now revive your interest in computing with the BBC Buggy. This is a three-wheeled vehicle which can be controlled by a BBC Micro and programmed to move in any direction, detect collisions, detect light, read a bar-code, and operate a pen-up/pen-down mechanism. In short it is a robot — and at around £120 it is the first to come within the range of the home computer user rather than the electronics hobbyist.

The Buggy is the fruit of a collaboration between the BBC Computer Literacy Project and the Microelectronics Education Programme. After discussing ideas for the BBC's *Making the Most of the Micro* series with producer David Allen, Mike Bostock, Technology Manager for the MEP, built a prototype Buggy using Lego bricks. "Everyone wants to build a robot", he says, "and at the age of 33 I finally built one".

When the Buggy goes on sale this month it will come as a construction kit containing a chassis, two stepper motors, three types of sensor, control cables and electronic circuit boards. To go with it there is a tape with 13 programs, documentation, a Buggy handbook and assembly instructions.

Fortunately the review robot arrived ready-built so we did not need to test the claims of Buggy-maker Economatics that the kit can be easily assembled in about two and a half hours using only a screwdriver.

The main body of the vehicle is a five-inch cube driven by two stepper motors which turn the front wheels. At the back there is a ball-bearing which acts as a balance wheel for the vehicle.

Using stepper motors greatly simplifies steering the Buggy since the motor can only be advanced by a fixed step at a time. This allows precise control of the vehicle's movement. Each motor has independent control over its respective wheel and the gearing is such that a single pulse to the motors rotates the Buggy by one degree.

It is comparatively easy to send the Buggy a specified distance forwards or backwards, or rotate it through any given angle. The two motors drive the vehicle at a rather stately pace with sufficient power for it to authoritatively brush aside obstacles such as books, in bulldozer fashion.

Top speed was measured at one and half miles per hour — hardly enough to trouble the man with the red flag. At the front is a split bumper with left and right microswitch collision detectors and above it a light detector — LDR. There is also a bar-code reader — BCR — mounted on a hinged arm which extends between the bumper and the LDR.

This consists of an infra-red light-emitting diode — LED — and photo-diode which respectively send out and receive infra-red light. The BCR detects a black line by measuring the amount of light it reflects. My only criticism of the vehicle's design is that the BCR arm is inconveniently positioned. Although it can fold back it tends to prevent the bumpers below from registering a head-on collision.

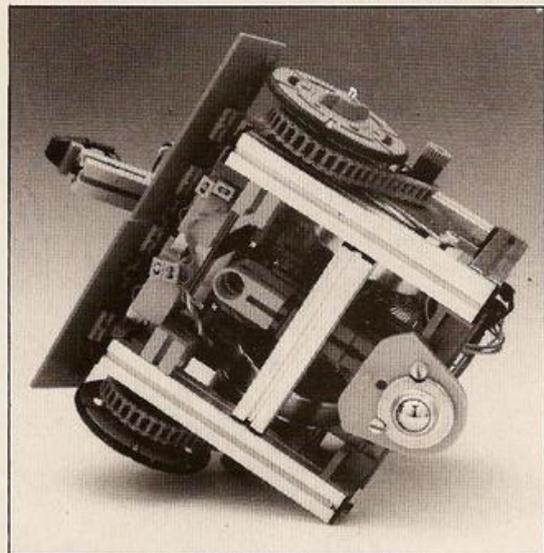
Logo-style turtle

In the Buggy's centre of rotation there is a pen-up, pen-down mechanism which is mounted on the centre axle and controlled by an electro-magnet. This will permit the Buggy to be used as a Logo-style turtle. It is not quite as accurate as a dedicated Logo turtle but is £180 cheaper.

On the BBC Micro the Buggy is controlled through the user and analogue-in ports. Both the LDR and BCR return an analogue input proportional to the intensity of light measured. The collision detectors send a digital on/off signal to the user port.

Each of the user port's eight bits provides a control line. Four of the lines from the user

(continued on page 53)



Dragon's Lair

I thought it would be easy . . . explore the Dragon's Lair and find the Crystal of Power with which to destroy him. But I didn't count on the dangers that confronted me. There were others in that mind boggling maze too!

The Ultimate 3D Maze-Adventure, for the 48K ZX Spectrum.

Joust

It's taken America by storm — now it's available for your ZX Spectrum! In this amazing new arcade game you Joust with the Dark Lords in an other-worldly setting. Quite amazing animation as you fly your Ostrich by controlling the flap of its wings! By Andrew 'Orbiter' Glaister

MONSTERS IN HELL

It was like a nightmare. Trapped in Hell, the all consuming flames below me, running from the Vampire monsters through a maze of platforms and ladders. I had Holy Power on my side, though, and could survive if I replenished it frequently. And the only way to kill them was to make them fall through holes I created with my hammer. But then the Mad Monk sent his ghouls after me . . . Any ZX Spectrum. By Mark Lewis

COSMIC SWARM

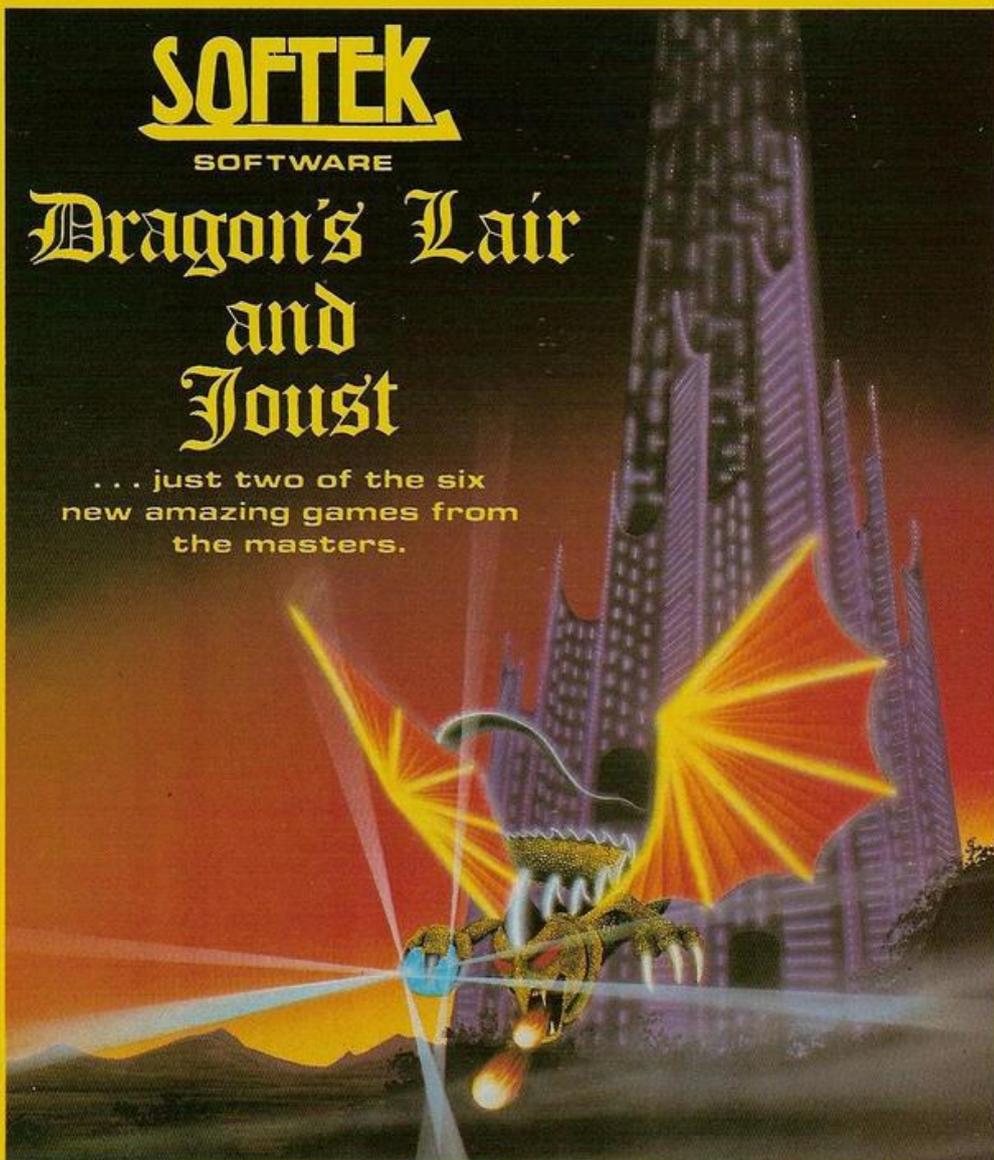
OK, I accept I'm to blame. I disregarded orders and entered the Altair sector. Eggs, eggs, everywhere — I shoot, two fantastical alien types appear, whose touch is deadly! They join, seemingly by chance, into a mutant which chases me! Probably the most original new space 'shoot-em-up' game to appear. Any ZX Spectrum. By Andrew Beale

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SOFTWARE

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new amazing games from
the masters.



MILLIPEDE

Milli the Millipede seemed indestructible; no matter how much of her body I shot away she kept coming! But then Sid the Spider appeared from nowhere, and Scorpi zoomed across dropping her indestructible fleas on me! A quite astounding version of the arcade favourite. £5.95. By Andrew Blake

FIREBIRDS

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ZX SPECTRUM SOFTWARE

(continued from page 51)

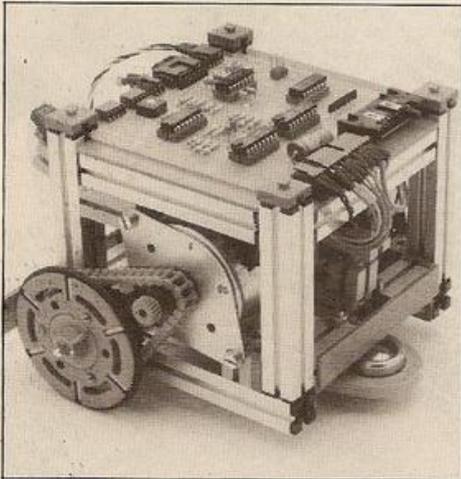
port are used to control the stepper motors; one bit is used to turn on and off the electro-magnet for the pen-up, pen-down mechanism, and two further bits are allocated to register the left and right collision switches.

I was pleasantly surprised at how easy it was to write controlling software for the Buggy. Once I found out how to write to and read from the user port it did not take long to write a short program to steer the Buggy from the keyboard, detect collisions and operate the pen.

Although the Buggy only runs on a BBC Micro at present, it should be possible to drive it from any micro with an eight-bit parallel port. Machines without analogue ports would be at a disadvantage and would require additional hardware to give the light sensors an on/off reading. Economatics is contemplating adapting the Buggy for the two machines on the DoI's list of recommended micros for schools — the Spectrum and Research Machines 380Z.

A robot can be described as an artificial intelligence in an artificial body. While the vehicle itself provides the body the BBC Micro or rather the programs it can run supply the intelligence. Along with the electronics and ironmongery almost 100K of software is supplied with the kit. The programs are graded and designed to take the user step by step up the artificial intelligence ladder.

In the process they show how a computer



can be used with a robot as a switching device, a memory, a graphics terminal, a programmable device, an information processor and a problem solving unit. Since they demonstrate what the Buggy is capable of they are worth describing in some detail.

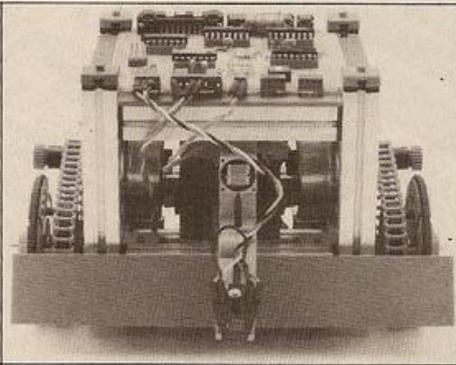
Test, the first program, checks that the Buggy is correctly set up and enables the user to test the sensors, displaying their input on the screen. This is followed by Switch, a short program, which lets you drive the Buggy in any direction by pressing the cursor keys. The vehicle is quick to respond and can be readily steered hither and thither.

As an advance on this facility Memory Switch records the key presses and can replay them in their sequence or in reverse order. This demonstrates how precisely the Buggy's movement can be controlled sending the Buggy along quite a complicated route several metres long and then commanding it to return,

bringing it back to within a few centimetres of its starting position.

Recorder draws a map on the screen of the Buggy's progress while giving readouts of its position in an instrument panel below the map. Collisions are registered with a convincing crashing sound. Snail likewise plots the Buggy's path but also allows you to give it a coded sequence of instructions first, such as R30 or F50 meaning Turn Right 30 degrees or Go Forward 50 centimetres.

There are two programs which show how the Buggy can read in quite complex information from bar-codes. In Tin Pan Alley it reads musical information from a line of bar-codes, plays the tune and displays an animated score on the screen. Bar-Code Route Planner



instructs the Buggy to follow route instructions given on bar-code cards.

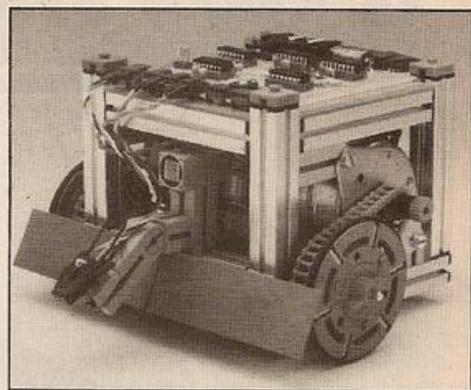
The remaining programs, in which the robot appears to act under its own control, demonstrate some of the principles of artificial intelligence. The Buggy is instructed to perform such tasks as seeking out an object and working out its size, following a black or white line, and measuring an enclosed area. Sunseeker programs the robot to track down a light source.

Once it has located its goal it homes in negotiating any objects in its way. Man versus Buggy requires the user to perform the same task — to drive the Buggy from the keyboard using the same information as is available to the computer which it presents on an instrument panel.

As soon as the vehicle starts to move in a purposeful manner it is difficult not to ascribe intelligence to its behaviour. One of the Buggy's predecessors, Dr Grey Walter's tortoise was a three-wheeled vehicle which could travel around a room avoiding obstacles. It was programmed to look for a power point to plug itself into and recharge its batteries when they ran low. Onlookers tended to feel empathy with it in its quest. The Buggy can provoke a similar response. It is bound to be a success in schools.

The 13 programs in the software kit are written in Basic and the procedures they contain can be incorporated in the user's own programs. There is clearly scope for more advanced artificial intelligence applications.

People who saw the Buggy on the BBC's *Making the Most of the Micro* series will have seen it finding its way around a maze until it reached a light source at the end and then returned to the start. If the robot were fitted with a grab-arm it could for example be programmed to demonstrate the principles of



the computerised warehouse. It would use the BCR to follow a line to a set of pigeon holes, then locate a pigeon hole which had been lit up, remove an item with a grab-arm, read its bar codes and use the information given to docket it elsewhere.

A grab-arm is one of the hardware expansions Economatics is considering. Other possibilities could be in the form of extra sensors such as a proximity detector or a heat detector.

The MEP stresses that the robot should not be seen just as a toy. But the term toy need not be applied dismissively. After all for most owners' home computers have no practical application and could be described as adult toys. Whether or not everyone wants to build a robot, the idea of controlling a robot exerts a fascination for most people. The Buggy's inventor Mike Bostock frankly describes it as "modern day Meccano."

People are not so much interested in the practical role of robots as uncomplaining drudges capable of performing menial tasks, as in their ability to carry out more complex and intricate routines. Linking the Buggy to the BBC Micro gives it considerable potential for such exercises in artificial intelligence.

The MEP which developed the Buggy sees it as finding a place in both the home and school. Andrew Hopkins who has written the manual describes it as one solution to the problem of introducing more technology into the curriculum. Whatever its application the Buggy is certainly enjoyable to play with as well being a useful introduction to control technology and artificial intelligence.

CONCLUSIONS

- The Buggy may not be able to do the washing-up or the housework for you but it can provide an excellent introduction to robotics and control technology.
- As an educational device which has its place in many different parts of the curriculum the Buggy should be very popular. It is fun to use and easy to operate. Its low cost also puts it within the reach of home computer users who are interested in robots.
- The Buggy's capabilities are well demonstrated by the 13 programs which accompany it. These do not exhaust its possibilities and there is plenty of scope for a variety of more complicated applications. ■

TEN YEARS AFTER Textet drove Sinclair out of the pocket calculator market the TX-8000 is ready to take on the ZX-81 and the Spectrum. As with the calculators Textet hopes to win customers by aggressive pricing. But although the £98 TX-8000 is now the cheapest colour micro — by a whisker from the Oric and by £27 from the Spectrum — it has only 4K RAM as opposed to the 16K of its rivals.

The Z-80 based TX-8000 has a specification that, on paper, looks very good compared with the ZX-81. When it is compared with, for example, that of the Oric, then a number of weaknesses become apparent.

Of the three colour computers under £125 — the Spectrum, Oric and TX-8000 — the TX-8000 is the largest. Its case is made of a cream plastic, which feels more brittle than the plastic used for its rivals — but it would still require an act of malice to break it. The design of the case is not as polished as that of its rivals, but it does have a gently sloping front which means the keys actually face the user.

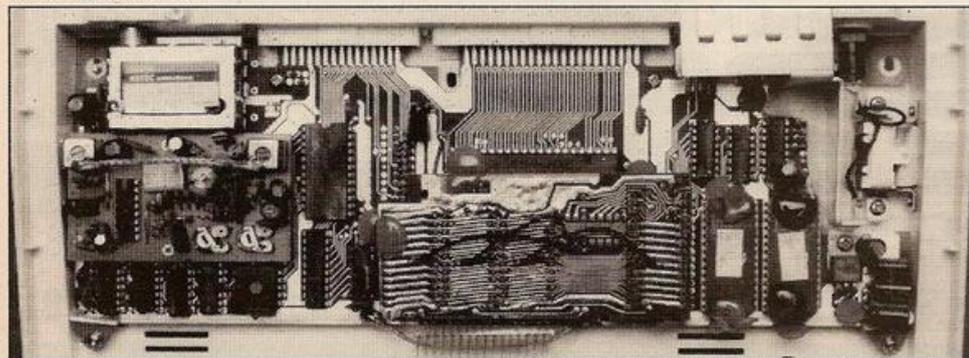
The dimensions of the case are 12in. wide by 6in. deep, 2in. high at the rear and 1in. high at the front. The panel containing the keys is dark brown and sunken into the body. There are 45 keys in a rubber keyboard which is very similar to that of the Spectrum. Not only do the keys squash down in the same way they even have that distinctive clammy feel to them. If anything the Textet keyboard feels worse than the Spectrum's.

Individual keys are smaller than on the Spectrum, but there are more of them. Keyboard layout is based on the usual QWERTY typewriter formation, which the TX-8000 mimics better than the Spectrum. This necessitates fewer key depressions, especially in the case of punctuation symbols which can only be achieved by a shifted key on the Spectrum but have their usual typewriter keys on the TX-8000.

Above the first eight number keys there are the corresponding colour names; yellow, blue, red, buff, cyan, magenta, orange and green. This is the same colour set as on the Spectrum but with the addition of buff and orange. Interestingly, there is no black or white, which look in theory to be unobtainable.

When using the keyboard the letter pressed is what appears on the screen, even though certain Basic keywords are printed above and below the keys. The keywords are accessed by the kind of finger gymnastics that put me off the Spectrum when it first appeared. Alongside the keyboard is a power light which tells you when the machine is on, which

With internal circuitry that looks like this (below) it is not surprising that colours are displaced by half a character on screen.



£98 TEXET TX-8000

sometimes is not apparent from looking at the screen.

On the right-hand side of the machine is a rocker-type switch, to turn the power on and off. This is a welcome feature, as anyone using a Spectrum or ZX-81 will know that the continual insertion and removal of the power supply plug eventually works it loose. So a cold reset — that is a reset of the computer which clears the RAM — is a simple operation.

Although the machine is marketed in this country as the Textet TX-8000, elsewhere it is known as the Video Technology VZ-200. This is taking badge engineering to new heights. The Textet is exactly the same as the Video Technology machine except for the VZ-200 badge. Both machines are manufactured in Hong Kong, the factory-door price of the VZ-200 being \$66 — less than £45.

The real significance of this similarity is that there are a number of interesting peripherals available for the VZ-200, which will work with the Textet. These include: 16K and 64K Ram extensions, joysticks, printer, light-pen, Modem, disc-drives and bar-code readers. There is also an interface unit which allows you to use any standard text or graphics printer. All these add-ons are manufactured by Video Technology in Hong Kong and will be available in the U.K. from Textet. Projected prices are: printer, £129; 64K Ram expansion, £52; £8 for a single paddle and £60 for a pair of cordless remote control joysticks.

Opening up the inside of the Textet is like digging in the garden of the Cricklewood house of horrors. A number of vaguely familiar objects are recognisable amongst the mess even though all the identifying codes on the chips have been painted out to preserve their anonymity. There is a black and white model of the VZ-200 in Hong Kong and one look inside the case of the Textet shows that it is basically a black and white computer that

has been converted for colour. The colour circuitry is antique by the standards of the Oric or the Spectrum, with a large number of presets, pots, coils and resistors.

On the rear of the machine are the usual power and TV output sockets. In addition there is a tape socket, which unlike conventional tape sockets is a stereo jack socket — the kind used on portable hi-fis. This connects to two mono jack plugs, red and black, the red one being the Ear connection and black the Mic.

There is also a monitor output — which will not work with most monitors. Also along the back of the machine, but covered by a couple of aluminium panels are the bus expanders. One is marked Memory Expansion and the other, Peripheral. This may imply that only one peripheral can be connected at a time. The panels are attached to the computer by two tiny screws.

Power for the micro comes from a transformer which would plug straight into the power socket except that it has a two-pin electric shaver-type plug. This needs a special adapter to enable it to be used with domestic U.K. power sockets. Unfortunately the pennies this adds to the price of the micro makes the Textet only a pound cheaper than the Oric.

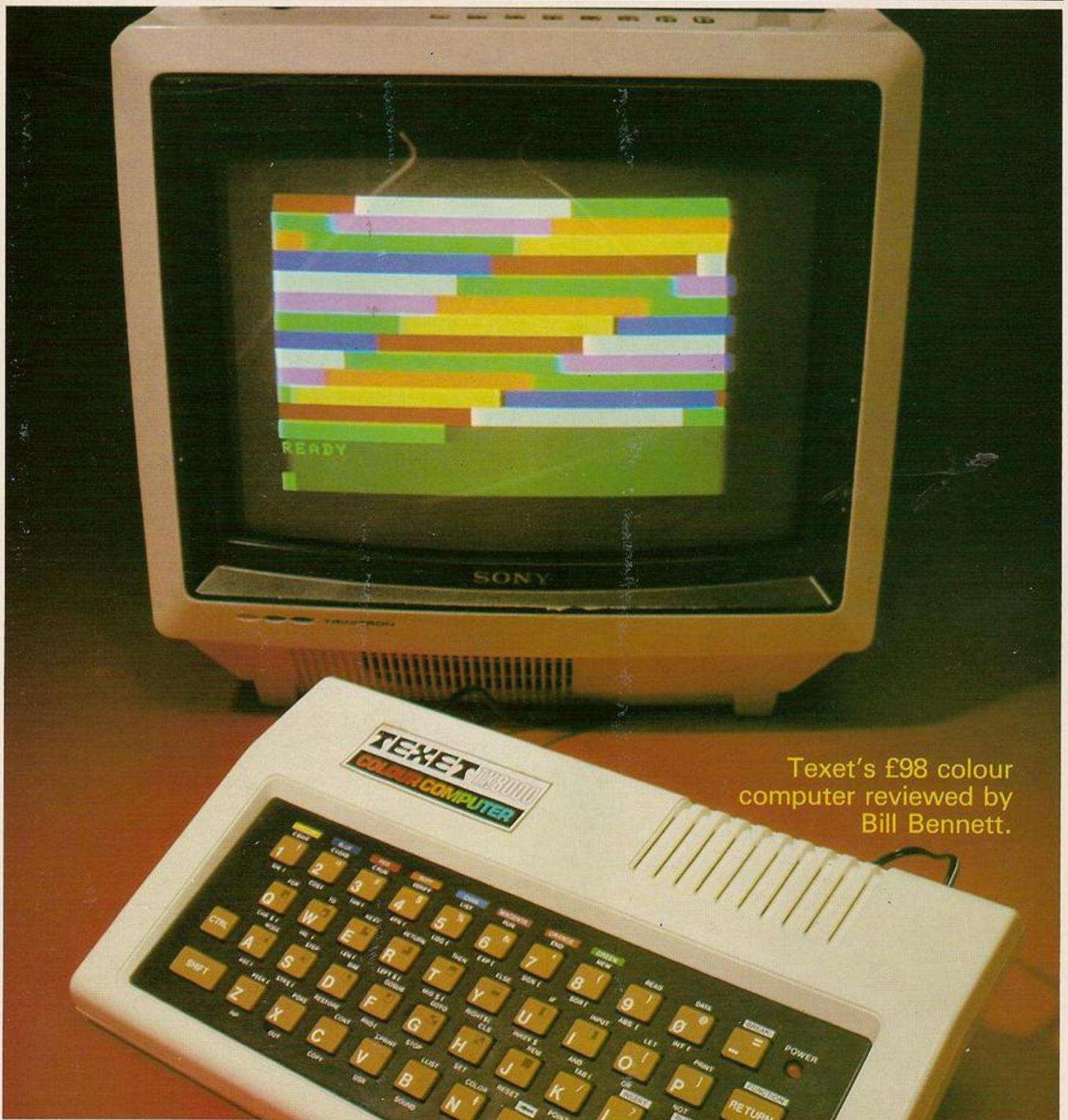
Because the transformer itself is attached to the plug its weight causes it to work its way out of the socket. While this is not likely to be dangerous, due to the insulation on the pins, it does mean that a programming session can be ruined and all work lost due to the resulting power failure.

When the machine is powered up the message: VIDEO TECHNOLOGY BASIC V1.0

appears. The letters are in light green on a darker green background with the whole surrounded by a black border. The cursor — a square of light green, flashes on and off. If the on/off switch is flicked momentarily to the off position and back again a bizarre effect on screen is caused by the memory-mapped screen area of RAM being filled with garbage.

The TX-8000 has only 4K RAM — and 2K is available for programs, the other 2K is for the screen. The maximum size of a numeric array defined in a Basic DIM statement is 1313 locations and a string array can hold 1751 strings.

Of course should you decide to use arrays that big, there will not be any room left for the program. Anyone who has used the ZX-81 might think 2K is a lot of memory, especially when it does not have to store the display as well. If you were a bit tight for space, you could try storing numbers as strings though.



Texet's £98 colour computer reviewed by Bill Bennett.

Arrays may be multidimensional, but be warned, arrays of more than one dimension eat heavily into the memory. By the time you get to an array of seven dimensions, (2,2,2,2,2,2,2), you have run out of memory.

A simple line of Basic, such as:
 $10 \times = 20$

only takes up four bytes so a reasonable program can be squeezed into the memory. However this compares very unfavourably with the Oric, which is only a fraction more expensive, but has a nominal 16K of RAM.

The organisation of the video memory is interesting, in the normal text mode — which is called from Basic by the command Mode(0), the first 512 bytes of video memory store the

ASCII codes of the screen characters.

Any of the machine's character set of 255 characters can be Poked into this memory, and of course it is the area that the Print command uses.

All the usual characters appear in the set, together with their inverses. In addition there is a subset of graphic characters which consist

of the character square divided into four smaller squares, filled in all possible combinations.

This graphic subset is repeated four times.

When the machine is initially turned on this character set appears in four different colours but use of the Color command — which is similar to Ink on the Spectrum — changes this, and the four sets seem to change to arbitrary colours.

(continued on page 59)

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(continued from page 57)

Color only affects the graphic symbols. There is no provision for printing words or letters in colour. What is strange is a lack of black or white on the screen. In practice the colour designated as Buff is slightly off-white and for most purposes can be used in its place. Black can be obtained only as the other colour in the graphic symbol character set.

There is a major problem with the colour on the Textet, it seems that each of the colours is attributed to a character space that is displaced half a character to the right of the printed character. That is, the printed characters and their assigned colours do not match up on the screen. This could be a fault in the review machine, but looking at the colour circuitry within it is not surprising.

It is a shame about the colour location problem, because the colours themselves are the brightest on any of the cheaper colour computers. The red is a little darker than it should be, but the blue and orange are as luminous as Day-Glo colours. The colours can be changed by altering the controls of your TV set, but the alignment problem cannot be ironed out.

The graphics characters can be printed or Poked on to the screen by using their character codes, but they are also accessible from the keyboard. To print them in, say, a pair of quotes inside a Print statement, you have to press both shift and control at once, then the relevant graphics key. Graphics are printed on the key switches, so you have some idea which one you are using. On the Z key a graphic block is printed which does not correspond to the character printed by that key, and keys: x, c, v, b, are merely repeats of characters that can be found elsewhere and consequently are not marked.

When printed directly from the keyboard the graphics characters appear in the default light and dark green colour set. After a Color command however they will be printed on the screen in that colour. The characters print on to the screen extremely fast in this mode, a thousand colour graphic strings taking less than 20 seconds. But there is a price to pay. A string can only contain graphic characters of one colour, and that colour is always the colour specified by the preceding Color command.

In the text graphics mode, mode 0, the screen is organised into 16 lines of 32 characters. This compares with 24 lines of 32 on the Spectrum — or more correctly 22 usable lines, and 28 by 40 on the Oric — which is a Prestel-like display.

High-Resolution mode, mode 1, is not really high-resolution at all. There are only 128 by 64 pixel locations, which is not much better than some — albeit much more expensive — microcomputers' text mode. This takes up the entire 2K of the video memory, which is interesting because 128 × 64 is not 2K, but 8K.

It works in a way that is similar to the text mode. There are 32 columns and 64 rows, each of which can have any value up to the eight-bit limit of 255. In text mode these normally represent characters, but in mode 1 they represent short graphic strings of four pixels, arranged in a line one after the other. Poking a value into one of these locations specifies the colour of each of those four pixels.

Obviously not all possible combinations of the eight colours in four pixels can be accommodated — there are 4,000. Unfortunately thanks to the colour misalignment, colour is not always visible in this mode.

Light green is the only possible background

CONCLUSIONS

- The Textet TX-8000 may enjoy a brief period of fame as the cheapest colour computer around but too many compromises have been made.
- The colour display on the screen needs tidying up as does the internal construction of the Textet. If this was done then the peripherals available for the TX-8000 — especially 64K expansion for £52 might make it worth a second glance.
- The shortcomings of the £98 Textet make the high standards of the £99 Oric and the £125 Spectrum seem all the more remarkable.

allowed in the so-called high-resolution mode. To let you know that the mode has changed from low-resolution/text to the pseudo high-resolution the border colour changes from soot black to the same lime green as the rest of the screen. This is to avoid any confusion between what might be called low-resolution 1 and low-resolution 2.

So bad is the colour misalignment that when a sine curve is displayed on the screen, it appears as black on the lime green background, with a hint of whatever the chosen colour was around the edges. This makes a mockery of the TX-8000's ability to display any of its eight colours at any one of the 128 by 64 locations.

Poking to the display is a complicated

business in this mode, so there are adequate Basic commands to handle the graphics. They are Set and Reset — which plot and unplot points on the screen, and Point which examines a position and tells you if it is on or off.

Despite the ventilation both in the top of and under the case, the machine can become very hot. This could be due to the poor thermal contact of the heat sink, which was only loosely connected to the power supply semiconductor. This can cause problems. When the machine was turned off momentarily — due to the transformer falling out of the socket — the television had to be retuned to obtain a picture.

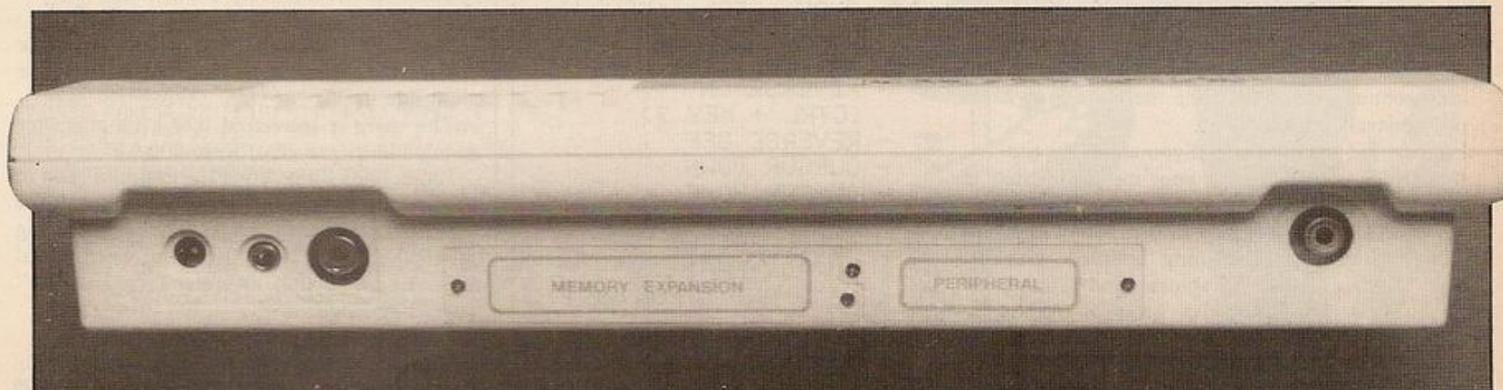
TX-8000 Basic is a fairly standard version of Microsoft Basic. It holds few surprises but does have some refinements that, if omitted, would make the Textet a very old-fashioned machine indeed. There is the Step to go with For . . . Next, and the Else to supplement the If . . . Then. As far as structures go, the TX-8000 is a non-starter.

Cassettes are loaded with the CLoad command, which causes the machine to print Bad on the screen whenever a load fails. Loading is extremely difficult because unlike the Spectrum there is no screen display to let you know how well the load is going.

CSave is accompanied by a Verify command, which no self-respecting micro would be seen without these days. All the tape operations are performed at 600 baud which is faster than the ZX-81 but slower than the Spectrum — the Oric allows you to choose speeds. The speed could be at the root of the loading problems but more likely the main offender is the power socket, which is located right next to the cassette socket.

Basic programming lines cannot be longer than two screen lines. If you try entering one longer you simply lose it without warning. The Sound command is feeble compared to the Oric. All it can do is play rather quiet tones — there is no loudspeaker. The Sound command has two parameters, the first being the pitch. This can have any integer value between 1 and 31. If a decimal number is input it simply truncates and plays the next one down. The second parameter is the length of the tone and this is variable between one and nine.

Numbers can only be printed to six significant figures which means that should a business be in such bad shape that it decides to install a TX-8000 as a computer, it will never be able process debts greater than £9,999.99. To ensure neatness trailing zeros are suppressed. ■



FANGS FOR THE MEMORY — 3.5K



HERE IS AN implementation of Snake for the Vic-20. Although in Basic, it is fast and addictive, and makes good use of defined and multicoloured graphics. The game, admittedly inspired by the veritable plague of ZX Snakes in February's Software File, just squeezes into the basic machine. Little space is left for instructions so do not enter line 10.

Using the S, X, < and > keys you steer the head of a snake. When you first Run the program, you get five seconds grace before the snake automatically moves down the screen.

The object is to clear the screen of flies and beetles. Watch out for the mushrooms though — they are poisonous. Both beetles and flies make the snake grow, but flies more so than beetles. The flies also score more. The more you eat, the faster the snake moves.

If you run into yourself, being a poisonous snake, you will die. One other snag — if you run into the surrounding fence, or try to move alongside yourself, you will find the snake stops, and your score decreases rapidly. And if your score ever gets below zero, the Vic assumes you have committed suicide. This is why you can only move left or down at the start. You could also find yourself boxed in.

Swarm of insects

If you manage to clear the screen, another swarm of insects descends, although the snake stays the same length, and a batch of 10 extra mushrooms grow. The game therefore grows progressively harder.

When the game is over, if you are in the top five scores, you can enter your initials in the Hall of Fame.

This program is a perfect illustration of how straightforward programming coupled with the Vic's excellent graphics and sound capabilities can produce a good enjoyable game.

Here is a breakdown of the program: lines 20-100 initialise it and line 50 lowers RAMtop

to protect defined graphics. The fixed graphics characters start at line 60.

S = Segment of snake
M = Mushroom
B = Beetle
F = Fly
W = Wall

At line 100, NM sets the initial number of mushrooms, and Poke V,47 sets the auxiliary colour for the defined graphics used in the program.

Lines 120-140 set up the starting position of the snake's head — HP — and tail — TP — and display it as well as setting its starting direction D and its head character H. Lines 170-190 wait five seconds for a key to be pressed and then continue. Lines 210-250 work out the snake's new direction, depending on which key was pressed, and from that work

out the character to be used for the snake's head.

All the checks on where the snake is are contained in lines 280-310. These lines also verify that the move is allowed, and branch to the appropriate part of the program if necessary.

Line 320 checks if all the beetles and flies have been eaten, and if they have, displays some more. This line also adds 10 more mushrooms. This is the end of the main loop.

Move-snake routine

The move-snake routine is at lines 500-570. It does this by simply moving the snake's head forward and erasing the tail. If the extra-length — EL — variable is greater than zero, it subtracts one from it and skips the erase tail section.

After it has erased the tail, it then looks for a segment next to it, which becomes the new tail. Incidentally, this is the reason why there must always be at least one character between "folds" of the snake as it twists and turns. Otherwise it could confuse this part of the program.

Lines 700-740 and 750-790 are the routines called when either a beetle or a fly is hit. They increase the score and the "extra length" counter.

Lines 800-830 are called when the snake either runs into the wall or tries to move alongside itself.

The score is converted into a six-character string and displayed at lines 900-920.

Lines 1000-1200 define the graphics used in the game, and lines 1500-1590 set up the screen display for the game. The lines starting at 1560 display the mushroom, beetles and flies. Lines 2000-2200 are the "game over" part. The length of the

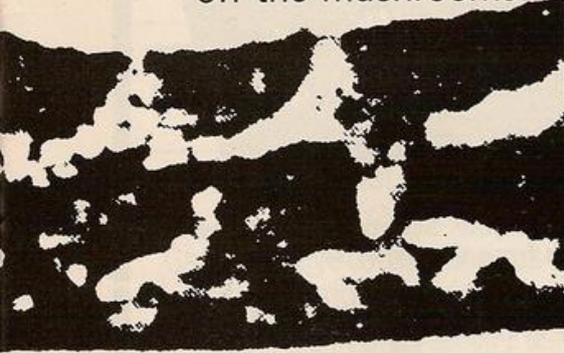
FOR I=1 TO ... NEXT
delay in line 2000 produces an interesting strobe effect. ■

THESE ARE SOME OF THE COLOUR AND CURSOR CONTROL CHARACTERS USED IN THE PROGRAM

```
FOR "█" READ INVERSE POUND  
(CTRL + KEY 5)  
"█" - BLACK (CTRL + KEY 1)  
"█" - WHITE (CTRL + KEY 2)  
"█" - CYAN (CTRL + KEY 4)  
"█" - GREEN (CTRL + KEY 6)  
"█" - YELLOW (CTRL + KEY 8)  
"█" - REVERSE ON  
(CTRL + KEY 9)  
"█" - REVERSE OFF  
"█" - CURSOR DOWN  
"█" - CURSOR HOME  
"█" - CLR  
"█" - CURSOR RIGHT  
"█" - CURSOR LEFT  
USE KEYS S AND X FOR UP  
AND DOWN  
USE KEYS < AND > FOR LEFT  
AND RIGHT
```

VIC-20

A python can swallow a sheep but this economical program by Andrew Dilley will not put any bulges in your Vic-20. If you're partial to flies and beetles, this is the game for you — but take our advice and lay off the mushrooms.



```

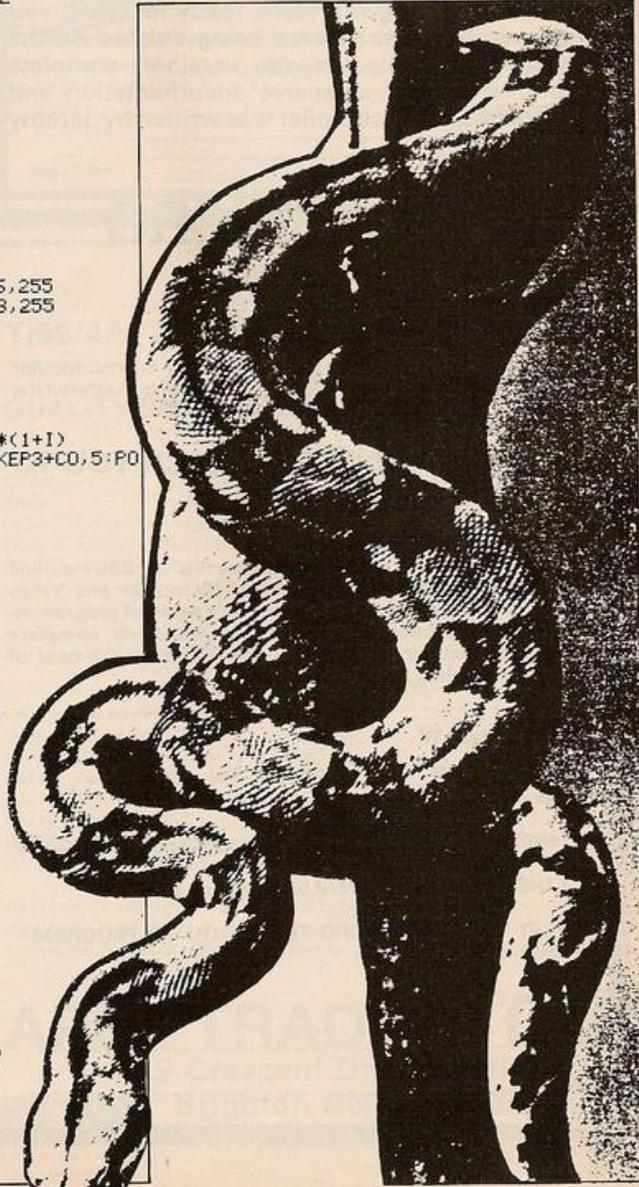
10 REM FOR "N" READ INVERSE POUND SIGN (CNTRL+KEY3)
20 DIMB$(5):FORI=1TO5:B$(I)="000000 ???":NEXT
40 DEFFNR(X)=INT(RND(1)*X)
50 POKE56,29:POKE52,29
60 S=42:M=39:B=40:F=41:W=171
70 TC=7680:C0=30720:S1=36874:S2=S1+2:S3=S2+1:V=S2+2:SR=V+1
80 GOSUB3000
100 NM=20:GOSUB1500:POKEV,47
120 HP=TC+10+22*2:L=5:TP=HP+L:D=22:H=46
140 POKEHP,H:POKEHP+CO,1:FORI=HP+1TOTP:POKEI,S:POKEI+CO,13:NEXT
150 SC=0:GOSUB900
160 PRINT"###"TAB(16)LEFT$(B$(1),6):
170 T=I
180 GETA$:IFA$=""ANDTI-T<300THEN180
190 GOTO210
200 IFSC<0THEN2000
205 GETA$
210 Z=22*(A$="S")-22*(A$="X")+(A$=",")-(A$=".")-D*(Z=0)+Z
250 H=-43*(D=1)-44*(D=-1)-45*(D=-22)-46*(D=22)
270 POKEHP,H:NP=HP+D:P=PEEK(NP)
280 IFP=MORP=STHEN2000
290 IFP=MORPEEK(NP+1)=SORPEEK(NP-1)=SORPEEK(NP+22)=SORPEEK(NP-22)=STHENGOSUB800
GOTO200
300 IFP=BTHENGOSUB700
310 IFP=FTHENGOSUB750
320 IFNB=0ANDNF=0THENNM=10:GOSUB1500:GOTO170
330 GOSUB500:GOTO205
500 POKES1,170
510 POKEHP+CO,13:POKEHP,S:HP=NP:POKEHP+CO,1:POKEHP,H
520 IFEL>0THENEL=EL-1:GOTO550
530 POKETP,32
540 TP=TP-(PEEK(TP+1)=S)+(PEEK(TP-1)=S)+22*(PEEK(TP-22)=S)-22*(PEEK(TP+22)=S)
550 POKES1,0
560 FORT=1TO150-4*L:NEXT
570 RETURN
700 POKESR,12:L=L+1:EL=EL+1
710 X=INT((100+5*L)/10)
720 FORI=1TO10:POKES2,200:POKENP,I+128
730 SC=SC+X:GOSUB900:POKES2,0:NEXT:POKESR,10:NB=NB-1:POKENP,32
740 RETURN
750 POKESR,14:L=L+2:EL=EL+2

```

```

760 X=INT((150+6*L)/10)
770 FORI=1TO10:POKES2,220:POKENP,I+128
780 SC=SC+X:GOSUB900:POKES2,0:NEXT:POKESR,10:NF=NF-1:POKENP,32
790 RETURN
800 POKES2,180
810 SC=SC-10:GOSUB900
820 POKES2,0
830 RETURN
900 S$=STR$(SC):Q=LEN(S$):S$=LEFT$("00000",7-Q)+RIGHT$(S$,Q-1)
910 PRINT"#####"S$
920 RETURN
1000 FORC=35TO46:FORZ=0TO7:READN:POKE7168+8*C+Z,N:NEXT:NEXT
1010 FORZ=8*32TO8*32+7:POKE7168+Z,0:NEXT
1020 RETURN
1100 DATA255,171,171,139,171,171,171,255,255,136,187,139,235,235,136,255
1120 DATA255,136,170,168,170,170,138,255,255,143,191,159,191,191,143,255
1140 DATA56,124,124,254,186,56,56,124,130,84,56,254,56,254,56,254
1160 DATA108,16,124,186,186,186,84,16,40,40,190,190,190,190,40,40
1180 DATA48,104,109,254,254,109,104,48,12,22,182,127,127,182,22,12
1200 DATA96,24,60,126,153,255,126,24,24,126,255,153,126,60,24,36
1500 POKE36869,255
1510 POKESR,10:PRINT"#####":TAB(11)"#####":
1520 FORI=0TO21:P1=TC+22+I:P2=TC+22*2+I:P3=TC+22*(1+I):P4=TC+21+22*(1+I)
1530 POKEP1,W:POKEP2,W:POKEP3,W:POKEP4,W:POKEP1+CO,5:POKEP2+CO,5:POKEP3+CO,5:PO
EP4+CO,5
1550 NEXT
1560 CH=M:C=4:N=NM:GOSUB1700
1570 CH=B:C=5:NB=15:N=NB:GOSUB1700
1580 CH=F:C=7:NF=5:N=NF:GOSUB1700
1590 RETURN
1700 FORI=1TON
1710 P=TC+FNR(20)+1+22*(FNR(19)+3)
1720 IFPEEK(P)>32THEN1710
1730 POKEP+CO,C:POKEP,CH
1740 NEXT
1750 RETURN
2000 POKES,200:FORT=1TO250:POKESR,2:FORI=1TO10:NEXT:POKESR,10:NEXT
2050 FORVO=15TO0STEP-.1:POKEV,VO:NEXT
2060 POKES,0:POKESR,12:POKE36869,240:POKE198,0
2070 PRINT"##### KILLED BY A DEADLY":PRINT"##### POISONED MUSHROOM"
2080 K=0:FORI=1TO5:IFSC>VAL(LEFT$(B$(I),6))THENK=I:I=5
2090 NEXT:IFK=0THENFORT=1TO1000:NEXT:GOTO2150
2100 PRINT"##### YOU ARE ONE OF THE TOP FIVE PLAYERS"
2110 PRINT"##### ENTER YOUR INITIALS":INPUTI:IFLEN(I)>3THEN2110
2120 FORI=4TOKSTEP-1:B$(I+1)=B$(I):NEXT
2130 B$(K)=S$+" "+I$
2150 POKESR,78:PRINT"#####HALL OF FAME"
2160 FORI=1TO5:PRINT"#####I" B$(I):NEXT
2170 PRINT"#####ANOTHER GO(Y/N)":INPUTY$
2180 IFY$="Y"THEN100
2190 IFY$="N"THENPRINT"##### THANKS FOR PLAYING":END
2200 GOTO2170
3000 POKESR,154:PRINT"##### S N A K E -- B Y T E"
3020 PRINT"##### USE THESE KEYS:"
3030 PRINT"##### UP DOWN LEFT RIGHT ##### X ##### DOWN"
3040 PRINT"##### EAT THE FLIES & PRINT BEETLES, BUT BEWARE"
3050 PRINT"##### THE DEADLY MUSHROOMS"
3060 GOSUB1000
3070 PRINT"##### HIT ANY KEY TO START":
3080 GETA$:IFA$=""THEN3080
3090 RETURN

```



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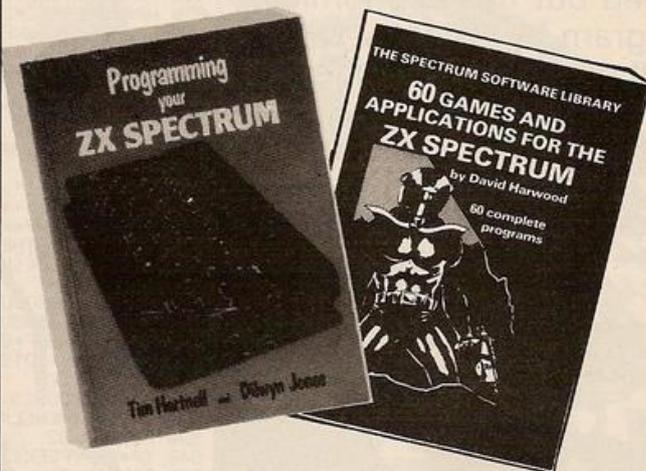
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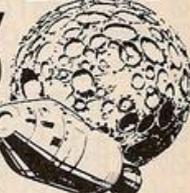
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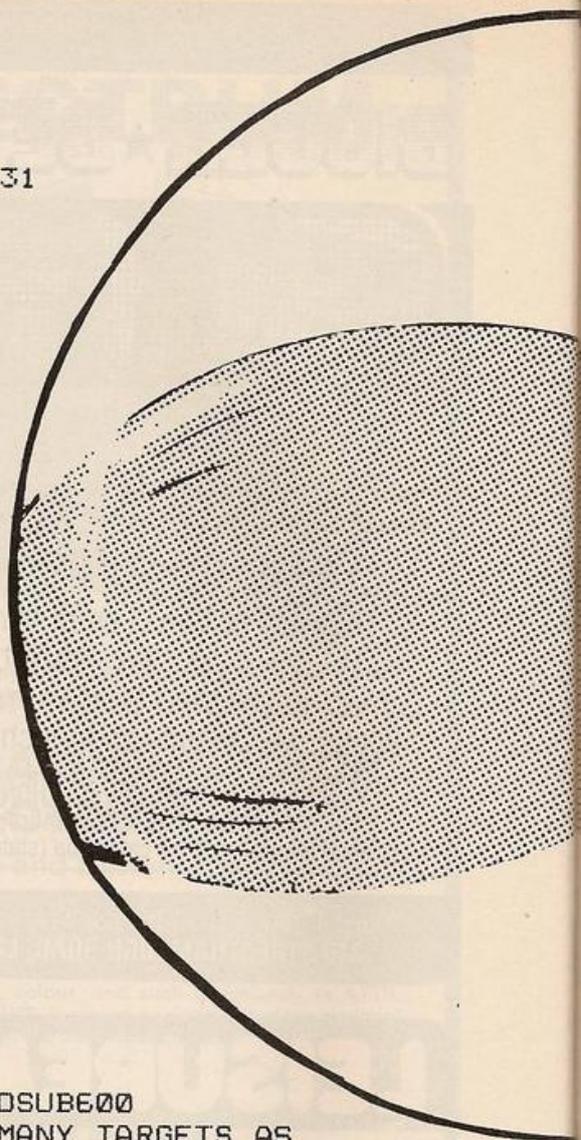


DEALER ENQUIRIES WELCOME

```

10 TIMER=0
20 GOTO320:CLS
30 A1=0
40 CLS:A=1056:Q=RND(7)+1
50 FORI=0TO62:SET(I,A1,Q):NEXT
60 FORI=0TO31:SET((A1*2)-(A1=31),I,Q):NEXT:IFA1=31
  THEN80
70 A1=31:GOTO50
80 L=1138:C=0:B=1:P=0:T=0:Y=48:X=TIMER
90 Z=INT(RND(448))+A+32
100 IFZ=L-B ORPEEK(Z)(>)96 THEN90
110 Y=Y+1:POKEZ,Y
120 '
130 A$=INKEY$:IFA$="M" ORA$="Z" THEN270
140 K=PEEK(L+B):IFK(>)96 THEN170
150 POKEL,96
160 L=L+B:POKEL,79:GOTO130
170 IF TIMER-X>3600 THEN490
180 IFK=Y ORK)111THEN230
190 C=SGN(B)*(33-ABS(B))
200 Z=87:IFK=111 THENC=-C:Z=43
210 SOUNDZ,1:IFPEEK(L+B+C)(>)96 THEN150
220 POKEL,96:L=L+B:B=C:GOTO160
230 IFK=Y THEN250
240 B=-B:SOUND61,1:GOTO150
250 Z=225:FORJ=1TO9:SOUND390-Z,1:NEXT
260 T=T+1:GOTO90
270 C=SGN(B)*(33-ABS(B))
280 Z=78:IFA$="Z" THENC=-C:Z=38
290 IFPEEK(L+C)(>)96 THEN150
300 POKEL,111+((A$="M")*19):SOUNDZ,1
310 P=P+1:B=C:GOTO160
320 CLS:PRINT@172,"REBOUND"
330 GOSUB600
340 PRINT:PRINT"  THE ULTIMATE GAME OF SKILL":GOSUB600
350 CLS:PRINT" YOU HAVE ONE MINUTE TO HIT AS"," MANY TARGETS AS
  YOU CAN BY
360 PRINT" PLACING PADDLES IN THE PATH OF";"," THE BALL.
370 PRINT:PRINT"  PRESSING 'Z' GIVES YOU '/'
380 PRINT"          'M' GIVES YOU ' '":POKE1242,92
390 PRINT:PRINT" IF YOU USE TOO MANY PADDLES "," YOUR SCORE WILL BE
  REDUCED."
400 PRINT@456,"PRESS ANY KEY"
410 GOSUB610
420 CLS:PRINT" YOU WILL NOT BE ABLE TO HIT ",",", TARGETS WHEN VERY
  CLOSE AND
430 PRINT:PRINT" UNWANTED PADDLES AND TARGETS ",",", MAY BE ERASED"
440 PRINT:PRINT" TO PLAY:-",",", SELECT 'A' FOR AMATEUR",",",
  'P' FOR PROFESSIONAL
450 PRINT:PRINT"          'N' TO END
460 GOSUB610:IFA$(<)"A" ORA$(<)"P"THENGOSUB610
470 IFA$="P" THENPOKE65495,0:GOTO30
480 IFA$="A" THEN30

```

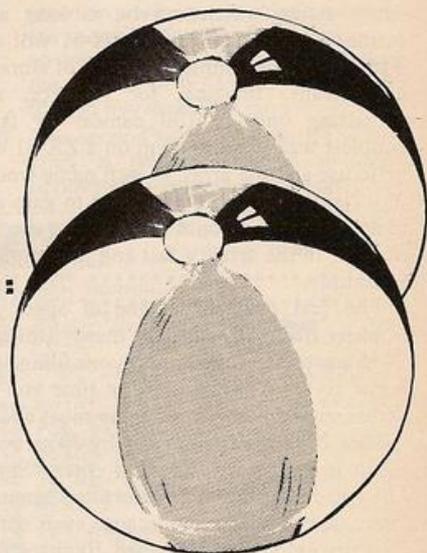


DRAGON

GAMES

You'll have to be fast off the mark to master Vincent Crockett's original game for the Dragon 32. Your quick reflexes come into play as you set the paddles which will send the ball racing towards a new high score. Your targets are the randomly-generated numbers that appear scattered over the screen. Full instructions are included in the program itself. Because Rebound uses Poke locations to increase speed of play, you must finish each game properly and not just stop using the Break key. Remember: you have only one minute per game and if you use too many paddles, your score will be reduced.

```
490 FORZ=250T04 STEP-6:SOUNDZ,1:NEXT
500 POKE65494,0
510 PRINT@108,"GAME OVER";
520 GOSUB600
530 CLS:PRINT@39,"YOU HIT";T;"TARGETS
540 PRINT@102,"YOU USED";P;"PADDLES
550 S=INT(8000*T/(P+70))/10
560 PRINT@166,"YOUR SCORE IS";S;"%"
570 IFS>HS THENHS=S:Z=200:FORJ=1T09:Z=350-Z:SOUNDZ,1:
  PRINT@224:PRINT@234,"its a record":FORZ1=1T030:
  NEXT:NEXT
580 PRINT:PRINT"          HIGH SCORE IS";HS;"%"
590 GOSUB600:GOTO440
600 FORI=1T02000:NEXT:RETURN
610 A$=INKEY$:IFA$=""THEN610
620 IFA$="N" THENEND
630 RETURN
```



REBOUND

ZX UNIFILE

ONE OF THE dreams that accompanies most micros into the home is the vision of massive information storage. Within weeks, every recipe will be stored, every cheque and bill recorded, phone numbers available at the mere touch of a button. Even if the dream does not turn into a nightmare, it usually fades for two reasons: first, for a great many purposes, the amount of benefit to be gained from putting information on to a micro simply does not justify the amount of work needed to program it in or to retrieve it; and secondly, large masses of information have a nasty habit of resisting all attempts to process them or present them in an orderly fashion — it is all very well storing the whole of the telephone directory on your micro but how do you actually persuade the thing to tell you what you want to know?

The program accompanying this article is directed at 16K ZX-81 owners who have decided that they do want to use their machines for information storage and retrieval but have run up against problems in practice. The system is called Unifile and it is, basically, an empty filing cabinet waiting to be filled with information which it will arrange according to instructions laid down by the user and, equally important, retrieve and display information or amend it.

The Unifile program stores its data in a single string which can be as long as the memory of your expanded ZX-81 will allow. This is not the simplest method of storage by any means. Imagine, for instance, a file consisting only of 100 names. By far the simplest way to store them on a ZX-81 would be to use a string array — each name would be in a clearly definable place and to gain access to any name you would have only to specify its number in the array, a fast and uncomplicated technique.

The real problem is one of space. It is unlikely that you will have many names with 20 characters in them, but if your filing system is not to break down the first time you come across such a name, your array must allow for at least 20 characters — a 100 by 20 array. The result is that every time you enter "Smith, J H" you have wasted an enormous amount of space in your memory because even with the punctuation you only needed 10 characters of the 20 you have set aside in the array.

If all you have to worry about is one hundred, or even two or three hundred names, then do put them into an array. But what if you wish to add details to the names, so that for each name entered into the file there may be five or six other items of information, all of which will require a space allocation in the array. Space enough in the memory for three hundred names now becomes space enough for only 50 names with their attendant details,

assuming that you allow a possible 20 characters for each item of information.

It is for this reason that most computer-filing systems use a storage method which allocates to each item of information only as much space as it actually needs and on the ZX-81 the only way to achieve this end is to pack each item into a string. The technique raises its own problems, as the following example will illustrate.

Name: Smith
C/name: John
Address: 12 North St
Town: Anytown
Phone: 0998-11111
Age: 35
Interests: Ferret washing

This is a typical entry from an imaginary file and is fairly self-explanatory. Packed into a string, however, it becomes slightly less clear: SMITHJOHN12 NORTH STANYTOWN 0998-1111135FERRET WASHING

It may still be decipherable to the human eye, but how is a program searching a string made up of many such entries, packed together, to know where one item begins and another ends. It would be much clearer if we marked each item, at the cost of very little extra space:

+SMITH*JOHN*12 NORTH ST*ANYTOWN* 0998-11111*35*FERRET WASHING+

We can now instruct our program, when it searches for a particular item, to recognise a plus sign as the beginning of an entry and an asterisk as marking individual items within that entry. Unfortunately such separator symbols can only be recognised if the string of information is examined character by character, which is fine when you are dealing with only a few entries but a little on the slow side if your file has grown to around 10,000 characters.

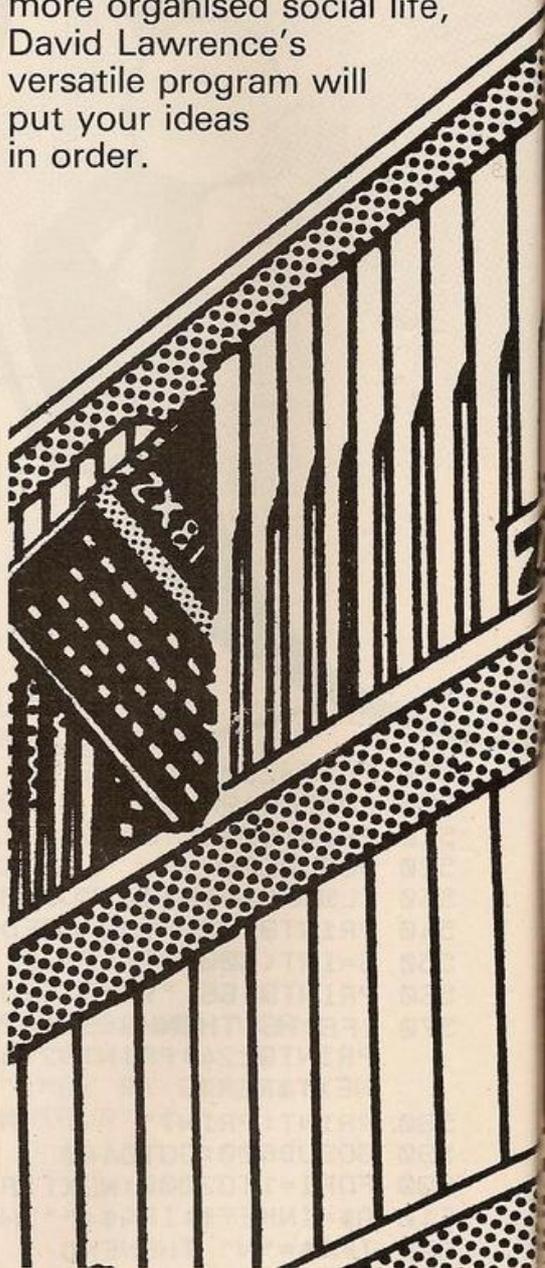
Some method is needed which allows the program to identify the beginning and end of an entry without examining every character in the file. The Unifile program achieves this by attaching to each entry a special indicator called a "string length indicator", or SLI.

In the case of a small system such as Unifile, the SLI does not need to be able to cope with huge entries and it is, in fact, one character whose Code value is the length of the whole entry.

This limits the length of each entry to 255 characters, or approximately five times as much information as was stored in our specimen entry, which has been found in practice to be adequate.

While the Unifile program cannot jump to the middle of its stored data and unerringly identify the beginning of an entry, using the SLIs it can quickly scan along its files, jumping from one entry to the next at an acceptable speed. A typical Unifile entry would be structured as follows:

If your aim is world domination or merely a more organised social life, David Lawrence's versatile program will put your ideas in order.



- an SLI recording the length of the whole entry
- an SLI recording the length of item 1
- item 1
- an SLI recording the length of item 2
- item 2
- an SLI for the next entry etc.

The Unifile program provides five facilities necessary to operating a useful storage and retrieval system: file structuring, information entry, amendment, search and display. First of all, file structuring. In the specimen entry given above, seven items of information were

ZX-81



Using the amendment function, individual items can be changed or whole entries deleted.

Two types of search function are provided. For the purposes of a normal search the user specifies an item to be searched for and the program compares this with each item contained in its files. However, only whole items are compared — a normal search would only come up with John Smith if the address being searched for were "12 North Street", it would pass over the entry if the specified address were simply North Street.

Special search, on the other hand, will identify every occurrence of a specified combination of characters such as North Street, or even 'Nor'. Special search is particularly useful for files which do not follow an orderly structure, such as recipes, where it may not be possible to predict precisely how many items of information will be needed and two or more end up being lumped together under the same heading. The disadvantage of special search is that it is considerably slower than normal search. For either form of search, when the specified item is discovered, the whole of the entry containing it is displayed.

The display function displays entries one at a time on command. All the program's functions are called simply from a menu section which is displayed on entry to the program and at relevant points during its use.

The beauty of the Unifile idea is that, once entered on to your ZX-81 and recorded on to a cassette, its uses are endless. A single user can, at one and the same time, be using one version to store his personal address book, with only two or three items per entry, while another version stores vastly more complex club records or business data.

The one major drawback of the program as listed is that it still does not use the memory space available as efficiently as possible — in fact it uses only half the space the ZX-81 would allow. The reason for this is that we have referred to our data storage string on both sides of a string equation, as in line 730. Upon encountering this instruction the ZX-81 promptly sets up a copy of B\$ in order that it may maintain a distinction between the new

B\$ that it is being asked to create and the old B\$ it is being asked to use as material. This problem can only be avoided by fixing the length of B\$ in the memory of the ZX-81 and working within that fixed length.

The method of doing this, outlined in the supplementary program notes, requires more program lines and is slightly slower in execution. This is because, instead of the economy of line 730, we have now to move B\$ in blocks whenever we wish to insert or remove data from the file. This version of the program should only be used, therefore, if you are likely to exceed 4K characters in your intended file. In order to use the second version, B\$ must be dimensioned when the file is about to be set up. The maximum length is between 9000 and 9500 characters and to set up a new file simply enter DIM B\$(9000) in direct mode, followed by Goto 1. Other than that there is no difference in operation.

- 395 Size is the variable used to store the number of characters so far recorded in B\$.
- 632 These extra lines check to see whether B\$, which is now of fixed length, will be overfilled by the current entry.
- 730 These two Gosubs replace the sections which added data or subtracted it from B\$.
- 1170 We cannot now use the length of B\$ as an indicator that the end of the data has been passed in a search, since no matter how little data is recorded, the length of B\$ is static.
- 1255 This line and 1320 use the spurious entry, inserted into the file when it was first set up, in order to detect the end of the file.
- 1860 This section — down to 1930 — uses an intermediate string — S\$ — to move blocks of B\$ up the string, in order to make room for more data. Since B\$ does not appear on both sides of a string equation any longer, it is not duplicated in the memory. Slightly more memory can be made available for storage by reducing the value of SHIFT in line 1860 and 1950, though this slows the program down.
- 1940 This section telescopes the file when an entry is removed and is simply the opposite of the previous section.

recorded about John Smith. The Unifile system allows any number of named items to be specified and any information retrieved later will be reproduced under the specified headings. The only limitation here is that the whole entry must not exceed 255 characters.

As to entry of information, once the types of information to be recorded in each entry have been specified, the program requests entries on the basis of the structure the user has laid down. Entries will be stored in alphabetical order of the first item.

```

1 GOTO 5
4000 SAVE "UNIFILE"
4010 STOP
4020 PRINT "*****"
50 PRINT "FUNCTIONS AVAILABLE"
60 PRINT "1) SET UP STRUCTURE OF FILE"
70 PRINT "2) ENTER INFORMATION"
80 PRINT "3) SEARCH/DISPLAY/CHANGE"
90 PRINT "4) STOP"
100 PRINT "PLEASE ENTER WHICH YOU REQUIRE:"
110 SLOW
120 INPUT Z
130 CLS
140 IF Z=1 THEN GOSUB 250
150 IF Z=2 THEN GOSUB 420
160 IF Z=3 THEN GOSUB 1030
170 IF Z=4 THEN GOSUB 200
180 CLS
190 GOTO 40
200 PRINT AT 10,5:"*****"
210 PRINT "PLEASE RE-RECORD IF NEW"
220 PRINT "INFORMATION HAS BEEN ENTERED"
230 STOP
240 REM *****
250 REM *****
260 REM *****
270 PRINT AT 0,8:"*****"
280 PRINT "HOW MANY ITEMS IN ENTRY?"
290 INPUT X
300 CLS
310 DIM A$(X,20)
320 PRINT AT 0,6:"*****"
330 FOR I=1 TO X
340 PRINT "ITEM ";I;": ";
350 GOSUB 1570
360 PRINT Q$(2 TO )
370 LET A$(I)=Q$
380 NEXT I
390 FOR I=1 TO X
400 GOSUB 1600
410 REM *****
420 REM NORMAL INPUT
430 REM *****
440 LET R$=""
450 PRINT AT 0,10:"*****"
460 PRINT "COMMANDS AVAILABLE"
470 PRINT "ENTER ITEM SPECIFIED TO 'ZZZ' TO QUIT FUNCTION"
480 PRINT "*****"
490 LET I=1 TO X
500 GOTO 420
510 GOSUB 1570
520 PRINT Q$(2 TO )
530 IF Q$="ZZZ" THEN RETURN
540 LET R$=R$+Q$
550 NEXT I
560 CLS
570 LET R$=CHR$(LEN R$+1)+R$
580 GOSUB 610
590 GOTO 420
600 REM *****
610 REM PLACE DATA IN FILE
620 REM *****
630 FAST
640 LET C=2
650 LET C1=C+1
660 DIM C$(100)
670 LET D$=C$
680 LET D$(1 TO CODE R$(2)-1)=R$(3 TO 1+CODE R$(2))
690 LET C$(1 TO CODE B$(C1)-1)=B$(C1+1 TO C1+CODE B$(C1)-1)
700 IF D$=C$ THEN GOTO 730
710 LET C=C+CODE B$(C)
720 GOTO 650
730 LET B$=B$(1 TO C-1)+R$+B$(C TO )
740 SLOW
750 RETURN
760 REM *****

```

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(continued from page 67)

```
770 REM CHANGE ENTRY
780 REM *****
790 LET C2=C2-1
800 LET C1=C+1
810 LET R$=""
820 PRINT "ENTRY ";C2;":-"
830 FOR I=1 TO X
840 GOSUB 1600
850 GOSUB 1620
860 PRINT AT 17,12;"SEARCH"
870 PRINT "COMMANDS AVAILABLE:"
880 PRINT ">NEWLINE LEAVES ITEM
UNCHANGED", ">""ZZZ"" DELETES WH
OLE ENTRY", ">ENTER NEW ITEM"
890 GOSUB 1570
900 IF Q$="" THEN LET R#=R#+B$(
C1 TO C1+CODE B$(C1)-1)
910 LET C1=C1+CODE B$(C1)
920 CLS
930 IF Q$="" THEN GOTO 960
940 IF Q$=""ZZZ" THEN GOTO 970
950 LET R#=R#+Q$
960 NEXT I
970 LET B#=B$(1 TO C-1)+B$(C+CO
DE B$(C) TO )
980 IF Q$=""ZZZ" THEN RETURN
990 LET R#=CHR$(LEN R#+1)+R$
1000 GOSUB 610
1010 RETURN
1020 REM *****
1030 REM SEARCH
1040 REM *****
1050 LET C=2
1060 LET C4=0
1070 LET C2=1
1080 PRINT AT 0,14;"SEARCH"
1090 PRINT ", "COMMANDS AVAILABLE
...
1100 PRINT ">INPUT ITEM FOR NORM
AL SEARCH", ">PRECEDE WITH ""SSS""
FOR", "SPECIAL SEARCH", ">PRECE
DE WITH ""III"" TO SEARCH", "FOR
1ST CHARACTER OF ENTRY"
1110 PRINT ">NEWLINE FOR 1ST ITE
M ON FILE"
1120 PRINT "*****"
1130 PRINT ", "INPUT SEARCH ITEM:
...
1140 GOSUB 1570
1150 LET S#=Q$
1160 IF S#="" THEN GOTO 1310
1170 IF C+2=LEN B$ THEN RETURN
1180 FAST
1190 LET C1=C+1
1200 IF LEN S#<4 THEN GOTO 1240
1210 IF S$(2 TO 4)="SSS" THEN GO
SUB 1730
1220 IF S$(2 TO 4)="III" THEN GO
SUB 1730
1230 IF C4=1 THEN GOTO 1310
1240 FOR I=1 TO X
1250 IF B$(C1 TO C1+CODE B$(C1)-
1)=S# THEN GOTO 1310
1260 LET C1=C1+CODE B$(C1)
1270 NEXT I
1280 LET C=C+CODE B$(C)
1290 LET C2=C2+1
1300 GOTO 1170
1310 LET C1=C+1
1320 IF C+2=LEN B$ THEN RETURN
1330 CLS
1340 SLOW
1350 PRINT "ENTRY ";C2;":-"
1360 GOSUB 1640
1370 LET C2=C2+1
1380 PRINT AT 16,12;"SEARCH"
1390 PRINT "COMMANDS AVAILABLE:"
1400 PRINT ">NEWLINE TO DISPLAY
NEXT ITEM", ">""ZZZ"" TO QUIT FUN
CTION", ">""AAA"" TO AMEND", ">""
CCC"" TO CONTINUE"
1410 INPUT P$
1420 CLS
1430 IF P#=""CCC" THEN GOTO 1170
1440 IF P#="" THEN GOTO 1310
1450 IF P#<>"AAA" THEN GOTO 1510
1460 LET C=C-C3
1470 LET C4=C
1480 CLS
1490 GOSUB 770
```

```
1495 LET C2=1
1500 LET C=0
1510 IF P#=""ZZZ" THEN RETURN
1520 CLS
1530 GOTO 1170
1540 REM *****
1550 REM FUNCTIONAL SUBROUTINES
1560 REM *****
1570 INPUT Q$
1580 LET Q#=CHR$(LEN Q#+1)+Q$
1590 RETURN
1600 PRINT A$(I,2 TO CODE A$(I,1
));";"
1610 RETURN
1620 PRINT B$(C1+1 TO C1+CODE B$(
C1)-1)
1630 RETURN
1640 FOR I=1 TO X
1650 GOSUB 1500
1660 GOSUB 1620
1670 LET C1=C1+CODE B$(C1)
1680 NEXT I
1690 LET C3=CODE B$(C)
1700 LET C=C+CODE B$(C)
1710 RETURN
1720 REM *****
1730 REM SPECIAL SEARCH
1740 REM *****
1750 LET C4=0
1760 FOR J=C+2 TO C+CODE B$(C)-L
EN S#+5
1770 IF S$(2 TO 4)="III" AND J>C
+2 THEN GOTO 1820
1780 IF B$(J TO J+LEN S#-5)<>S$(
S TO ) THEN GOTO 1810
1790 LET C4=1
1800 RETURN
1810 NEXT J
1820 RETURN
```

Two subroutines to be added.

```
1830 REM *****
1840 REM MOVING DATA
1850 REM *****
1860 LET SHIFT=512
1870 FOR I=LEN B$-LEN R$ TO C ST
EP -SHIFT
1880 IF I-SHIFT<C THEN LET SHIFT
=I-C
1890 LET S#=B$(I-SHIFT TO I)
1900 LET B$(I-SHIFT+LEN R$ TO I+
LEN R$)=S#
1910 NEXT I
1920 LET B$(C TO C+LEN R#-1)=R$
1930 RETURN
1940 FAST
1950 LET SHIFT=512
1960 LET SIZE=SIZE-CODE B$(C)
1970 FOR I=C+CODE B$(C) TO LEN B
$ STEP SHIFT
1980 IF LEN B#-I+1<SHIFT THEN LE
T SHIFT=LEN B#-I+1
1990 LET S#=B$(I TO I+SHIFT-1)
2000 LET B$(C TO C+SHIFT-1)=S#
2010 LET C=C+SHIFT
2020 NEXT I
2030 RETURN
```

These lines complete the change.

```
390 LET B$(1 TO 4)="" .="" +CHR$(
255)
395 LET SIZE=5
485 PRINT "FILE SIZE:";SIZE;"/"
;LEN B$
632 LET SIZE=SIZE+LEN R$
634 IF SIZE<=LEN B$ THEN GOTO 6
40
636 PRINT AT 14,10;"FILE NOW FU
LL"
638 LET SIZE=SIZE-LEN R$
639 RETURN
730 GOSUB 1860
970 GOSUB 1940
1170 REM DELETE THIS LINE
1255 IF B$(C1 TO C1+CODE B$(C1)-
1)="" COPY " THEN RETURN
1320 IF B$(C1 TO C1+CODE B$(C1)-
1)="" COPY " THEN RETURN
```

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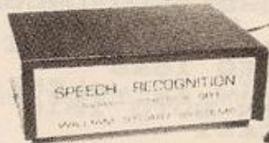
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BBC

Chris Melville plunges into the BBC's MOS — the handy machine-code routines already inside the Micro.



DIG INTO OPERATING SYSTEM

LAST MONTH I looked at the machine-level programming of the BBC using its assembler. This month I will deal with the useful machine-code routines already inside the firmware of the machine — that is, the Machine Operating System or MOS.

There are several slightly differing operating systems available, each one an improvement on the last. To identify your operating system, type:

```
*FX 0
```

and then press Return.

Operating systems around at the moment include the OS 0.1 — the first issue and the most common, sadly bug-ridden and lacking several important features such as the ability to drive discs, support extra paged ROMs, receive data on the RS-423 port and several important input-output routines. The OS 1.0 is a revision of 0.1, and can handle discs, paged ROMs, RS-423 reception, and has a full complement of system routines, although there are still some minor bugs.

There were then various issues with minor differences until the OS 2.1 — the one now being put on ROM. This features all the features of 1.0 as well as some useful new graphics routines to be used as starting points for sophisticated shape-filling algorithms. These will be incorporated into Issue 2 Basic as an extra set of Plot commands.

When referring to the MOS, I will be referring to OS 0.1 since this is compatible with the rest in most respects. I will point out any differences as I go.

The operating system of the BBC computer is a set of routines which control the input-output and housekeeping functions of the micro. These include VDU drivers for printing, plotting — that is, everything that can be performed by the VDU function in Basic; sound-chip management — the routines that control the operation of the sound chip as specified in Basic Sound and Envelope statements; cassette filing system operations; and keyboard handling. The routines form a central core around which the high-level language interpreter operates, as shown in figure 1.

Since the MOS routines are powerful tools for the assembly language programmer as well as the machine's own interpreter, Acorn was careful that they were made as accessible as

possible. There are several entry points to the MOS. Since the MOS is so big — around 16K — and contains so many routines, it was necessary to provide a modified method of calling these routines, rather than the straightforward listing of a suitable calling address for each routine.

The MOS is divided into 13 sections, each performing a particular task or collection of tasks, each of which has an address to which an assembly language, JSR or Basic Call,USR can refer.

Where there are several tasks to a section, it is necessary to specify which one is being called by placing an identification number in the accumulator just before executing the call. Figure 2 is a comprehensive summary of the OS features.

The sections that comprise the MOS are shown in the left-hand column of figure 2. We will take them one by one.

Oswrch — OS WRite CHAracter in accumulator: also known as the "VDU driver", this section is responsible for the input-output to the VDU — which includes the 32 ASCII control characters as well as the printable character set.

The Basic statement VDU a,b,c... is equivalent to:

```
A% = a : CALL OSWRCH : A% = b : CALL OSWRCH
```

or

```
LDA # a : JSR OSWRCH : LDA # a : JSR OSWRCH
```

in Basic and assembler respectively.

This is obviously a very powerful routine because it means that all Basic screen commands can be written as a series of VDU commands and therefore all can be easily performed at assembly-language level.

Suppose, for example, we wished to do the following sequence of operations in assembly language:

1. Select mode 2 — mode 2 in Basic is equivalent to VDU 22,2
2. Set graphics foreground colour red — GCOL 0,1 which is equivalent to VDU 18,0,1.
3. Draw a line between (100,100) and (300,200).

The latter is done by

```
MOVE 100,100 : DRAW 300,200
```

or VDU 25,4,100;100;25,5,300;200;

which is again the same as

```
VDU 25,4,100,0,100,0,25,5,44,1,200,0
```

The operations can be written as one long VDU statement:

```
VDU 22,2,18,0,1,25,4,200,0,100,0,25,5,44,1,200,0
```

Which is easily written in assembly language:

```
LDA # 22 : JSR OSWRCH : LDA # 18 : JSR OSWRCH : LDA # 0 . . . etc
```

Or, to make it more tidy and less bulky:

```
FOR x% = 1 TO 17
```

```
READ a%
```

```
[ : LDA # a% : JSR OSWRCH : ]
```

```
NEXT x%
```

```
DATA 22,2,18,0,1,25,4,200,0,100,0,25,5,44,1,200,0
```

Outputting prompts or messages from a machine-code program can be a tedious business on a bit-mapped machine like the BBC, but again the Oswrch routine helps make light work of this. The following procedure can be used in an assembly-language program to generate the code to output a message, which is passed to the procedure as a string parameter:

```
DEF PROCMESSAGE(x$)
```

```
LOCAL i%
```

```
FOR i% = 1 TO LEN (x$)
```

```
[ : LDA # ASC(MID$(x$,i%,1)) : JSR OSWRCH : ]
```

```
NEXT i%
```

```
ENDPROC
```

Of course, before you can call Procmessage you must leave the assembler and then re-enter it after the call. The procedure generates five bytes of code for every character in the message, so ensure you have reserved enough memory.

Oswrch, and all the other Osnames, is not a defined constant. You should set it at the beginning of a program and use it to aid readability. The actual value it has varies from one MOS issue to the next but you can set it so that it does not matter which MOS you have. This is done by:

```
OSWRCH = !&20E AND &FFFF
```

The reason for this obscure-looking command will become clear later.

Osbyte — OS routines that use the processor's registers to pass byte-size parameters. We have seen how the entire

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range of VDU commands can be performed by a call to `Oswrch` but these do not constitute the entire range of screen-handling facilities provided by Basic, such as altering the flash-rates of colours and seeing what character lies at the position of the text cursor. These are all performed in Basic by the `*FX` command, which also controls many other machine functions not connected with the screen — see page 418 of the manual. The `Osbyte` routines provide the entire range of `*FX` commands in the same way as `Oswrch` did the VDUs, though this time there are many differing routines and we choose which one we want by placing an identification number in the accumulator prior to the call. In common with the VDU statement, the `*FX` statement may have more than one parameter, for example:

```
*FX 12,50
```

sets the keyboard auto-repeat to half a second. However, there are never more than three parameters so the entire statement can be performed in one go by passing the parameters in the A,X and Y registers of the 6502A. This avoids the need for repeated calling, necessary in the `Oswrch` section. For the call

```
*FX a,b,c
```

a is the call number and is passed in the accumulator; b is the first parameter, present

on the most calls, and is passed in the processor's X register; c is the second parameter, only present on a few calls, and is passed in the Y register. So the

```
*FX 12,50
```

call would be done as follows:

```
LDA# 12 : LDX# 50 : JSR OSBYTE
```

`Osbyte` having been previously defined. In some cases success/failure indicators or results are returned in the register. You should consult the manual to see further. The value of `Osbyte` is set by

```
Osbyte = ! &20A AND &FFFF
```

Osword — OS routines whose parameters are taken from specified words or memory. So far we can perform a large range of useful functions using `Oswrch`, where each call provides one parameter in the accumulator, and `Osbyte`, where each call gives up to three parameters in the processor's only three registers. There are a few more important features we would need regularly that need a lot more specified parameters than either `Oswrch` or `Osbyte`. For example it is vital that the OS provides sound-generating routines otherwise we would be left to manipulate the sound chip's registers ourselves if we required sound to be produced from a machine-code program. However the Basic's Sound and Envelope statements need a lot of parameters — far too many to be passed in the A,X,Y registers of the processor. The technique used to make these `Osword` calls is to use the A register as before — that is, to identify the function required — see figure 2 — and to pass the Address of a block of locations in RAM where we have previously stored the parameters in a predefined order in the X register — low byte — and Y register — high byte. A good example of this process is sound generation.

`Oswrch`, `Osbyte` and `Osword` are by far the most useful MOS sections to the assembly language programmer but for completeness I will briefly describe the other MOS parts.

Osrch — this MOS section deals with inputting characters from the keyboard. This is not really as useful as it sounds since most purposes will require that typing ahead has no effect and so an `Osbyte` call of 129 would be a better method. Contrast this to the two forms of `Inkey` statements — a negative argument tests whether a key is held at that instant.

```
OSRDCH = !&210 AND &FFFF
```

is the preferred definition of the address.

Osfind, **Osgbpb**, **Osput**, **Osaget**, **Osargs**, **Osfile** — these are all calls to deal with the setting up of a data file on the current filing system, and then performing transfers to and from it.

Osnewl — this simply causes a new line to be started on the screen

```
OSNEWL = &FFFE7
```

Osasci — equivalent to `Oswrch` except that a line feed is issued if, on calling, the accumulator contains `&0D`.

```
OSASCI = &FFFE3
```

Osccli — This provides another way of calling MOS routines. If, on calling `Osccli`, the 6502A's X and Y registers point to the start of a command line in memory. Suppose we had

```
TV 0,255
```

stored in successive bytes from location `&2345` then we would put `&45` into X and `&23` into Y. Then the command line interpreter will interpret and execute the command.

```
OSCLI = ! &208 AND &FFFF
```

That concludes the machine-operating system sections. At this point it would be wise to point out that there is a price to be paid for all the power and flexibility of the routines provided by the MOS and it is speed. A little time must be taken for the MOS to examine your call and cause execution of the correct routine inside of the section you have called to. However, this may not be such a disadvantage since the chances are that, should you have written your own routine to do the job, it would not be as efficiently coded as those inside the MOS and would thus be slower anyway.

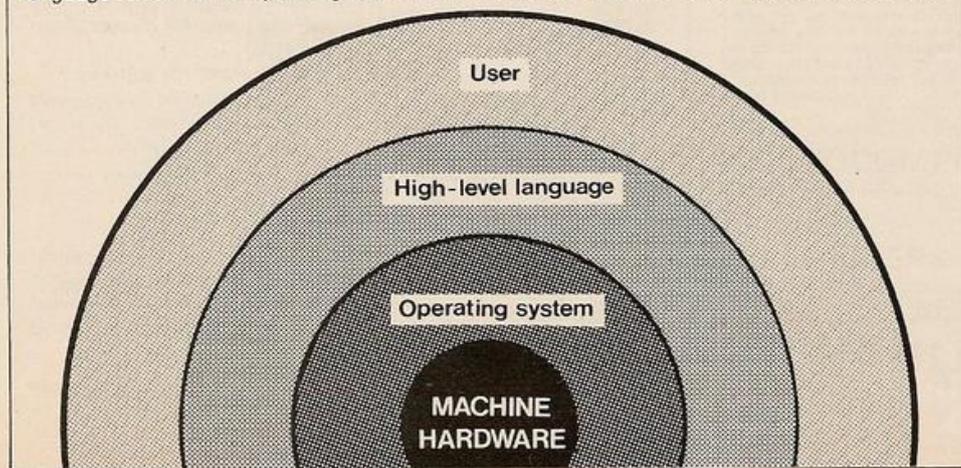
Up until now we have assumed that when we execute a call such as `JSR Oswrch` — with `Oswrch` defined as `&FFFE` — the program flow goes directly to `&FFFE` and the routine starts there. This raises an immediate problem; when a second processor is fitted the whole memory-map of the machine changes and it can no longer be guaranteed that the routine actually begins at `&FFFE` in the second processor.

Similarly, if you were to update your OS to the latest version, it would be highly unlikely that that particular routine was still held at the same starting address. In both cases, any calls such as the above would fail and therefore the program would fail also, unless it was modified suitably. These problems are neatly avoided by introducing indirection into the call mechanism. In simple terms, the real sequence of events when we call a MOS routine is: first, we make our call, as before, to an address in the range `&FF00` to `&FFFF`. Second, the operating system then looks at two consecutive bytes in RAM and from them obtains a 16-bit address previously put there by the bootstrap on power-up or Break. This address may change from machine to machine depending on the MOSs and whether or not second processors are fitted, but it always points to the start in memory of the code that performs the routine we originally wanted. This 16-bit RAM-held address is called the Vector for that particular call. Third, the routine can now be performed by jumping to the address given by the vector.

Although all of the vectors are originally set at power-up, since they are held in RAM there

(continued on next page)

Figure 1. The user relates to the operating system via the Basic interpreter. The high-level language relates to the operating system via machine code, but using pre-written OS routines.



(continued from previous page)

is nothing to stop us changing them so that they point to our own routines in RAM. We could then write routines which completely replace those in the MOS.

I will now demonstrate writing a routine which performs a small operation before branching to the address that was the original vector. This program will cause the BBC to beep every time a key is pressed on the keyboard. First of all we have to be able to produce a Beep in machine code, which is achieved using a call to the Osrdoch routine for sound generation. The stages for this are first, set up a parameter block — this can be done in Basic at the start:

```
10 DIM PARAM% 7 : OSWORD=! (&20C)
   AND &FFFF
20 FOR i%= 1 TO 8
30 READ p% : ? (PARAM% + i% - 1) = P%
40 NEXT
50 DATA &11,0,&F6,&FF,&14,0,2,0
```

See page 461 of the manual to see how a sound parameter block should be arranged. The Data statement gives rise to the parameters equivalent to those in the Sound statement:

```
SOUND &11,-10,20,2
```

Assemble the code to call up the sound routine in Osrdoch:

```
70 DIM P% 30
80 |
90 .beep PHA:TXA:PHA:TYA:PHA
100 LDA# 7
110 LDX# PARAM% MOD 256
120 LDY# PARAM% DIV 256
130 JSR OSWORD
140 PLA:TAY:PLA:TAX:PLA
150 RTS
160 |
```

Run this program and then do Call Beep and you should hear a short tone. Lines 90 and 140 Save and Restore the A,X,Y registers, since this will be necessary in the full program.

We must now decide how to arrange things so that the subroutine Beep gets called every time a key is pressed. When a key is pressed, three things happen, one, an interrupt tells the processor that this has occurred; two, the MOS uses its Osrdoch routine to take this character from the keyboard; three, the character is possibly echoed to the screen and further action may be taken.

Since two and three involve Operating System calls, we could intercept them by changing the vector of which one we choose so that it points to Beep. It turns out that it is best to choose number two. Three further modifications are required to complete the program. Save the value of the Osrdoch vector so that the proper Osrdoch routine can still be called at the end of the beep routine.

```
60 v% = ! (&210) AND &FFFF
```

Now call the real Osrdoch routine after our Beep routine so that the proper things still happen when we press a character.

```
145 JSR v%
```

The Basic program should change the Osrdoch vector to point to Beep, but only after its old value has been saved.

```
170 ?(&210) = BEEP MOD 256 : ?(&211) = BEEP DIV 256
```

The program can now be run and deleted; the key-beep will remain. Although not very practical in itself, this is a good illustration of the way in which it is possible to use a little ingenuity to attain a desired effect.

MOS section	Address	Vector	Function	Routines inside
OSGBPB	&FFD1	21A	Load/Save Memory	
OSFIND	&FFCE	&21C	Opening files	Open for read (&40), Open for Write (&80) Close (0), Open for Read and Write (&c0)
OSBGET	&FFD7	&216	Reads Byte	—
OSBPUT	&FFD4	&218	Writes Bytes	—
OSARGS	&FFDA	&214	Attributes	—
OSFILE	&FFDD	&212	R/W Files	Contents of accumulator decide what to Read/Write
OSRDCH	&FFE0	&210	Reads from Input Stream (IS)	
OSWRCH	&FFEE	&20E	Writes to IS	Causes output of character or control code whose ASCII code is in accumulator
OSASCI	&FFE3	none	Writes to IS	As above, but new line if accumulator = &0D
OSNEWL	&FFEE	none	Writes to IS	Outputs line feed, carriage return only
OSWORD	&FFF1	&20C	Miscellaneous	Reads line from input stream to RAM (0) Reads internal clock (1) Writes internal clock (2) Reads interval timer (3) Writes interval timer (4) Reads a byte across the Tube (5) Writes a byte to processors memory across Tube (6) Performs sound (7) Envelope definition (8) Reads a pixel colour at specified position (9) Reads dot pattern on non-control character (A) Returns palette/logical colour relationship (B)
OSBYTE	&FFF4	&20A	Effects	The following are in numerical order of accumulator contents. Prints MOS report — Choose input stream Choose output stream Enable or disable cursor edit keys (4) Parallel or serial printer select Define printer, ignore character Set serial port receive rate (7) Set serial port transmit rate Select flash speed of foreground colour (9)Background..... Miscellaneous enablesdisables Empty buffers Select ADC channel number (16) Starts analogue-to-digital conversion Clear soft keys Pause until fields are synchronised Explode user-definable key memory Empty chosen buffer Cancel escape condition (124) Set escape condition Acknowledge presence of escape condition (126) Select base number for soft-key codesshift.....control.....shift/control..... Perform escape enable/disable escape keyinterrupt request for user 6522ACIA 6850
OSCLI	&FFF7	&208	Interpreting command line	

Figure 2: Summary of facilities offered by operating systems 1.0 and above. The call numbers for the routines inside are shown in brackets.

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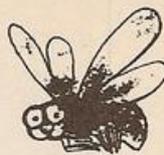
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We can supply Epson MX80 and MX100 printers to run direct from the MZ80K (i/o box not needed) for £48 plus printer price. We also specialize in interfacing printers to the MZ80K, MZ80A and MZ80B both with and without the i/o box.

```

10 REM *****
20 REM ** **
30 REM ** S.D. 6/82 **
40 REM *****
49 REM VBI AND DLI ROUTINES
50 FOR I=1536 TO 1613:READ A:POKE I,A:NEXT I:POKE 206,4:POKE 207,4:A=USR(1536)
60 DATA 104,160,10,162,6,169,7,76,92,228,173,199,2,205,200,2,240,16,198,207,208,25,169,5,133,206
70 DATA 173,200,2,141,199,2,208,13,198,206,208,9,169,10,133,207,165,208,141,199,2,169,0,133,209,
76,98,228
80 DATA 72,138,72,166,209,189,75,6,141,10,212,141,26,208,232,134,209,104,170,104,64,155,152,24
89 REM CHANGE CHARACTER SET
90 GOSUB 3000
99 REM STRINGS HOLDING PRINT POS.
100 DIM C$(7),X$(7),Y$(7),X5$(7),Y5$(7),X7$(7),Y7$(7),X6$(7),Y6$(7),X14$(7),Y14$(7),X10$(7),Y10$(7)
(7)
105 DIM X11$(7),Y11$(7),X9$(7),Y9$(7),BX(7),BY(7)
110 FOR I=1 TO 7:X5$(I)=CHR$(8+I):Y5$(I)=CHR$(8+I):X7$(I)=CHR$(8+I):Y7$(I)=CHR$(9):X6$(I)=CHR$(8+I)
(7)
115 Y6$(I)=CHR$(10-I):X14$(I)=CHR$(9):Y14$(I)=CHR$(10-I):X10$(I)=CHR$(10-I):Y10$(I)=CHR$(10-I)
120 X11$(I)=CHR$(10-I):Y11$(I)=CHR$(9):X9$(I)=CHR$(10-I):Y9$(I)=CHR$(8+I)
129 REM CHOOSE INPUT DEVICE
130 GRAPHICS 18:POKE 756,START/256:NEXT I:POSITION 6,3: ? #6;"choose":POSITION 4,5: ? #6;"1 paddle"
"
131 REM 'paddle' & 'joystick' IN INVERSE CHAR.
135 POSITION 8,6: ? #6;"or":POSITION 4,7: ? #6;"2 joystick":OPEN #1,4,0,"K"
140 GET #1,A:IF A<49 OR A>50 THEN 140
150 POSITION 9,9: ? #6;CHR$(A):INDEV=A-48
199 REM PROGRAM INITIALIZATION
200 DIM F(7),ST$(10),BP$(4):BP$="burp":MAXWAIT=6:MAXBUG=30
210 RESTORE 220:FOR I=1 TO 10:READ A:ST$(I)=CHR$(A):NEXT I
220 DATA 7,5,6,0,1,3,2,0,0,4
280 POKE 208,37:5=1:REM 208 IS BUG COLOR
285 REM INITIAL DIFFICULTY SELECTION
286 GRAPHICS 1:POKE 708,229:POKE 712,155:GOSUB 700:GOSUB 400
289 REM RESTART GAME
290 FOR I=1 TO 7:F(I)=0:NEXT I:SCORE=0:NUMBUG=0:BONUS=50
300 GRAPHICS 1:POKE 756,START/256:GOSUB 700:X=X5:Y=Y5:POKE 708,229:POKE 709,54:POKE 710,227:
POKE 712,155
305 REM DRAW
306 GOSUB 2000:POSITION 8,5:GOSUB 905
308 REM MAIN LOOP
309 IF INDEV=2 THEN GOSUB 500:GOTO 320
310 S=INT((PADDLE(0)-45)/20):IF S>7 THEN S=7
312 IF S<1 THEN S=1
314 S=S-S
320 POSITION 8,5:GOSUB 900+S
325 IF INDEV=2 AND STRIG(0)=0 THEN GOSUB 1000
330 IF INDEV=1 AND PTRIG(0)=0 THEN GOSUB 1000
339 I=0:IF WAIT>1 THEN WAIT=WAIT-1:GOTO 350
340 WAIT=MAXWAIT
341 I=I+1:IF I=8 THEN 350
342 IF F(I)=0 THEN 341
345 IF F(I)=2 THEN 347
346 RESTORE 800+I:READ DX,DY,BX,BY:POSITION BX,BY: ? #6;CHR$(129):F(I)=2:BX(I)=BX:BY(I)=BY:GOTO 3
41
347 RESTORE 800+I:READ DX,DY:POSITION BX(I),BY(I): ? #6;" ":BX(I)=BX(I)+DX:BY(I)=BY(I)+DY
348 POSITION BX(I),BY(I): ? #6;CHR$(129):IF BX(I)>5 AND BX(I)<13 AND BY(I)>5 AND BY(I)<11 THEN 37
0
349 GOTO 341
350 IF BUG>1 THEN BUG=BUG-1:GOTO 360
352 BUG=MAXBUG:IF NUMBUG=7 THEN 360
354 I=INT(RND(0)*7)+1:IF F(I)>0 THEN 354
356 F(I)=1:NUMBUG=NUMBUG+1
360 GOTO 309
369 REM BUG GOT TO FROG
370 POSITION 8,5: ? #6;" .":FOR I=1 TO 6:POKE 708,38:SOUND 0,100,12,10:FOR J=1 TO 50:NEXT J
375 POKE 708,36:SOUND 0,150,12,10:FOR J=1 TO 10:NEXT J:NEXT I:SOUND 0,0,0,0
398 GOSUB 400:GOTO 290
399 REM PROMPT FOR NEW GAME
400 POSITION 4,13: ? #6;"PRESS start":POSITION 6,14: ? #6;"TO PLAY":REM USE IN INVERSE CHAR. IN TH
ESE TWO LINES
401 POSITION 4,16: ? #6;"PRESS select":POSITION 3,17: ? #6;"FOR DIFFICULTY"
402 POKE 53279,8:K=PEEK(53279):IF K=6 THEN 420
404 IF K=5 THEN MAXWAIT=MAXWAIT-1:MAXBUG=MAXBUG-5:IF MAXBUG<5 THEN MAXBUG=30:MAXWAIT=6
406 POKE 656,0:POKE 657,3: ? 7-MAXWAIT
408 FOR I=1 TO 100:NEXT I
410 GOTO 402
420 POSITION 5,16: ? #6;" " :POSITION 3,17: ? #6;" "
430 IF SCORE>MAXSCORE THEN MAXSCORE=SCORE
440 RETURN
499 REM JOYSTICK SUBROUTINE
500 S=STICK(0):IF S=15 OR S=13 THEN RETURN
510 S=ASC(ST$(S0-4)):RETURN
599 REM BURP SUBROUTINE
600 POKE 77,0:X=1:Y=0:FOR K=1 TO 4:X=X+1:Y=Y+1:POSITION X,Y: ? #6;BP$(K,K):NEXT K
620 FOR K=250 TO 150 STEP -3:SOUND 0,K,2,10:NEXT K
630 X=1:Y=0:FOR K=1 TO 4:X=X+1:Y=Y+1:POSITION X,Y: ? #6;" ":NEXT K:RETURN
699 REM CHANGE DISPLAY LIST
700 A=PEEK(560)+256*PEEK(561):POKE A+3,198:POKE A+15,134:POKE A+24,134
710 IF PEEK(A)<>66 THEN A=A+1:GOTO 710
720 POKE A,71:POKE A+3,7:POKE A+4,65:POKE A+5,PEEK(A+7):POKE A+6,PEEK(A+8)
722 POKE 512,54:POKE 513,6:POKE 54286,192
730 POKE 656,0:POKE 657,3: ? 7-MAXWAIT:POKE 656,0:POKE 657,15: ? MAXSCORE
740 POSITION 2,19: ? #6;"dif score high":RETURN
800 REM X-Y INCREMENTS & STARTING POS.
801 DATA 1,-1,0,18
802 DATA 1,0,0,9
803 DATA 1,1,0,0
804 DATA 0,1,9,0
805 DATA -1,1,18,0
806 DATA -1,0,18,9
807 DATA -1,-1,18,18
900 REM PRINT EYES ON FROG
901 X=X9:Y=Y9: ? #6;" )":RETURN

```



CRA O TOLD TOA

Gulp down those bugs as you drift lazily on your lily-pad with Stan Ockers' game for the Atari.

YOU PLAY the part of an extremely hungry toad. Your object is to eat all bugs before they reach you by pointing the toad's beady eyes at the incoming bug. You will find that your tongue snakes out and slurps up the bugs when you press the Fire button. Points are scored depending on the difficulty level. However, if the bug hits you, you die. The level of difficulty can be set at the start of the game. Either a joystick or paddle controller can be used.

The bugs are made to blink on and off by a Vertical Blank Interrupt — VBI — routine that changes the bugs' colour to background colour and back. The VBI routine also has an important function in connection with another routine, the Display List Interrupt routine.

The display list is modified, lines 700-720, to change the text area to two mode 2 lines and also to set display list interrupts at three points down the vertical height of the screen. When these interrupts occur the DLI routine changes the background colour depending on a counter which counts the DLIs. During the vertical blank period this counter is reset to zero, ready for the next screen. This technique gives separate colours to the sky, water and score areas.

The character set has been altered enabling the toad to be printed in graphics mode 1. This

WZY

AD



gives a choice of upper case and punctuation or lower case and graphics symbols. It is best to pick the former and change the punctuation starting with that above the numerals on the keyboard, leave the quotation mark alone. The set must first be moved from ROM to RAM and I use a machine-code routine stored in ZZ\$ to do this — line 3000.

To move the tongue around, keep track of the print positions. I put these locations in strings; a set of Xs and Ys for each direction — lines 100-120. The positions are recovered from the strings by using the ASC function — lines 1002 and 1004.

Atari Basic can restore data values to the beginning of a certain line. This function is used in picking up the starting position and increments of the bugs — 346 to start or line 347 to continue — flags — F(I) — keep track of the condition of the bugs; 0 means the bug is active, 1 it is in motion and 2 means that it collided with something.

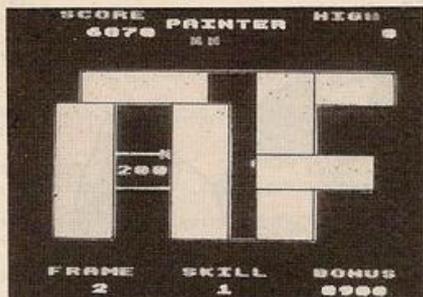
Wait and Bug are counters that skip over the start-a-bug and move-bug sections. When the counters reach zero, a new bug is started or all the bugs are moved and the counters are set to Max Wait, Max Bug respectively. The larger these maximums, the slower things go and the difficulty level is increased by reducing Max Wait and Max Bug.

```

902 X$=X11$:Y$=Y11?:? #6;" (:RETURN
903 X$=X10$:Y$=Y10?:? #6;"# #:RETURN
904 X$=X14$:Y$=Y14?:? #6;"$ #:RETURN
905 X$=X6$:Y$=Y6?:? #6;"Z Z":RETURN
906 X$=X7$:Y$=Y7?:? #6;"& &":RETURN
907 X$=X5$:Y$=Y5?:? #6;"' ':RETURN
999 REM TONGUE ROUTINE
1000 I=0
1001 I=I+1:IF I=8 THEN 1010
1002 POSITION ASC(X$(I)),ASC(Y$(I)):GET #6,A:C$(I,I)=CHR$(A)
1004 POSITION ASC(X$(I)),ASC(Y$(I)):? #6;CHR$(13):SOUND 0,7-1,8,8:IF A=129 THEN GOTO 1050
1005 GOTO 1001
1010 I=I-1:IF I=0 THEN 1020
1012 POSITION ASC(X$(I)),ASC(Y$(I)):? #6;C$(I,I):SOUND 0,7-1,8,8:GOTO 1010
1020 IF BURP=1 THEN GOSUB 600:BURP=0
1022 SOUND 0,0,0,0:RETURN
1049 REM GOT A BUG
1050 F(S)=0
1060 SCORE=SCORE+10*(7-MAXWAIT):POKE 656,0:POKE 657,8:? SCORE;" " :NUMBUG=NUMBUG-1
1070 IF SCORE>BONUS THEN MAXWAIT=MAXWAIT-1:MAXBUG=MAXBUG-5:BONUS=BONUS+100*(7-MAXWAIT):BURP=1
1072 IF MAXBUG<5 THEN MAXBUG=5:MAXWAIT=1
1080 POKE 656,0:POKE 657,3:? 7-MAXWAIT
1090 C$(I,I)=" ":I=I+1:GOTO 1010
1999 REM PRINT FROG SUBROUTINE
2000 POSITION 6,6:? #6;"+- +?":POSITION 6,7:? #6;"+----+?":POSITION 6,8:? #6;"+-----?"
2010 POSITION 6,9:? #6;"-- +?":POSITION 5,10:? #6;"+----+?":POSITION 5,11:? #6;"-----?"
2020 POSITION 5,11:? #6;"-----":RETURN:REM INVERSE CHAR. IN THIS LINE
2999 REM CHANGE CHAR. SET SUBR.
3000 DIM ZZ$(32):RESTORE 3010:FOR I=1 TO 32:READ A:ZZ$(I)=CHR$(A):NEXT I
3010 DATA 104,104,133,204,104,133,203,104,133,206,104,133,205,162,4,160,0
3020 DATA 177,203,145,205,136,208,249,230,204,230,206,202,208,240,96
3030 POKE 106,PEEK(106)-5:GRAPHICS 0:START=(PEEK(106)+1)*256:POKE 756,START/256:POKE 752,1:? "IN
INITIALIZING ...."
3040 A=USR(ADR(ZZ$),57344,START):RESTORE 3100:FOR I=START+8 TO START+119:READ A:POKE I,A:NEXT I
3050 RETURN
3100 DATA 0,34,85,62,54,85,34,0,0,102,102,102,0,0,0,0,255,241,241,241,129,129,255,255
3110 DATA 255,189,189,189,129,129,255,255,143,143,143,143,143,129,129,255,255,255,129,143,143,143,12
9,255,255
3120 DATA 255,129,129,143,143,143,255,255,129,241,241,241,129,255,255,255,129,129,241,241,241,24
1,255,255
3130 DATA 240,240,240,240,240,240,15,15,15,15,15,15,15,0,0,0,0,24,24,48
3140 DATA 255,255,255,255,255,255,255,255,145,145,255,145,145,255,255

```

A + F SOFTWARE A + F

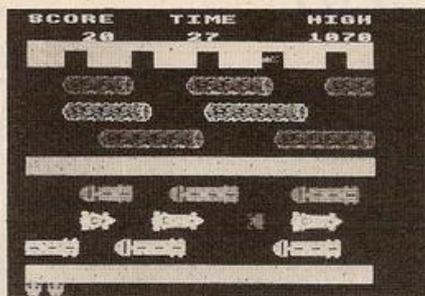
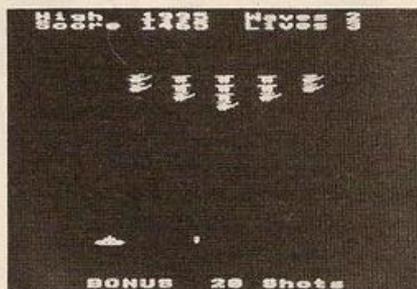


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 ◀ Runs in colour on the Atom without F.P. BBC cassette £8. Disk £11.50.
 Atom cassette £6.90.
 Spectrum cassette £5.75.

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 BBC Cass. £8.00 Disc £11.50.
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Listing 1.

```

5*KEY 10 "7&18=&10:MOLD:IM"
10 LX=&D00
20 chr%=&C00:oswerch=&FFEE
30 DIM TX 600
40 TX=&D21
50 DIM DX 15
60 DX=LX+1:d%=LX+9
70 DIM MX 15
80 M%=LX+17
90 FOR O%=MX TO MX+12 STEP 4
100 READ K%:!O%=K%:NEXT
110 FOR opt = 0 TO 3 STEP 2
120 P%=TX
130EOPt opt
140 .gchar STX &70
150STY &71 \ store X%,Y%
160LDA &601
170STA &7E \ find string address
180LDA &602
190STA &7F
200LDY #0
210LDA (&7E),Y
220STA &72 \ store lsb string add
230INY
240LDA (&7E),Y
250STA &73 \ store msb string add
260INY
270INY
280LDA (&7E),Y
290STA &74 \ store string len
300LDA #0
310STA &75 \ zero counter
315 \ ***** main control routine *****
320 .nchr JSR rot
330 JSR OPUT
340 INC &75
350 LDA &75
360 CMP &74 \ compare length re counter
370 BCC nchr
380 RTS \ end of control loop

1000 \***** START OF ROTATE ROUTINE *****
1010.rot LDA #0
1020STA &7D
1030LDY &75
1040LDA (&72),Y \ get chr from string
1050CMP #127 \ system or user-defined ?
1060BCC R1
1070SBC #224
1080STA &77 \ ordinal No user-defined
1090LDA #&0C \ base of user characters
1100JMP R2
1110.R1 SBC #31
1120STA &77 \ ordinal No user-defined
1130LDA #&C0 \ base of system characters
1140.R2 STA &7E \ store base value
1150LDA #0 \ multiplies ordinal number by eight
1160STA &7C
1170LDA &77
1180LDX #2
1190CLC
1200.R3 ROL A
1210ROL &7C
1220DEX
1230BPL R3
1240CLC
1250ADC &7D \ add to base value and store
1260STA &7D \ the result in &7D/E
1270LDA &7C
1280ADC &7E
1290STA &7E
1300LDY #7 \ move the character definition
1310.R4 LDA (&7D),Y \ into DX
1320STA DX,Y
1330DEY
1340BPL R4
1350 \***** START OF TURN ROUTINE *****
1360LDA &70 \ original value of X%
1370STA &7F
1380BEQ R8 \ no turn required
1390.R5 LDY #7 \ No of bytes in def
1400.R6 LDA DX,Y \ get a byte (listing continued on next page)

```

ALL BBC CHARACTERS GREAT AND SMALL

GROUPS OF PEOPLE and the young are supposed to find the 20-column modes of the BBC Micro easier to read. Personally I have never found this true. The double-width characters are too far removed from any other form of printed character to be easily recognisable; double-width and double-height characters would be much more effective. The double-height characters of mode 7 can be used very effectively to title and highlight parts of the text without this disadvantage, however no other graphics mode allows different-sized characters to be mixed on the screen. Another shortcoming of the text capability of the high-resolution modes is the inability to produce text in any other orientation than the conventional left-right direction. It is useful, for example, to label graphs by plotting text from the bottom to the top of the screen, or with games to plot a user-defined character in more than one orientation.

Having grown used to having these facilities available on other machines, I produced the machine-code program shown in listing 1 to make possible a much more flexible use of text in BBC high-resolution graphics modes. Specifically it will plot a string on to the screen in any one of four orientations in any one of four character sizes.

The four possible sizes are normal, double-width, double-height, and double-width and height. These sizes are related to the normal character sizes for the graphics mode you are

Mix double-height, normal and double-width text on the screen at the same time. Fintan Culwin shows you how to do it.

Listing 2.

```

232 DEF PROCGCHAR(X%,Y%,string%)
1005 LOCAL LX,TX
1010 IF X%<0 OR X%>3 THEN PROCERRR
1020 IF Y%<0 OR Y%>3 THEN PROCERRR
1030 FOR LX=1 TO LEN(string%)
1040 TX=ASC(MID$(string%,LX,1))
1050 IF TX<32 OR TX>126 AND TX<125 THEN PROCERRR
1060 NEXT LX
1070 CALL &0D21,string%
1080 ENDPROC
1100 DEFPROCERRR
1110 PRINT"Incorrect use of gchar function"
1120 PRINT"Called with '",X%',"',Y%',"',string%"
1130 END

```

Listing 3.

```

135 .gchar LDA #0
136 STA &76
137 ROL &76 \ STORE CX
140 STX &70
>
1510 .R8 LDA &76 \ normal or inverse?
1520 BEQ R12 \normal !
1530 LDY #7 \ start of invert
1540 .R11 LDA DX,Y
1550 EOR #&FF \ invert here
1560 STA DX,Y
1570 DEY
1580 BPL R11 \ end of invert
1590 .R12 RTS \** END OF ROT**

```

currently using. The double-width and double-height options refer to the screen and not to the character — take a deep breath and think about it.

The size is selected by the value of Y% when the routine is called. The values are 0 for normal, 1 for double-width, 2 for double-height and 3 for double-width/height. These are controlled in a similar manner by the value of X%. The routine itself does not perform any error-checking on the values of X% and Y%. Values of Y% in excess of three will cause a default of double-width/height, but values of X% higher than three will cause disastrous results.

The string to be plotted is passed to the routine via the Call command. The first argument to the Call command is the entry point to the routine. In this case, the absolute value is &0D21 labelled by the variable GChar. The second argument to the Call is the variable name of the string, and not the string itself. The characters within the string can include any printable character. A random noise pattern will result if any control codes are passed in the string.

It is possible to perform error checking on the string and on the control variables from within the routine, but in the interests of keeping the code as short as possible I have omitted them from the version presented here. Instead, I have included listing 2 which is a procedure to check for these errors and halt

(continued on next page)

(continued from previous page)

program execution if such an error occurs. It uses X% and Y% as formal parameters to the procedure so it is safe to use these within the main body of the program without any confusion.

The routine was written on a machine fitted with operating system 0.1 EPROM. One of the jobs the routine has to do is to calculate the position in memory where the character definitions have been stored. The new user guide describes an Osword call implemented from version 1.0 onwards which will do this. If you have OS 1.0 fitted, the code given in listing 3 will ensure that the whole program runs smoothly.

Routine protection

The routine occupies less than 200 bytes hex and can thus fit into less than two pages of memory. Page &0D is reserved for user-supplied resident routines. If this and the following page are used, then the routine will only occupy one page of what is usually user memory. The routine has to be protected against the Resetting of Page by the operating system when the break key is pressed. This is done by the Key 10 definition in line 5. Before a final version of the routine is loaded or run this page must be reserved for it by resetting Page to &1000.

Once a working copy of the routine is successfully installed in the memory at this position a direct copy of the code can be made by Saving this section of memory. To do this use the *Save command.

For example

```
*SAVE "gchar" 0D00 0FFF
```

The code can be directly loaded back into memory using the *Load command

```
*LOAD "gchar"
```

Both of these operations are best done with full CFS information displayed. To do this use the command

```
*OPT 1,2
```

Remember to reset Page before attempting any Basic and to protect the Reset as described.

A note to model A owners or even extravagant users of model Bs. Up to two extra pages of memory can be obtained by resetting Page downwards. Program memory usually starts at &0E00. The page below this is reserved for user-supplied routines. If these are not being supplied then Page can be reset to &0D00 to allow Basic to use it. Page &0C is where the user-defined character information is stored. If user-defined characters are not being used within the program then this also can be used for program memory. The reset has to be protected against the Break key as described.

Most of the routine is explained in outline by the comment entries in the listing. It should be possible, if you are familiar with 6502 machine code, to reduce or enlarge the number of options fairly easily. The only non-standard part of the code is the method of storing the cursor movement information. The information for moving the cursor is stored in the 16-byte data block labelled by M%.

Each byte of data holds the information for horizontal and vertical movement of the cursor. The byte is split into two nybbles —

four bits — each nybble holds a three-bit number and the sign. The first — left-most — nybble holds the up-down information in the order high bit, middle bit, low bit and sign.

Where sign is 0 for upward movement and 1 for downward movement. The second nybble holds information for left/right movement in a similar way but the order of the bits is reversed. Sign 0 indicates rightward movement and sign 1 leftward. This allows the maximum movement between characters of seven-character cells in any direction. The information is extracted from the data block decoded and implemented in the cursor subroutine.

If you are not conversant with BBC assembler the program can be copied directly into your machine.

Type and test

To facilitate typing and testing the program the actual location of the code can initially be left to the machine operating system. This will allow the routine to be entered and tested without bothering to reset Page, and possibly overwrite the program if any problems arise. To do this omit lines 5, 40, 60 and 80 until the routine has been fully tested. Then Load the program from &1000 upwards before re-entering the missing lines which locate it in pages &0D and &0E.

The final point to note is that the information is actually sent to the screen by continually redefining character 224 which is consequently unavailable for other uses within the user program. This restriction is accounted for within the ProcGchar procedure listing given.

(listing continued from previous page)

1410LDX #7	\ No of bits	3160JSR dtoD	\ transfer rhs info
1420.R7 ROL A	\ Push off a bit	3170JSR hsPl1	\ send rhs to screen
1430ROR d%,X	\ catch within d%	3180JSR curs	\ move cursor
1440DEX		3190RTS	\ ** END OF DWIHI **
1450BPL R7	\ any more bits ?	4000	\ ***** START OF HEIGHT SPLIT *****
1460DEY		4010.hsPl1 LDA #1	\ heightsPl1
1470BPL R6		4020STA &7F	\ set up counter
1480JSR dtoD	\ move turned character back to D%	4030LDY #0	
1490DEC &7F		4040.h1 LDA D%,Y	
1500BNE R5	\ any more turns ?	4050PHA	
1510.R8 RTS	\ ** END OF ROT **	4060INY	
2000	\ ***** START OF OUTPUT ROUTINE *****	4070CPY #8	\ Push eight bits of definition
2010.OPUT LDA &71	\ original value of Y%	4080BMI h1	\ onto Processor stack
2020CMP #0		4090.h2 LDY #7	
2030BEQ normal	\ Y%=0	4100.h3 PLA	\ take four bits off
2040CMP #1		4110STA ohr%,Y	\ stack and put into ochr
2050BEQ dwid	\ Y%=1	4120DEY	
2060CMP #2		4130STA ohr%,Y	\ twice
2070BEQ dhe1	\ Y%=2	4140DEY	
2080JMP dwih1	\ Y%>=3	4150BPL h3	\ four bits done ?
2090RTS	\ ** END OF DPUT CONTROL **	4160LDA #224	
2095	\ ***** START OF NORMAL *****	4170JSR oswerch	\ send to screen
2100.normal JSR DtoD	\ normal size	4180LDA &7F	
2110LDA #224	\ move D% to O%	4190BEQ h4	\ branch if all done
2120JSR oswerch	\ send to screen	4200LDA #8	
2130JSR curs	\ move cursor	4210JSR oswerch	
2140RTS	\ ** END OF NORMAL **	4220 LDA #11	
2300	\ ***** START OF DOUBLE WIDTH *****	4230JSR oswerch	\ else move cursor
2310.dwid JSR DtoD	\ moves charcter definition	4240DEC &7F	\ and decrease counter
2320JSR wsPl1t	\ to O% then sPl1ts into D%&d%	4250JMP h2	
2330JSR DtoD		4260.h4 RTS	\ ** END OF HSPLIT **
2340LDA #224		4500	\ ***** START OF WORD SPLIT *****
2350JSR oswerch	\ send first Part to screen	4510.wsPl1t	\ sPl1ts character
2360JSR dtoD		4520LDX #1	\ in ochr into
2370JSR DtoD		4530STX &7F	\ D% and d%
2380LDA #224		4540.s1 LDY #3	\ no of bits to move
2390JSR oswerch	\ send second Part to Printer	4550.s2 LDX #7	\ no of bytes to
2400JSR curs	\ move cursor	4560.s3 LSR ohr%,X	\ Push off a bit
2410RTS	\ ** END OF DWID **	4570BCC s4	\ JUMP if not set
3000	\ ***** START OF DOUBLE HEIGHT *****	4580ROR D%,X	
3010.dhei JSR hsPl1	\ hsPl1 addresses screen directly	4590SEC	
3020JSR curs	\ move cursor	4600ROR D%,X	\ Put two set bits into D%
3030RTS	\ ** END OF DOUBLE HEIGHT **	4610JMP s5	
3100	\ ***** START OF DOUBLE WIDTH/HEIGHT *****	4620.s4 ROR D%,X	
3110.dwih1 JSR DtoD	\ transfer definition to ochr	4630CLC	
3120JSR wsPl1t	\ sPl1t horizontaly	4640ROR D%,X	\ put two blanks into D%
3130JSR hsPl1	\ send lhs to screen	4650.s5 DEX	\ any more bytes
3140LDA #10		4660BPL s3	
3150JSR oswerch	\ move cursor	4670DEY	\ any more bits
		4680BPL s2	
		4690LDA &7F	

```

4700LSR A
4710BCC s6 \ branch if all done
4720JSR Dtod \ else send this half to d%
4730DEC &7F \ and decrease the counter
4740JMP s1 \ and do the other half
4750.s6 RTS ** END OF WSPLIT **
5000 \***** START OF CURSOR CONTROL ****
5010.curs LDA #0
5020STA &7D
5030STA &7E
5040LDA &71 \ get original value of Y%
5050CLC
5060ROL A
5070CLC
5080ROL A \ multiply it by eight
5090ADC &70 \ add result to original value of X%
5100TRV
5110LDA M%,Y \ and use as an offset to the data table
5120STA &7F
5130LDX #4 \ store nybble controlling left/right
5140 .C1 ROR A
5150ROL &7D
5160DEX
5170BNE C1
5180LDA &7F
5190LDX #4 \ store nybble controlling up/down
5200.C2 ROL A
5210ROL &7E
5220DEX
5230BNE C2
5240LSR &7D \ decode left/right
5250BCS m1 \ character data
5260LDA #9 \ prime for right
5270JMP m2
5280.m1 LDA #8 \ prime for left
5290.m2 JSR cmv \ move left/right
5300LDA &7E
5310LSR A
5320STA &7D \ decode and transfer up/right
5330BCS m3
5340LDA #11 \ prime for up
5350JMP m4
5360.m3 LDA #10 \ prime for down
5370.m4 JSR cmv \ move up/down
5380RTS \ ** END OF CURS **
5390 \***** START OF CURSOR MOVER ****
5400.cmv LDX &7D \ No of moves
5410.c1 BEQ c2 \ branch if all done
5420JSR oswerch \ move cursor
5430DEX \ decrease counter
5440JMP c1
5450.c2 RTS \ ** END OF CMV **

```

```

5999 \***** UTILITY ROUTINES ****
6000 .Dtd LDY #7 \ copies D% to ochr%
6010 .z1 LDA D%,Y
6020 STA ochr%,Y
6030 DEY
6040 BPL z1
6050 RTS \ ** END OF D to O **
6060 .dtd LDY #7 \ copies d% to D%
6070 .z2 LDA d%,Y
6080 STA D%,Y
6090 DEY
6100 BPL z2
6110 RTS \ END OF d to D **
6120 .Dtd LDY #7 \ copies D% to d%
6130 .z3 LDA D%,Y
6140 STA d%,Y
6150 DEY
6160 BPL z3
6170 RTS \ END OF D to d
6180J
6190 NEXT
7000 MODE 4
7010VDU 23,8202,0,0:0
7020VDU 5
7030 VDU 23,225,24,60,90,126,60,24,60,66
7040a$="Testing": GOSUB 7500
7050a$=STRING$(7,CHR$(225)):GOSUB 7500:GOTO 7040
7500Y%=0: X%=0:PRINTTAB(16,11):CALL 9char,a$
7510X%=1:PRINTTAB(15,17):CALL 9char,a$
7520X%=2:PRINTTAB(22,17):CALL 9char,a$
7530X%=3:PRINTTAB(23,11):CALL 9char,a$
7540Y%=1: X%=0:PRINTTAB(12,6):CALL 9char,a$
7550X%=1:PRINTTAB(12,17):CALL 9char,a$
7560X%=2:PRINTTAB(25,22):CALL 9char,a$
7570X%=3:PRINTTAB(25,11):CALL 9char,a$
7580Y%=2: X%=0:PRINTTAB(16,9):CALL 9char,a$
7590X%=1:PRINTTAB(18,20):CALL 9char,a$
7600X%=2:PRINTTAB(22,20):CALL 9char,a$
7610X%=3:PRINTTAB(28,8):CALL 9char,a$
7620Y%=3: X%=0:PRINTTAB(12,4):CALL 9char,a$
7630X%=1:PRINTTAB(7,20):CALL 9char,a$
7640X%=2:PRINTTAB(25,25):CALL 9char,a$
7650X%=3:PRINTTAB(30,8):CALL 9char,a$
7660 B$="Press":X%=0:Y%=3:PRINTTAB(6,30):CALL 9char,B$
7670 B$="the":Y%=2:PRINTTAB(17,30):CALL 9char,B$
7680 B$="SPACE":Y%=3:PRINTTAB(21,30):CALL 9char,B$
7685 B$="BAR":Y%=1:PRINTTAB(32,30):CALL 9char,B$
7690PRINTTAB(1,1): REPEAT UNTIL GET=32
7700 RETURN
9000 DATA &3C0A2C00,&3A092A00
9010 DATA &7C3A2C30,&7A392A30

```



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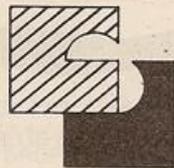
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THE SPEED of Forth and being able to redefine standard graphic characters are features of the Jupiter Ace which make it ideal for improved quality printing — either on screen or on paper — a parallel printer has been promised by Jupiter Cantab.

The *Jupiter Ace Handbook* explains that the character set is contained in RAM addresses 11264 to 12287. These characters can be changed by writing new values into this RAM, but cannot be read back again. The initial character set is created from the ROM when the computer is switched on. The raw data to generate the characters is contained in ROM bytes 7547 to 8187 which consist of an abbreviated set of ASCII characters 32 to 127. If you want to see this data, define the words DD and Change01 as follows:

```
: DD
  DUP 16 + DUP ROT
  DO
    I C@ 256 + 2 BASE C!
    . DECIMAL 32 EMIT I . CR
  LOOP ;
: CHANGE01
  11264 48 8 * + 8 0
  DO
    DUP 128 SWAP C! 8 +
    DUP 255 SWAP C! 7 -
  LOOP
  1- 255 SWAP C! ;
```

Now enter CHANGE01 INVIS CLS 7547 DD and enter further DD as required. The program displays the ROM data in succession — with an additional character on the left-hand side — and the byte number at the right. The word Change01 has turned the character 0 into a black square and the character 1 into a white square, so that the ASCII characters are readily discernible.

If you look carefully at this section of ROM, you will see that the ASCII characters 32 to 62 copy seven bytes at a time. The top line of each character is a zero byte. ASCII characters 63 to 94 only use six bytes each with zero top and bottom, while 95 to 126 use seven as before. Finally character 127 uses all eight bytes.

When you have finished looking at the ROM, enter Abort to clear the data stack.

The ROM data provides a very simple means of returning any character set you may have devised back into the original form. For example, we do not want 0s and 1s to look like black and white squares for the rest of their lives. The word Reset emulates the action of the computer when it is first switched on, restoring to original any altered characters between 32 and 127.

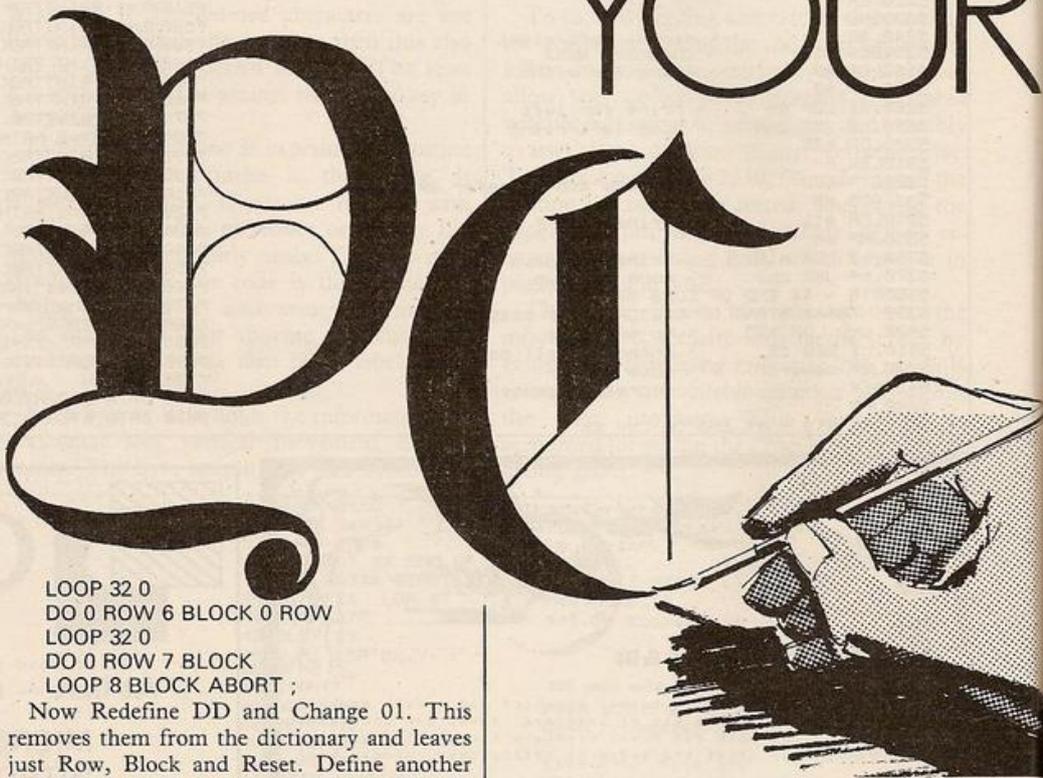
Two utility words are needed — ROW which enters a single byte where ordered, and BLOCK, which copies a prescribed block of data from the ROM.

```
: ROW
  OVER C! 1+ ;

: BLOCK
  0 DO
    OVER C@ ROW SWAP
    1+ SWAP
  LOOP ;

: RESET
  7547 11520 31 0
  DO 0 ROW 7 BLOCK
```

CHARACTER EXERCISES FOR YOUR

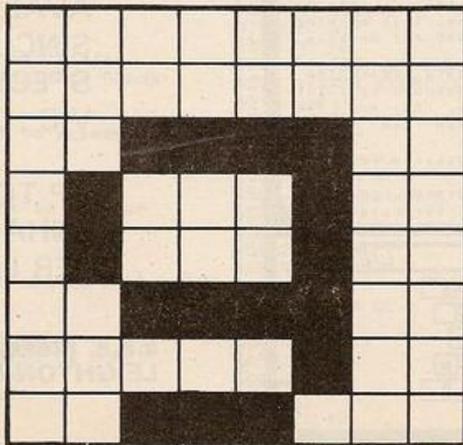


```
LOOP 32 0
DO 0 ROW 6 BLOCK 0 ROW
LOOP 32 0
DO 0 ROW 7 BLOCK
LOOP 8 BLOCK ABORT ;
```

Now Redefine DD and Change 01. This removes them from the dictionary and leaves just Row, Block and Reset. Define another word Test to display all the characters on the screen:

```
: TEST
```

BEFORE



```
127 32
DO I EMIT
LOOP 4 1
DO I EMIT
LOOP ;
```

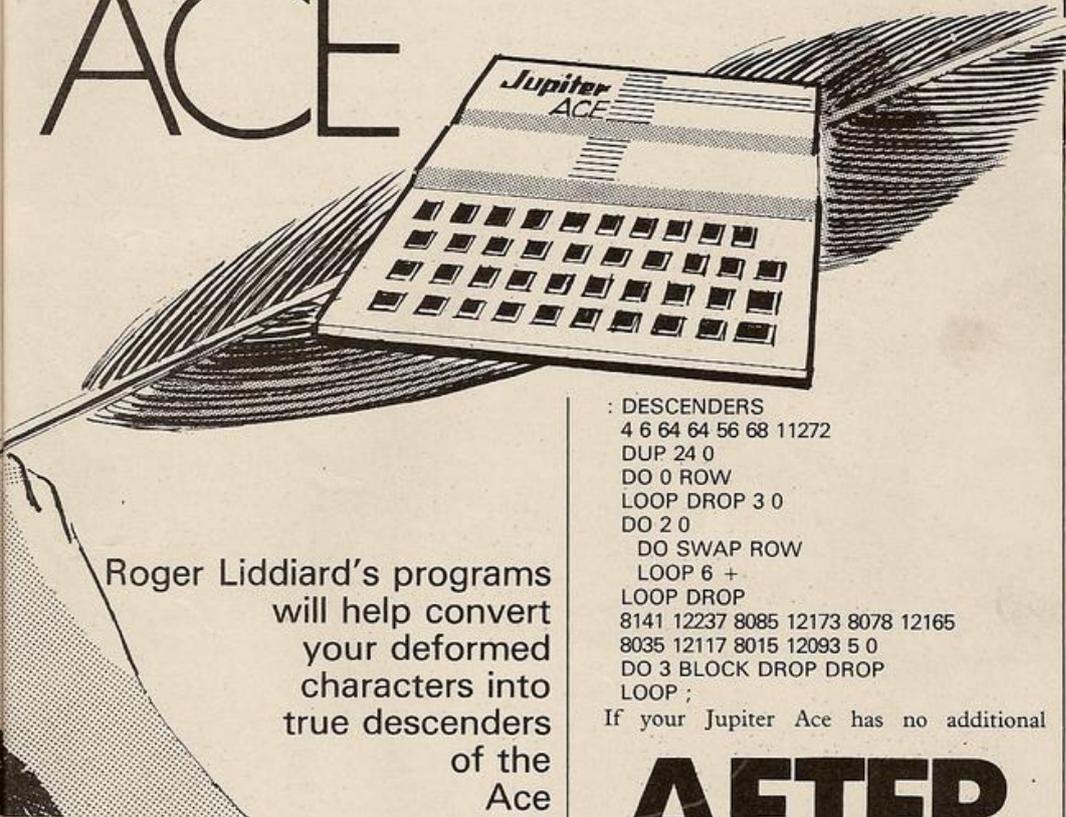
You will notice that three graphic characters appear at the end — we will need to look at these later on; they will be changed into something more useful.

Examine the letters critically — several things detract from their appearance: the lines of writing are too close together; some lower case letters seem to be too short, not lining up with the top of the other letters; and the descenders — the tails that are supposed to fall below the line — hardly descend at all.

To overcome cramped writing one simple remedy is to print a blank line between lines of type. At first this might appear to space the lines out too far, but if the blank lines are used to draw better descenders and we increase the size of the capitals, the spacing looks just right.

The word Capital increases the height of ASCII characters 63 to 94 — it simply doubles

R-FORMING OR ACE



Roger Liddiard's programs will help convert your deformed characters into true descenders of the Ace

up on the top two lines of the characters:

```
: CAPITAL
7764 11768 32 0
DO 2 BLOCK SWAP
4 + SWAP 6 +
LOOP DROP DROP ;
```

The offending lower-case letters are stretched in a similar manner to smooth out their tops:

```
: LCASE
1 1 4 4 4 1 4 1 4 1 4 7977 12048 11 0
DO 3 PICK BLOCK 3 PICK -
SWAP ROT - 7 + SWAP 8 +
LOOP DROP DROP ;
```

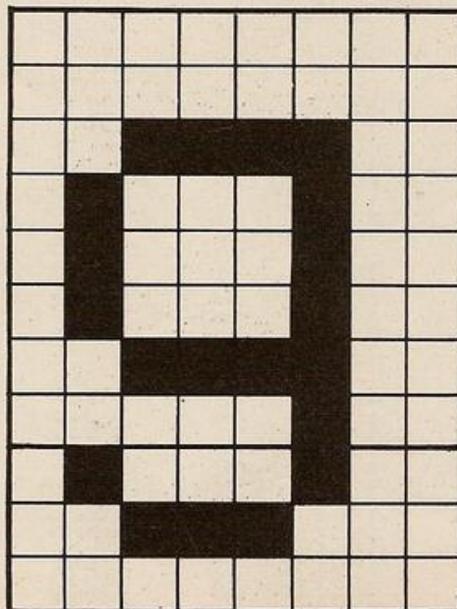
Now to put proper tails on your letters. The letters g, j, p, q and y are re-defined and their tails are drawn in graphic characters 1, 2 and 3. Yes, you only need three tails — those of g, j, and y are the same.

The word Descenders makes this transformation — of course the tails are lost until we double space the typing, but you can see them being formed in the last three characters of Test.

```
: DESCENDERS
4 6 64 64 56 68 11272
DUP 24 0
DO 0 ROW
LOOP DROP 3 0
DO 2 0
DO SWAP ROW
LOOP 6 +
LOOP DROP
8141 12237 8085 12173 8078 12165
8035 12117 8015 12093 5 0
DO 3 BLOCK DROP DROP
LOOP ;
```

If your Jupiter Ace has no additional

AFTER



memory, you will soon be running out of space, but do not worry — once the new set of characters has been formed, we can clear the dictionary and start again with some new words. So Save what we have done so far, then enter
CAPITAL LCASE DESCENDERS FORGET
RESET

which should clear out the dictionary — check it with VList. Now the finale.

Start by entering two utilities:

```
32 VARIABLE NN
: PRINT ;
```

Then define the word DType. It is quite long but its effect is dramatic:

```
: DTYPE
32 NN ! FIND DUP 6 + SWAP 5 - @ 13 -
BEGIN
DUP 32>
IF
ELSE DUP NN !
THEN NN @ 0 >
WHILE
BEGIN
INKEY DUP 80 =
IF PRINT
THEN
UNTIL NN @ - SWAP DUP NN @ +
SWAP NN @
TYPE SWAP 32 NN @ - SPACES 32 0
DO 113 113 113 112 112 121 106 103
0 15388 @ 32 - C@ 8 0
DO DUP 4 ROLL = ROT + SWAP
LOOP DROP DUP
IF
ELSE DROP 32
THEN EMIT
LOOP
REPEAT DROP DROP ;
```

DType is used in conjunction with a word containing text. It starts on a new line so the text is best arranged in complete paragraphs. The first 32 letters are typed out, followed by a line of blanks and descenders. It then waits for you to press any key before repeating the process with the next 32 letters. This control facility is very useful when you need to control the amount of text you wish to display, for example when a printer is used to copy a screenful of text. A dummy word Print has been included — if the letter P is pressed this subroutine is called up — it will be useful in the future. To use DType, define some text such as

```
: P1 .' abcdefghijklmnop etc. ' ;
```

preferably with more than one line of characters. Because DType uses the word Find, and calculates the length of text in P1, another word must appear in the dictionary after P1, otherwise the bytes in P1's header which define its length, will not be complete. So add a dummy word :P2 ; on the end.

Now enter

```
INVIS CLS DTYPE P1
```

when the first line is complete, press any key and the next line will appear. The advantages of storing text in colon definitions are that the length of text is not limited to 256 characters and full Edit facilities are available. In addition, memory space is not wasted in defining new words such as String. Successive paragraphs can be displayed by means of

```
DTYPE P1 DTYPE P2 DTYPE P3 etc.
```

and paragraphs can be interspersed with additional blank lines by the use of CR as required. Your text can be Saved on tape in the normal manner. ■

THIS PROGRAM will run only on the 1K ZX-81, and so RAM packs must be disconnected before the program is loaded. Before entering the machine code, space must be reserved for it. The easiest way to do this is with Rem statements, so type in lines 1 and 2 as:

```
1 REM 344 zeros
2 REM 167 zeros
```

It is advisable to enter lines 1 and 2 in Fast mode.

When the Rem statements are complete, enter the following hex code loading program.

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

Run the program, and in response to the input prompt enter the bytes in the column on the left-hand side of the address column — each two characters make one byte. For example, one may enter the first five bytes of the machine code in a block or one byte at a time, thus:

2A3240 NEWLINE 54 NEWLINE 5D NEWLINE and so on. Do not enter any spaces with the hex codes. Take your time when entering the

machine code, as one wrong byte could cause disaster. If at any time you make a mistake, break out by inputting a single S. Then type in line 10 again, but this time with an address you know to have been correctly loaded. Then continue from that address by running the program.

When all of the machine code has been entered, break out by entering a single S, and then type in line three as:

```
3 RAND USR 16530
```

then delete lines 10 to 90.

Now Save the program before running it. After saving the program, type in, as direct commands

```
RAND
```

then

```
RUN
```

If everything is running happily, your jet should be resting on a flat area of landscape ready for take off, a hilly landscape should be moving towards you, and the flak should be moving across the screen. If your aeroplane collides with the hillside it will explode, stopping the program.

Keys 1,2,3,4,5,Q,W,E,R, and T move your plane up, and keys A,S,D,F,G,Z,X,C, and V move it down. Keys 6,7,8,9,0,Y,U,I,O,P drop a bomb from the jet. Shooting a base —

represented by an A — earns you 10 points.

If something has gone wrong, turn off the power supply and then reload the program from tape. To debug it, enter the following program:

```
10 FOR F = 16514 TO 17030
20 LET X = PEEK F
30 PRINT CHR$(INT (X/16)+28);
  CHR$(X - INT(X/16) * 16 + 28)
40 NEXT F
```

and run it. The machine code is displayed 22 bytes at a time. After checking each byte for errors, enter:

```
CONT NEWLINE
```

for the next 22. When an incorrect byte is found, correct it by Poking its address with the decimal equivalent of the correct byte — see conversion tables at the back of the ZX-81 manual. When debugging is complete, delete lines 10 to 40. To speed the game up, Poke address 16627 with a number between 1 and 15; to slow the game down, Poke address

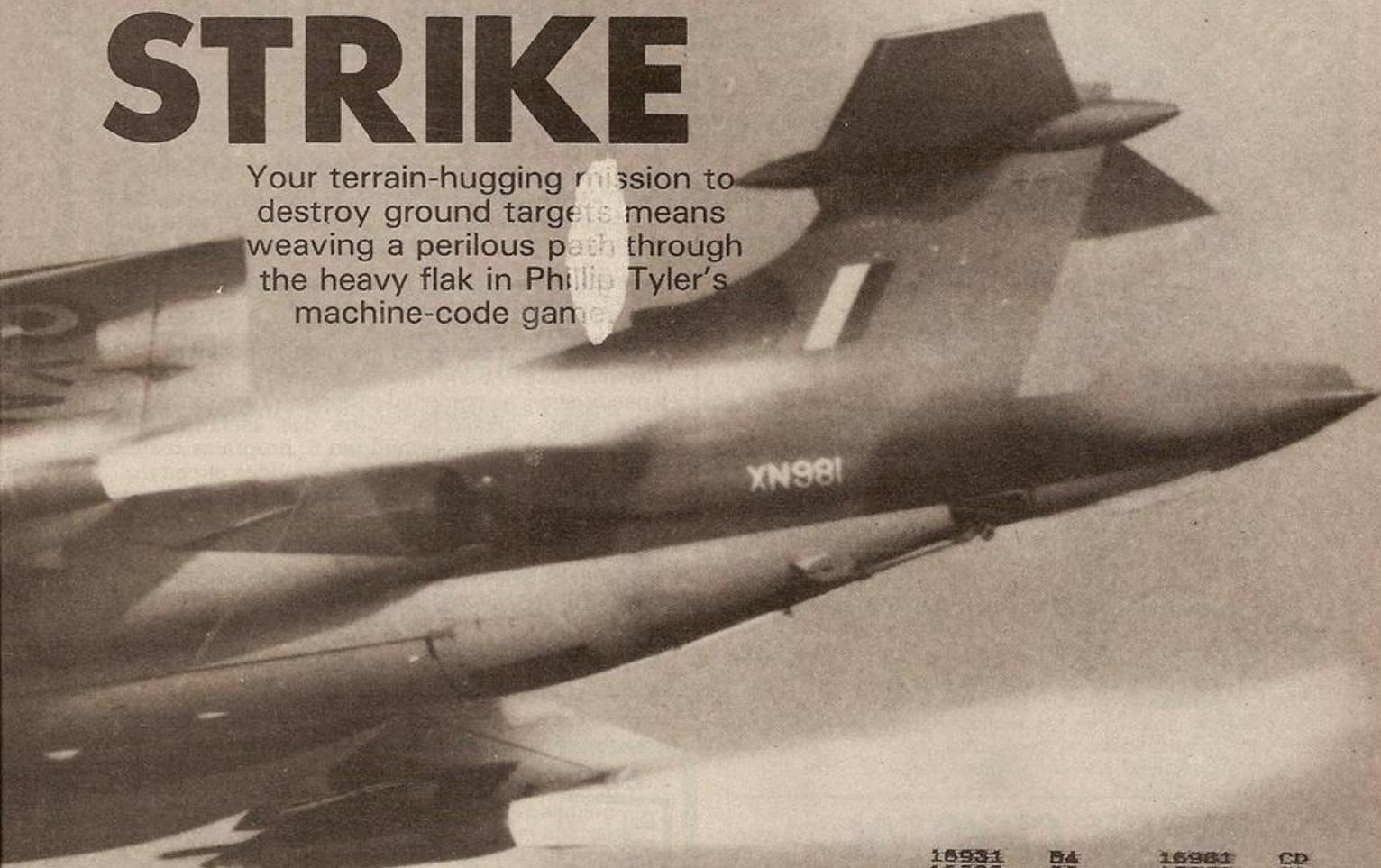
16627 with a number between 16 and 255.



16514	2A	16547	10	16580	36	16615	3C	16655	5D	16699	12
16515	32	16548	F0	16581	82	16617	40	16656	2A	16700	00
16516	40	16549	3E	16582	2A	16618	11	16657	06	16701	19
16517	54	16550	76	16583	0C	16619	12	16658	12	16702	E5
16518	5D	16551	D7	16584	40	16620	00	16659	7E	16703	CD
16519	29	16552	0D	16585	11	16621	19	16660	FE	16704	82
16520	29	16553	28	16586	07	16622	22	16661	86	16705	40
16521	19	16554	F3	16587	00	16623	3E	16662	28	16706	44
16522	29	16555	0E	16588	19	16624	40	16663	0C	16707	3E
16523	29	16556	02	16589	11	16625	01	16664	FE	16708	01
16524	29	16557	3E	16590	11	16626	00	16665	82	16709	3C
16525	19	16558	08	16591	40	16627	10	16666	28	16710	FE
16526	22	16559	06	16592	06	16628	0B	16667	04	16711	05
16527	32	16560	13	16593	06	16629	78	16668	3E	16712	20
16528	40	16561	D7	16594	05	16630	FE	16669	04	16713	02
16529	C9	16562	10	16595	01	16631	00	16670	18	16714	3E
16530	3E	16563	FD	16596	14	16632	20	16671	11	16715	01
16531	1C	16564	3E	16597	00	16633	0A	16672	FE	16716	10
16532	06	16565	76	16598	0E	16634	3A	16673	1B	16717	F7
16533	06	16566	D7	16599	01	16635	4C	16674	20	16718	47
16534	D7	16567	0D	16600	14	16636	40	16675	04	16719	E1
16535	10	16568	20	16601	00	16637	3C	16676	3E	16720	11
16536	FD	16569	F3	16602	23	16638	32	16677	00	16721	EC
16537	3E	16570	2A	16603	72	16639	4C	16678	18	16722	FF
16538	76	16571	0C	16604	23	16640	40	16679	09	16723	36
16539	D7	16572	40	16605	00	16641	CB	16680	FE	16724	08
16540	0E	16573	11	16606	00	16642	47	16681	00	16725	19
16541	09	16574	AA	16607	F2	16643	28	16682	28	16726	10
16542	3E	16575	00	16608	2A	16644	77	16683	05	16727	FB
16543	00	16576	19	16609	0C	16645	2A	16684	1A	16728	FE
16544	06	16577	36	16610	40	16646	8C	16685	FE	16729	04
16545	13	16578	86	16611	11	16647	40	16686	82	16730	28
16546	D7	16579	23	16612	AA	16648	11	16687	20	16731	28
				16613	00	16649	80	16688	F3	16732	F5
				16614	19	16650	00	16689	10	16733	E5
				16615	22	16651	19	16690	23	16734	CD
						16652	0E	16691	13	16735	82
						16653	03	16692	10	16736	40
						16654	54	16693	DD	16737	7C
								16694	23	16738	FE
								16695	20	16739	32
								16696	20	16740	E1
								16697	D4	16741	30
								16698	11	16742	82

ZX-81 GROUND STRIKE

Your terrain-hugging mission to destroy ground targets means weaving a perilous path through the heavy flak in Philip Tyler's machine-code game.



16743	36	16789	00	16835	3C	16883	2A	16931	B4	16981	CD
16744	26	16790	18	16836	40	16884	3C	16932	2B	16982	3E
16745	F1	16791	08	16837	FE	16885	40	16933	0C	16983	40
16746	3C	16792	0B	16838	08	16886	23	16934	40	16984	7C
16747	47	16793	0B	16839	28	16887	18	16935	11	16985	E1
16748	3E	16794	55	16840	08	16888	3E	16936	0C	16986	FE
16749	04	16795	28	16841	FE	16889	2A	16937	00	16987	26
16750	90	16796	04	16842	26	16890	3E	16938	19	16988	30
16751	47	16797	0B	16843	28	16891	40	16939	22	16989	1C
16752	FE	16798	50	16844	04	16892	06	16940	3E	16990	11
16753	00	16799	50	16845	FE	16893	00	16941	40	16991	13
16754	28	16800	0B	16846	FE	16894	7E	16942	18	16992	00
16755	00	16801	38	16847	FE	16895	FE	16943	14	16993	19
16756	11	16802	11	16848	E6	16896	08	16944	78	16994	18
16757	EC	16803	11	16849	19	16897	28	16945	FE	16995	14
16758	FF	16804	FF	16850	36	16898	21	16946	00	16996	36
16759	19	16805	2A	16851	17	16899	FE	16947	20	16997	00
16760	38	16806	3C	16852	23	16900	26	16948	0A	16998	FE
16761	00	16807	40	16853	36	16901	20	16949	36	16999	B4
16762	10	16808	36	16854	17	16902	17	16950	00	17000	20
16763	FB	16809	00	16855	C9	16903	36	16951	11	17001	08
16764	2A	16810	23	16856	18	16904	00	16952	15	17002	26
16765	3C	16811	36	16857	06	16905	3A	16953	00	17003	7E
16766	40	16812	00	16858	76	16906	0C	16954	19	17004	FE
16767	23	16813	19	16859	08	16907	40	16955	06	17005	76
16768	7E	16814	7E	16860	02	16908	11	16956	50	17006	20
16769	FE	16815	00	16861	09	16909	05	16957	16	17007	FA
16770	82	16816	FE	16862	00	16910	00	16958	BF	17008	18
16771	25	16817	00	16863	00	16911	19	16959	36	17009	08
16772	03	16818	20	16864	FA	16912	00	16960	1B	17010	26
16773	2B	16819	11	16865	CD	16913	7E	16961	22	17011	7E
16774	18	16820	2B	16866	02	16914	3C	16962	3E	17012	FE
16775	4A	16821	7E	16867	02	16915	0C	16963	48	17013	76
16776	CD	16822	00	16868	65	16916	26	16964	21	17014	28
16777	BB	16823	00	16869	28	16917	20	16965	40	17015	02
16778	02	16824	20	16870	04	16918	05	16966	40	17016	36
16779	CB	16825	05	16871	CB	16919	36	16967	06	17017	34
16780	45	16826	36	16872	64	16920	1C	16968	06	17018	EB
16781	28	16827	86	16873	20	16921	2B	16969	C5	17019	E1
16782	04	16828	23	16874	64	16922	08	16970	5E	17020	72
16783	CB	16829	36	16875	20	16923	18	16971	23	17021	2B
16784	4D	16830	82	16876	0E	16924	F5	16972	56	17022	73
16785	20	16831	2A	16877	2A	16925	77	16973	E5	17023	23
16786	05	16832	0B	16878	3E	16926	18	16974	EB	17024	23
16787	11	16833	40	16879	40	16927	06	16975	7E	17025	C1
16788	14	16834	18	16880	7E	16928	FE	16976	FE	17026	10
			40	16881	FE	16929	34	16977	76	17027	C5
				16882	03	16930	20	16978	20	17028	C3
				16883	28		0E	16979	10	17029	F1
				16884	05		3E	16980	ES	17030	40

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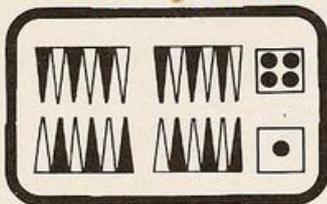
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Force your opponent into a corner — that is your goal in this interactive game by Andrew Foord for the 16K ZX Spectrum. Two people can play simultaneously using the keyboard — instructions are shown in the program. The players shoot along the grid leaving a trail of deadly orgone energy in their wakes. This manifests itself on the screen as a wall. To survive you must force your antagonist to career helplessly into either your wake or his own: both will prove equally fatal. The program gives a view of the action — looking from an angle of 45° — by using Bright to make the top of the trail brighter than the front. The player to win is the first to achieve a score of 10. Different trace elements can be injected into the energy-conversion cycle of your overlander to alter the colour of the exhausted field of primary energy you leave in your wake. You can have any colour you want as long as it is not black. To make the game really confusing the two players can even be the same colour.

```

1000 PRINT AT b,a; FLASH 1;" "
1010 LET s1=s1+1
1020 GO TO 3000
2000 PRINT AT y,x; FLASH 1;" "
2010 LET s2=s2+1
3000 FOR f=30 TO 60: BEEP .001,f
: NEXT f
3010 PRINT INVERSE 1;AT 9,11;"PL
ayer 1:";s1
3020 PRINT INVERSE 1;AT 11,11;"P
Layer 2:";s2
3030 FOR f=60 TO 30 STEP -1: BEE
P .001,f: NEXT f
3035 IF s1>9 OR s2>9 THEN GO TO
4000
3040 IF INKEY$("<>") THEN GO TO 30
40
3050 PRINT AT 20,3; INVERSE 1;"P
RESS ANY KEY TO CONTINUE"
3060 IF INKEY$("<>") THEN GO TO 10
3070 GO TO 3060
4000 PRINT FLASH 1;AT 13,10;"PLA
YER ";(s2=10)+1;" WINS"
4010 INPUT "Another go? "; LINE
a$
4020 IF a$="" THEN GO TO 4010
4030 IF a$(1)("<>") THEN RUN
4040 STOP
8000 BORDER 0: PAPER 0: INK 7: C
LS
8010 PRINT "This is:"
8020 PRINT TAB 13;"CHASER" TAB
9;"© ANDREW FOORD"
8030 PRINT "The object of CHASE
R is to force the other player in
to a wall."
8040 PRINT " Each player has a
chaser which leaves a trail, the
chasers can not stop until one
is destroyed."
8050 PRINT TAB 12;"CONTROLS"
8051 REM ^-Graphic C, v-Graphic
D
8055 PRINT TAB 14;"^ < > v"
8060 PRINT "Player 1.      2 0 U
A"
8070 PRINT "Player 2:      0 0 P
L"
8080 PRINT TAB 14;"^ < > v"
8100 INPUT "Players 1 colour? (1
TO 7) ";c1
8110 IF c1<1 OR c1>7 THEN GO TO
8100
8120 INPUT "Players 2 colour? (1
TO 7) ";c2
8130 IF c2<1 OR c2>7 THEN GO TO
8120
8140 RETURN
9000 FOR f=0 TO 7 STEP 2: POKE U
SR "a"+f,170: POKE USR "a"+f+1,8
5: NEXT f
9010 FOR f=0 TO 6: POKE USR "a"+
f,120: NEXT f: POKE USR "5"+7,25
5
9020 RESTORE : FOR f=0 TO 7: REA
D a: POKE USR "c"+f,a: POKE USR
"d"+7-f,a: NEXT f
9030 DATA 0,0,0,20,34,0,0,0
9040 RETURN

```



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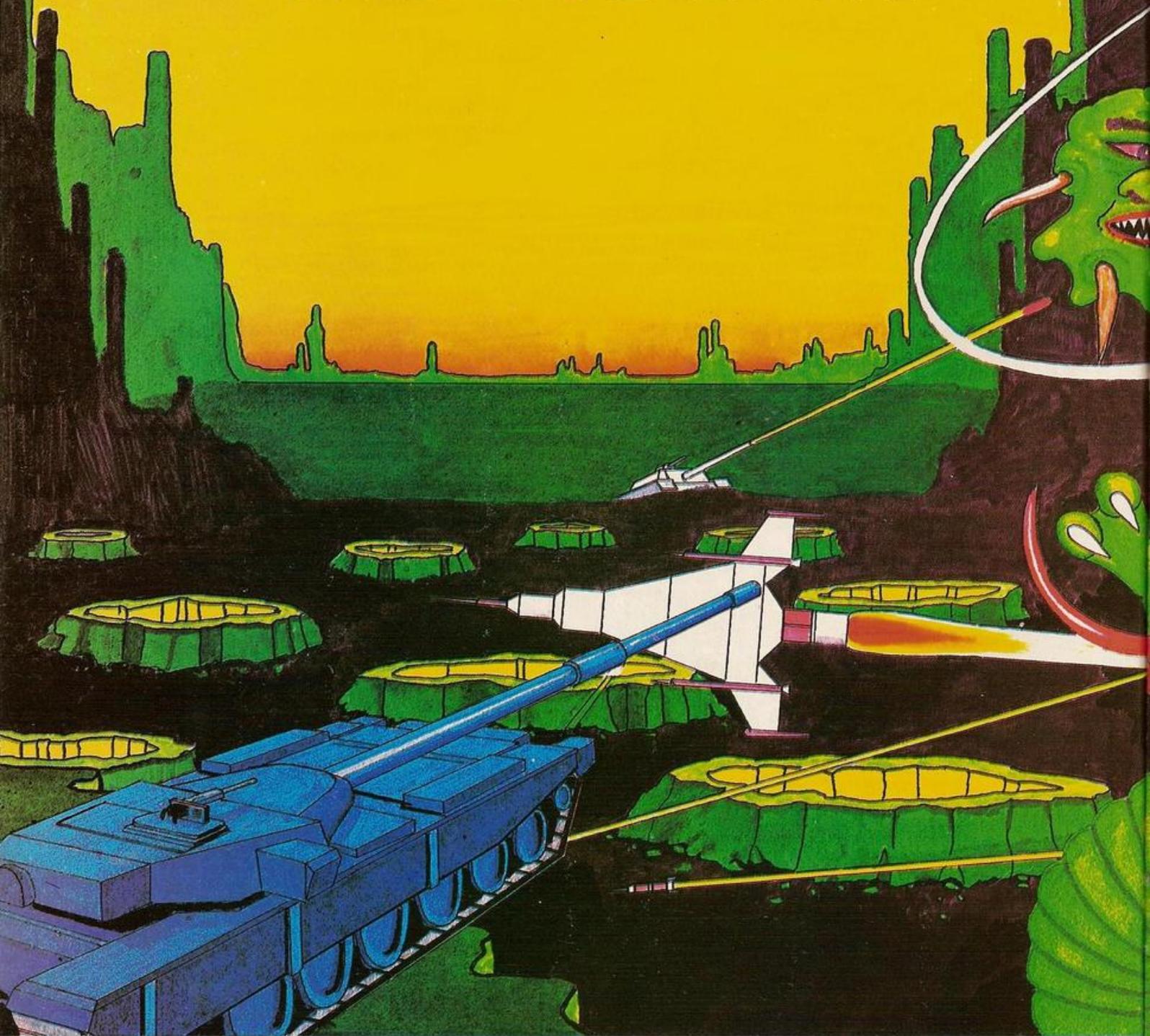
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A VARIABLE is a named memory area inside the Vic which can store varying data. This data can be in the form of numbers or characters. If you can remember algebra at school it typically looked like

$$x+2=y$$

where x and y are variables. Obviously the value of y will vary as the value of x varies. There are two types of numeric variables used by the Vic — integer and floating point, which is sometimes called real.

Integers are whole numbers with no decimal point and the Vic can only deal with them in the range -32768 to +32767. The Vic will assume that numbers are positive unless you tell it otherwise. Examples of integers are:

1, 100, -32000, 999

Floating-point numbers can have a decimal point and cover a much wider range than integers. Floating-point numbers can also be expressed as a mantissa with an exponent.

VIC-20



Savour Clive Finnis' recipe for slimmer and faster programming with this first course in Vic variables.

VARIABLES: FIRST COURSE ON A PLATE

Simply, this means that the number 1234.5678 can be expressed as a mantissa of 1.2345678 and an exponent of 3, where the exponent means "times 10 to the power of 3", or in this case 1,000. This would be entered into the Vic as:

1.2345678E3

This might seem an unnecessary complication but in fact it makes the entry of very large and very small numbers easier.

For example the number 1,000,000,000.0 in mantissa and exponent form is 1E9 and the number .0000123 will be 1.23E-5.

A negative exponent can be thought of as "move the decimal point to the right", whereas a positive exponent means "move the decimal point to the left". On these two examples we moved the decimal point nine places to the left and ended up with an exponent E9, and in the second case we moved it five places to the right and had an exponent of E-5.

The range covered by the Vic is from $\pm 1.70141183E+38$ to $\pm 1.93873588E-39$, and the Vic works to nine digits of accuracy. Try some numbers outside this range and see what the Vic makes of them.

But how does the Vic expect you to define variables? What is the syntax for describing a variable? The computer only acts on one, two or three significant characters of the variable name — although variables can be much longer. The first character must be alphabetical. The simplest variable names will be just one alphabetical character — for example, A

In reality the Vic sees this as two characters, one alphabetical, the other a "nothing" character, that is ASCII 0 or null. Try the following:

```
PRINT CHR$(65)
```

You get the letter A — correct? Now try

```
PRINT CHR$(65)CHR$(66)
```

You get AB. Let us, introduce the ASCII 0 or null character in the middle to see what it does. Type

```
PRINT CHR$(65)CHR$(0)CHR$(66)
```

The printout reads AB again — in other words the ASCII null is completely ignored. So when we define our variable names as A, I or X the Vic stores A0, I0, X0.

If you decide to use a second character this can be alphabetical or numeric — that is A through to Z or 0 through to 9, so that AA, A9, XA, X1 are all valid names.

Our third significant character can only be \$ or %. These characters define the type of variable that the one or two preceding significant characters represent.

Any variable followed by the % sign means that this is an integer variable. Any variable followed by the \$ sign is defined as a string variable. Any variable not followed by % or \$ is by default a real variable. Examples of valid variable names are

A	AA	A1	Z9	for real
1A%	AA%	A1%	Z9%	for integer
A\$	AA\$	A1\$	Z9\$	for string

Note that you can use, say, A, A% and A\$ in one program and the Vic will quite happily differentiate between them — it sees them as three quite separate variables.

Where possible try to pick variable names which mean something to you and relative to the job that they are performing. There are traps for the unwary, though. Say you are using the variable CO. There will be a hidden syntax error in the following apparently good line:

```
FORI=100TOCOSTEP-1
```

The problem? Vic sees the CO of the variable and the S of Step as Cos which is of course a Basic function.

The cure? Put a space between CO and S or

find another variable name. What is wrong with C on its own? It will save you two bytes in this instance alone.

In some cases it might be more convenient to use whole words as variable names instead of just one or two characters. For example, if you are writing a program to help sort out your home finances, variables such as Interest, Balance, Debit mean far more when working through your listing than, say, In, Ba and De.

You do not often get something for nothing though and this is no exception. You gain in program clarity — you lose in using more memory to do the same job. Every time your program uses, say, the variable name Interest, it needs eight bytes of memory to store it — one byte for every character. So the difference between using In and Interest is six bytes for each time it is used.

Integer variables are quite literally a waste of time and effort. As you will see later all numeric variables — forget about strings for the moment — are stored as floating-point numbers. Thus when we ask the Vic to perform integer arithmetic as follows:

$$X\% = Y\% + Z\%$$

it first takes the floating-point contents of Y% and converts them to integer, then it takes the floating-point contents of Z% and converts them to integer, adds these two integers, then converts from integer to floating point and stores the contents in X%. Not only are you wasting time while the processor performs unnecessary tasks, but the % character uses up one extra byte of memory every time it occurs in the program. Tails you lose, heads you cannot win.

This does not apply to integer arrays. Significant memory saving can be achieved by defining an array as an integer instead of real.

We saw earlier that you cannot use Basic
(continued on next page)

Address 4096

BASIC



variables



arrays



free memory

String data



Address 7679

Memory map. Variables are stored immediately following the end of the Basic program in memory, and they are immediately followed by the arrays.

(continued from previous page).

command words or functions as variable names — for example Cos, Sin, New, Print would all be thrown out as syntax errors if you tried to use them as variable names. There are three other reserved words which you cannot use as general-purpose variable names because they are already used by the Vic for specific variables.

ST — short for Status — is used to monitor input-output functions to the screen, cassette, keyboard or serial bus.

TI is used for the real-time clock. This is updated every 0.016 seconds by an interrupt routine.

TI\$ is a string variable of six characters length and it will return a real time in the format HHMMSS. It may be initialised — set to zero — easily by TI\$="000000".

So now you know something about real and integer variables, but what is the string variable that keeps popping up?

String variables are used to store not numeric information, like real and integer numbers, but any of the 256 ASCII characters available on the Vic. Thus whereas the variable A may contain 1.2345, the variable A\$ may contain the word computer. String variables are written to — filled up — in the following manner:

```
A$="COMPUTER"
```

The contents must be framed by the quotation marks Shift and 2 on your keyboard.

String variables are not restricted to storing the letters A through to Z, but can store Vic graphics and control characters as well. For example try the following routine:

```
10 LET A$="(clear screen)"
20 PRINT A$
```

where (clear screen) is the Shift and Clear Home.

If we Run this routine the screen will clear just as if we had typed

```
PRINT"(clear screen)"
```

Note that the Let in line 10 is optional in Vic Basic. Line 10 could have been written as

```
10A$="(clear screen)"
```

String variables can be up to 255 characters long. This, at first, seems rather difficult to achieve as the maximum number of characters that the Vic will accept for one line of Basic is 88, and this must include the line number itself. We can achieve long string variables — if we really want to — by the process of concatenation of variables. This is really just a complicated way of saying adding together of

string variables. For example, the program

```
10 A$="YOUR"
20 B$="COMPUTER"
30 C$=A$+B$
40 PRINTC$
```

produces the result

```
YOURCOMPUTER
```

C\$ has effectively taken the contents of A\$ (Your) and has joined on the contents of B\$ (Computer) to form the longer string.

Using the CHR\$ command other characters may be added to the string. For example to get a slightly better format to the result we can amend line 30 to read:

```
30 C$=A$+CHR$(32)+B$
```

which will give us

```
YOUR COMPUTER
```

Character 32 is "space" in the Vic. Another way of achieving the same result here would be to use the construction

```
30 C$=A$+" "+B$
```

Try different combinations yourself. Use the cursor keys and colour characters inside string variables and see what results you get. Try to make a string variable 255 characters long by using concatenation and discover the error message that the Vic will print if you exceed this number.

It is also possible to perform comparisons between string variables by using the following format

```
IF A$=B$ THEN etc.
```

Of course when it comes to operating on variables there are far more operators available for the numeric variables. One word of warning, though: if you want, say, the square of variable A, it might be tempting to use exponentiation of the form

```
B=A^2
```

However, whereas this will give you the correct result, it is a very slow operation in Basic and you would be better advised to use the less impressive but faster construct

```
B=A*A
```

So now we have a grasp of the different types of Vic variable and how to use them. But how does the Vic store these variables? To answer that we must first look at the memory map.

In an unexpanded Vic, user memory starts at address 4096 and finishes at address 7679. Addresses 7680 to 8191 are the screen area and thus the total RAM available is 4K of which 0.5K is for the screen leaving the infamous 3.5K for you. To be fair, the reason why RAM is limited on the Vic is because RAM chips were expensive when Commodore

designed the Vic a few years ago. The cost of the 4K chips used in the Vic was probably more than 64K chips cost today because of phenomenal advances in RAM technology.

Anyway, back to memory maps. Variables are stored immediately following the end of the Basic program in memory, and they are immediately followed by the arrays. This variable storage area stores both the names and contents of numeric variables, but stores the name only of string variables along with an address of where the actual contents of that variable can be found. The contents of string data are stored downwards from address 7679, that is, top of memory. Thus free memory is actually the gap between string data moving downwards from top of memory and the end of arrays moving upwards.

As the boundaries between these different areas will move as the Basic program is edited, or string variables are changed, or whatever, the Vic must keep a careful note of where these boundaries are. The addresses of these boundaries are stored in specific memory locations in standard low-byte/high-byte order. I know some beginners get confused by these terms: put simply, the Vic can only store eight bits of information in each memory address because it is an eight-bit machine. Eight bits give you a total range of from 0 to 255 only, but the Vic can address a total of 65,535 addresses. Thus to get this range it is generally necessary to use two bytes for each address stored as low byte that is, least significant and high byte — the most significant. The actual address is low byte + 256 (high byte). If you work out 255 + 256 x 255 you get 65,535 — thus we can address the whole Vic range using this format.

The locations which we are interested in are as follows:

	Low byte	High byte	Address
Start of Basic on unexpanded Vic	43	44	
	1	16 =	4097
Start of variables	45	46	
Start of arrays	47	48	
End of arrays	49	50	
End of strings moving downwards	51	52	
Top of memory on unexpanded Vic	55	56	
	0	30 =	7680

Thus we know that variables are stored in the area which starts at the address pointed to by locations 45 and 46 and finishes at the address pointed to by locations 47 and 48.

The Vic stores all variables regardless of whether they are real, integer or string in a similar way in this area, namely two bytes for name, five bytes for contents — or the address of where the contents are stored in the case of strings. But if only two bytes are used for the variable name, how does the Vic store the three significant characters that it requires to define each variable? It does this by adding 128 to the first or second character depending on the type of variable. For example, the real — floating point — variable AA will be stored as 65 65 where 65 is the ASCII code for A. The variable AA\$ will be stored as 65 193 — that is 65 (65 + 128). The variable AA% will be stored as 193 193.

(continued on page 101)



ZX Spectrum

BLUE EDIT	RED CAPS LOCK	MAGENTA TRUE VIDEO	GREEN INV. VIDEO	CYAN	YELLOW	WHITE	BLACK DELETE
1	2	3	4	5	6	7	8
DEF FN	FN	LINE	OPEN #	CLOSE #	MOVE	ERASE	POINT
SIN	COS	TAN	INT	RND	STR\$	CHR\$	CODE
Q	W	E	R	T	Y	U	I
ASN	ACS	ATN	VERIFY	MERGE	ABS	VAL	IN
READ	RESTORE	DATA	SGN	G	SCR	LEN	OUT
A	S	D	F	THEN	H	J	O
STOP NEW	NOT SAVE	STEP DIM	TO FOR	GOTO	GOSUB	LOAD	POKE
LN	EXP	LPRINT	{	}	CIRCLE	VAL\$	USR
Z	X	C	V	B	N	M	L
COPY	CLEAR	CONT	CLS	BORDER	NEXT	PAUSE	LET
BEEP	INK	PAPER	FLASH	BRIGHT	OVER	INVERSE	ATTR
CAPS SHIFT							ENTER
							BREAK SPACE



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You may decide to begin with the 16K version. If so, you can still return it later for an upgrade. The cost? Around £60.

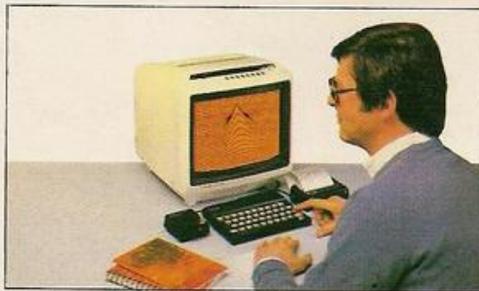


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Employing Sinclair BASIC (now used in over 500,000 computers worldwide) the ZX Spectrum comes complete with two manuals which together represent a detailed course in BASIC programming. Whether you're a beginner or a competent programmer, you'll find them both of immense help. Depending on your computer experience, you'll quickly be moving into the colourful world of ZX Spectrum professional-level computing.

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



Key features of the Sinclair ZX Spectrum

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

Sinclair ZX Spectrum—technical data.

Dimensions

Width 233 mm
Depth 144 mm
Height 30 mm

CPU/memory

Z80A microprocessor running at 3.5 MHz.
16K-byte ROM containing BASIC interpreter and operating system.

16K-byte RAM (plus optional 32K-byte RAM on internal expansion board) or 48K-byte RAM.

Keyboard

40-moving-key keyboard with full upper and lower case with capitals lock feature. All BASIC words obtained by single keys, plus 16 graphics characters, 22 colour control codes, and 21 user-definable graphics characters. All keys have auto repeat.

Display

Memory-mapped display of 256 pixels x 192 pixels; plus one attributes byte per character square, defining one of eight foreground colours, one of eight background colours, normal or extra brightness and flashing or steady. Screen border colour also settable to one of eight colours. Will drive a PAL UHF colour TV set, or black and white set (which will give a scale of grey), on channel 36.

Sound

Internal loudspeaker can be operated over more than 10 octaves (actually 130 semitones) via basic BEEP command. Jack sockets at the rear of computer allow connections to external amplifier/speaker.

Graphics

Point, line, circle and arc drawing commands in high-resolution graphics.

16 pre-defined graphics characters plus 21 user-definable graphics characters. Also functions to yield character at a given position, attribute at a given position (colours, brightness and flash) and whether a given pixel is set. Text may be written on the screen on 24 lines of 32 characters. Text and graphics may be freely mixed.

Colours

Foreground and background colours, brightness and flashing are set by BASIC INK, PAPER, BRIGHT and FLASH commands. OVER may also be set, which performs an exclusive-or operation to overwrite any printing or plotting that is already on the screen. INVERSE will give inverse video printing. These six commands may be set globally to cover all further PRINT, PLOT, DRAW or CIRCLE commands, or locally within these commands to cover only the results of that command. They may also be set locally to cover text printed by an INPUT statement. Colour-control codes, which may be accessed from the keyboard, may be inserted into text or program listing, and when displayed will override the globally set colours until another control code is encountered. Brightness and flashing codes may be inserted into program or text, similarly. Colour-control codes in a program listing have no effect on its execution. Border colour is set by a BORDER command. The eight colours available are black, blue, red,

magenta, green, cyan, yellow and white. All eight colours may be present on the screen at once, with some areas flashing and others steady, and any area may be highlighted extra bright.

Screen

The screen is divided into two sections. The top section – normally the first 22 lines – displays the program listing or the results of program or command execution. The bottom section – normally the last 2 lines – shows the command or program line currently being entered, or the program line currently being edited. It also shows the report messages. Full editing facilities of cursor left, cursor right, insert and delete (with auto-repeat facility) are available over this line. The bottom section will expand to accept a current line of up to 22 lines.

Mathematical operations and functions

Arithmetic operations of +, -, X, ÷, and raise to a power. Mathematical functions of sine, cosine, tangent and their inverses; natural logs and exponentials; sign function, absolute value function, and integer function; square root function, random number generator, and pi.

Numbers are stored as five bytes of floating point binary – giving a range of $+3 \times 10^{-39}$ to $+7 \times 10^{38}$ accurate to $9\frac{1}{2}$ decimal digits.

Binary numbers may be entered directly with the BIN function. =, >, <, >=, <= and <> may be used to compare string or arithmetic values or variables to yield 0 (false) or 1 (true). Logical operators AND, OR and NOT yield boolean results but will accept 0 (false) and any number (true).

User-definable functions are defined using DEF FN, and called using FN. They may take up to 26 numeric and 26 string arguments, and may yield string or numeric results.

There is a full DATA mechanism, using the commands READ, DATA and RESTORE.

A real-time clock is obtainable.

String operations and functions

Strings can be concatenated with +. String variables or values may be compared with =, >, <, >=, <=, <> to give boolean results. String functions are VAL, VAL\$, STR\$, and LEN. CHR\$ and CODE convert numbers to characters and vice versa, using the ASCII code.

A very powerful string slicing mechanism exists, using the form a\$(x TO y).

Variable names

Numeric – any string starting with a letter (upper and lower case are not distinguished between, and spaces are ignored).

String – A\$ to Z\$.

FOR-NEXT loops – A-Z.

Numeric arrays – A-Z.

String arrays – A\$ to Z\$.

Simple variables and arrays with the same name are allowed and distinguished between.

Arrays

Arrays may be multi-dimensional, with subscripts starting at 1. String arrays, technically character arrays, may have their last subscript omitted, yielding a string.

Expression evaluator

A full expression evaluator is called during program execution whenever an expression, constant or variable is encountered. This allows the use of expressions as arguments to GOTO, GOSUB, etc.

It also operates on commands allowing the ZX Spectrum to operate as a calculator.

Cassette interface

The ZX Spectrum incorporates an advanced cassette interface. A tone leader is recorded before the information to overcome the automatic recording level fluctuations of some tape recorders, and a Schmitt trigger is used to remove noise on playback.

All saved information is started with a header containing information as to its type, title, length and address information. Program, screens, blocks of memory, string and character arrays may all be saved separately.

Programs, blocks of memory and arrays may be verified after saving to confirm successful saving.

Programs and arrays may be merged from tape to combine them with the existing contents of memory. Where two line numbers or variables names coincide, the old one is overwritten.

Programs may be saved with a line number, where execution will start immediately on loading.

The cassette interface runs at 1500 baud, through two 3.5 mm jack plugs.

Expansion port

This has the full data, address and control busses from the Z80A, and is used to interface to the ZX Printer, the RS232 and NET interfaces and the ZX Microdrives.

IN and OUT commands give the I/O port equivalents of PEEK and POKE.

ZX81 compatibility

ZX81 BASIC is essentially a subset of ZX Spectrum BASIC. The differences are as follows.

FAST and SLOW: the ZX Spectrum operates at the speed of the ZX81 in FAST mode with the steady display of SLOW mode, and does not include these commands.

SCROLL: the ZX Spectrum scrolls automatically, asking the operator "scroll?" every time a screen is filled.

UNPLOT: the ZX Spectrum can unplot a pixel using PLOT OVER, and thus achieves unplot.

Character set: the ZX Spectrum uses the ASCII character set, as opposed to the ZX81 non-standard set.

ZX81 programs may be typed into the ZX Spectrum with very little change, but may of course now be considerably improved. The ZX Spectrum is fully compatible with the ZX Printer, which can now print out a full upper and lower case character set, and the high resolution graphics; using LLIST, LPRINT and COPY. ZX81 software cassettes and the ZX 16K RAM pack will not operate with the ZX Spectrum.

sinclair ZX Spectrum

Program 1. The variable lister.

```
63000 PRINT "J":Z8=PEEK(45)+256*PEEK(46)
63001 Z9=0:IFZ8>=PEEK(47)+256*PEEK(48)THENEND
63002 IFPEEK(Z8)>127THENPRINTCHR$(PEEK(Z8)-128);:Z9=37:GOTO63004
63003 PRINTCHR$(PEEK(Z8));
63004 Z8=Z8+1:IFPEEK(Z8)<128THENPRINTCHR$(PEEK(Z8));:GOTO63006
63005 PRINTCHR$(PEEK(Z8)-128);:IFZ9=0THENZ9=36
63006 PRINTCHR$(Z9),:Z8=Z8+6:GOTO63001
```

(continued from page 96)

The Vic places variables into the variable storage area as and when it encounters them in a Basic program. In the following program, A would be stored first, then B, then C\$.

```
10A=1:B=10:C$="C"
```

Program 1 is a utility which will list all the variables' names used in a Basic program. It uses two variables itself, Z8 and Z9, and takes up about 230 bytes.

Line 63000 clears the screen and sets Z8 to the address of the start of variables.

Line 63001 sets 9 to zero. Thus if we subsequently

```
PRINTCHR$(Z9)
```

it will print the ASCII null mentioned earlier. This also checks whether Z8 is equal to or greater than the address of the end of variables. This step is obviously redundant for the first pass through the program.

Line 63002 checks whether the character stored at address Z8 is greater than 127 and if it is, subtracts 128 to give us a printable character in the range A to Z. Z9 is then set to 37 which means a subsequent

```
PRINTCHR$(Z9)
```

will give a % character — that is, we have detected an integer variable as the first character is greater than 127.

Line 63003 prints the character if it was originally less than 127.

Line 63004 increments Z8 by 1 so that we are now looking at the second character of our variable name and a similar process to that in line 63002 is performed.

Line 63005 sets Z9 to 36 — the character code for \$ — if it has not already been set to the % code.

Line 63006 prints Z9 which can now be 0, 36(\$), or 37(%), and then increments Z8 by 6 to pick up the first character of the next variable name. The program then loops back to line 63001 to continue the process.

How do you use this utility? It needs to be in memory with the main Basic program whose variables you want to list. More of how to get it in later. You must then Run your program and when it ends type

```
GOTO63000
```

This will start the utility, the screen will clear and the variables encountered in the Basic program will be listed. Ignore Z8 and Z9 which are listed at the end — they belong to the utility itself. Do not type Run63000 or all you will get is Z8 and Z9 on their own. This is because Run automatically does a Clr which clears the variable storage area.

If your main Basic program does not end but, say, continuously loops, press Run/Stop and Restore keys, then type

```
GOTO63000
```

The variables used will still be in the variable storage area. Remember, though, that they are placed there only as and when encountered by your Basic program, so try to ensure that it is run for long enough, or all possible subroutines are entered before pressing the Run/Stop, Restore keys or some variables may be left off your list.

Now how do we get the utility into memory? Well, one way is to Load your main program from cassette and then to type in the utility from the listing. Ensure that you do not already use lines 63000 and 63006 inclusive, of course, or you will overwrite them. This is obviously tedious and prone to errors. You cannot Load the utility from cassette as this automatically clears memory first and would thus delete your main program.

What is needed is the ability to merge or append programs — but this facility is not available on the Vic — or is it?

The following procedure was devised by Jim Butterfield — a Commodore Vic supremo. The trick is to save the utility on to cassette not as a standard binary file but as an ASCII data file and then to fool the Vic into accepting keyboard entry from the cassette.

Here is the procedure — it is a little complicated but mighty handy in lots of cases. First type in the utility from the listing. Save in the normal way typing

```
SAVE "VARIABLES"
```

This will give you a normal binary file as a back up in case anything goes wrong. Now type

```
OPEN1,1,1,"VARIABLES(ASCII)":CMD1:LIST
Press Record and Play on the tape cassette when asked to do so.
```

When the tape stops type

```
PRINT#1:CLOSE1
```

You now have the utility saved as an ASCII file. What we did here was to Open the cassette for a Write operation; set the Vic output from the screen to the cassette; and then listed the program not to the screen but direct on to the cassette. We then closed the file and returned everything to normal.

Now to merge this with your Basic program which is already in memory. Firstly, make sure that you rewind the tape to the beginning of the utility ASCII file. Then type

```
POKE19,1:OPEN1
```

and press Return. Press Play on tape and the

cassette will search for the file, finally reporting:

```
FOUND VARIABLES (ASCII)
```

Clear the screen and type exactly three cursor downs so that you are now on line four. Type ?"(home)":POKE198,1:POKE631,13:POKE153,1 and press Return. Note that (home) means the Clr Home key.

The motor will whirr into life and after a short time an error message will display on the screen. Ignore it.

If you now List you will find the utility tucked on to the end of your Basic program and you can Run and Goto 63000 as previously described.

This merging technique is also very useful for adding your favourite subroutines to a program already in memory.

Different programming techniques are generally required if you are trying to save space or trying to speed up a program. Unfortunately it is sometimes difficult to do both at once. If you are trying to save space, use single characters for variable names and minimise the number of variables that you use. Remember each new variable needs seven bytes in the variable storage area, and that string variables also need space in the string data area to store their text. To speed up a program you need to ensure that a specific variable can be found quickly by the Basic interpreter. You remember how Basic allocates variables into the variable storage area as and when it encounters them in the Basic program? Every time the Basic interpreter encounters a variable, it jumps to the variable storage area and sequentially scans along until it finds that variable name. Obviously, if that variable is first in the list, it finds it faster than if it is the last in the list. Thus to speed up the process we need to ensure that speed-critical variables, or the most commonly-used variables, are at the front of the list. We can do this by assigning them to dummy values in the first line of our Basic program.

If you are using a constant value in several places in a program it will speed up operation if you assign a variable name to it. For example if you are using the constant 32897.123 a lot, this uses up nine bytes every time it occurs. It also slows down the operation as Basic has to read in all nine characters and convert them to a floating-point number for internal use. An initial assignment of A=32897.123 will not only save you memory but time as well. ■



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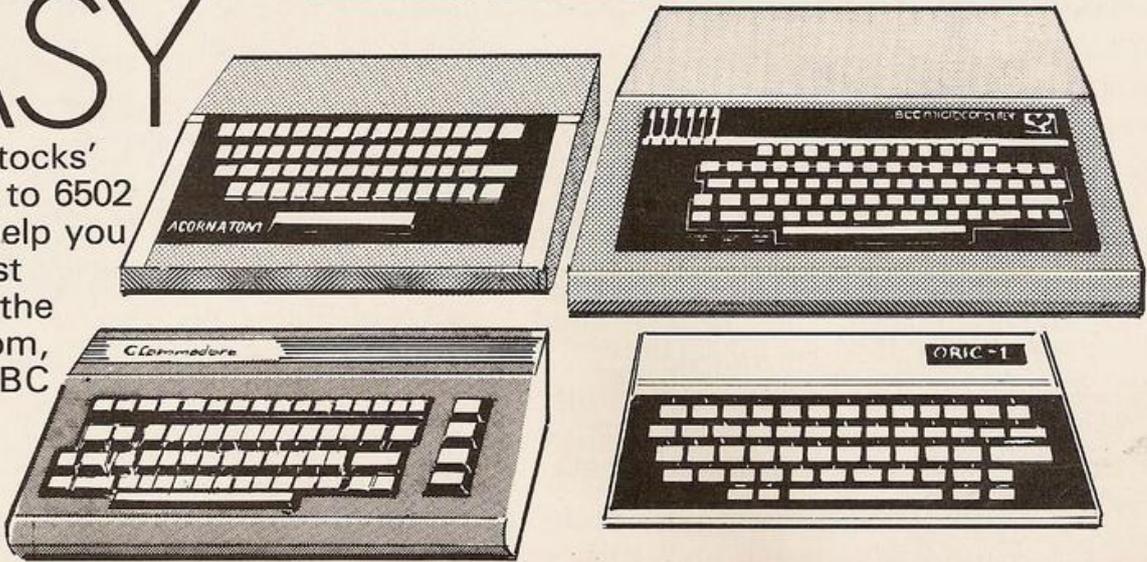
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Darryl Mattocks' new guide to 6502 code will help you to write fast games for the Vic-20, Atom, Oric and BBC Micro.



MACHINE CODE

THIS ARTICLE is aimed at those of you who would normally read the words machine code, scream, and turn the page quickly. If you have done this in the past, now is the time to change. Did you realise that Basic itself is a machine-code program, and that every instruction such as Print, Let and Poke is converted into machine code, and then run as machine-code subroutines? This tends to make Basic very slow — a machine-code program is in the order of 100 times faster than its Basic equivalent.

As in Basic, machine code is made up of a series of instructions which are executed sequentially — one after the other — starting from the one in the lowest memory location and working up through the memory. As in Basic we have instructions allowing us to jump to a new location — Goto — execute a subroutine and return to the instruction following the subroutine call — Gosub and Return — add number, subtract, conditional jumps — If-Then-Goto — and so on. The only trouble with machine code is that these instructions are set out differently.

A command in machine code is called a mnemonic and the thing that this mnemonic manipulates is called an operand. This is illustrated in figure 1, a short segment of machine code.

Unfortunately, these mnemonics and operands cannot be typed directly into the computer. To speed things up, each mnemonic is represented by a numerical code — varying from 0 to 255. These special codes are called operation codes — op-codes for short — and it is these op-codes that the computer can understand and act on.

In figure 1 then, A9 represents the LDA # command, 85 the STA command and 60 the RTS. Using these op-codes and operands then, we can reduce any program to a series of numbers.

For variables in machine code we have registers. A register is similar to a variable in Basic — that is, it can be set to contain a particular value which can then be added to or subtracted from in a similar pattern to the variables in Basic.

Now here is the catch. We have only five registers, and of those, only three are available to play with. If that is not bad enough, they can only contain integer values from 0-255 inclusive. It may look grim, but let us assess exactly what we have available.

Register symbol	Name
A	Accumulator
X	X register
Y	Y register

SP (or S) Stack pointer
S (or P) Status register

The A register is the most used, and most important register of the five. The X register is used mainly as a variable or offset. The Y register is used mainly as a variable or offset. The SP and S registers are pretty tricky and win a separate section of their own later on; but basically the SP shows current position on stack, and S is the basis of conditioned jumps, etc.

Now let us try a simple machine-code program for adding up the two numbers stored in memory locations — from now on referred to as bytes 0 and 1 and storing the result in the second byte — byte 2. The equivalent Basic program to do this would be
POKE 2, PEEK (0) + PEEK (1)

In machine-code this looks like this:

Op-code	Operand	Mnemonic	Comment
18		CLC	Clear the carry bit
A5	00	LDA 0	Load the Accumulator from byte 0
65	01	ADC 1	Add contents of byte 1
85	02	STA 2	Store the Accumulator in byte 2
60		RTS	Return to Basic

(continued on page 107)

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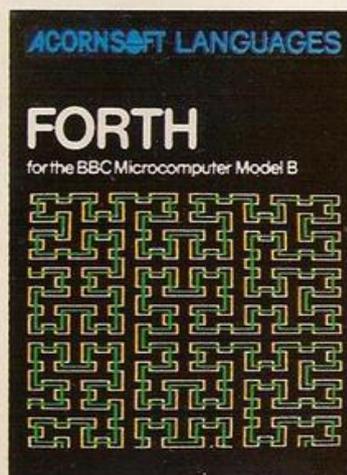
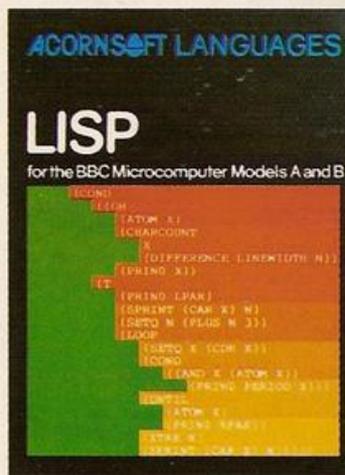
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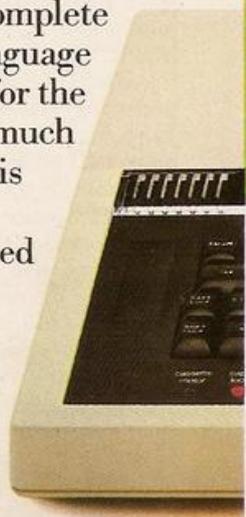
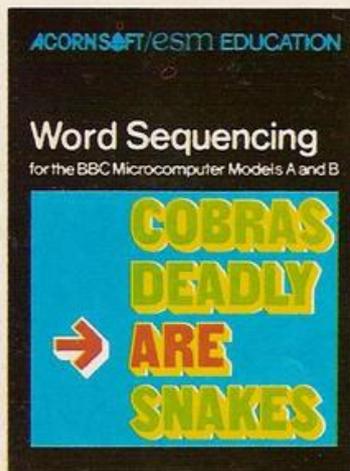
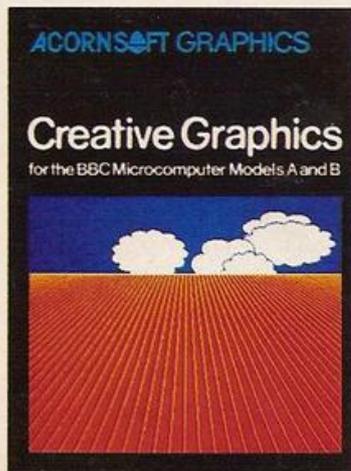


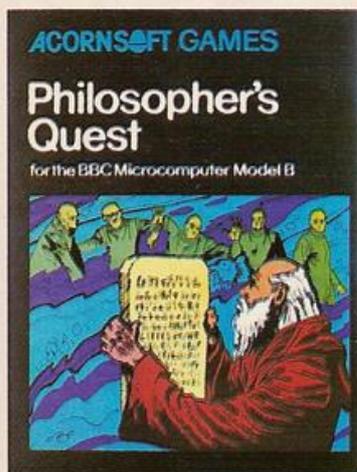
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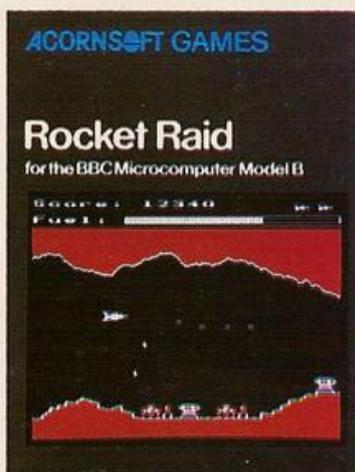
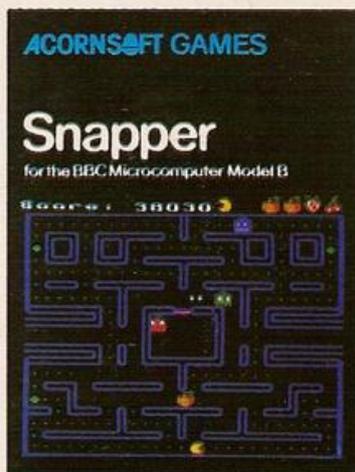
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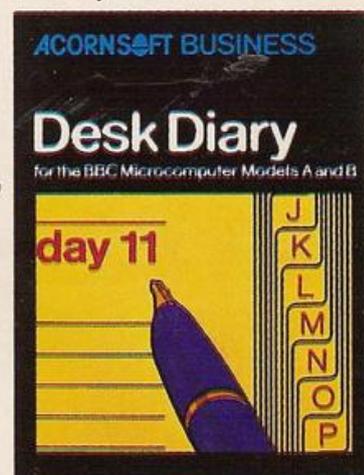
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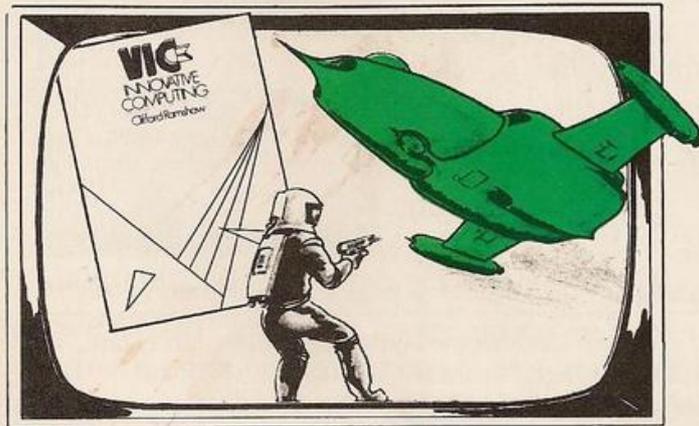
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(continued from page 103)

There is an odd quirk in 6502 when adding up: the only Add command we have is ADC — add with carry. This takes the contents of the carry flag and adds them to the result of the original calculation we were hoping to make. If the carry flag were set then — say it was set to 1 — the result obtained when the ADC is performed would be 1 too high. So the CLC command sets carry equal to zero and we should get the right result.

So now we have our machine-code program in the form of op-codes and operands, where can we put this little masterpiece? On the Vic-20, it is best placed directly under the screen memory, as here it will not interfere with Basic at all.

A program to Poke our machine-code program into memory is given in figure 2.

Type it in and Save it. Check lines 50, 60 and 100 especially as any mistake here could cause a crash. When "Finished" appears our program has been loaded into bytes 6700 6707. To run this program we use the Sys command. To run the machine code starting at 6700, type in

SYS 6700

and hit Return. You should get an almost instantaneous reply of "Ready" and the cursor blinking. The machine has run the program, but it was so fast that you did not notice. To check that it has done something try —

PRINT PEEK (00) + PEEK (1), PEEK (2)

As location 2 = location 0 + location 1, the two printed numbers should be the same.

The stack is an area of memory situated around 600-650 reserved for remembering data in a first in last out — FILO — manner. It is called a stack because of its similarities with a stack of other things, for example, plates. If you have a stack of plates and then add a plate to the top of this stack, then the next plate you take from that stack must be the one you have just added. The same is true for our memory stack. The last item to be pushed into the top of the stack will be first to be pulled off it.

It is by using the stack that Basic returns from a subroutine to the right place, knows when it has finished a For-Next loops and so on. The pointer which tells the 6502 what position it is at in the stack is the stack pointer register SP. As return addresses are added to the stack each time a subroutine call is made, it is best to avoid using the stack as much as possible. Unless you keep a strict record of what exactly you are doing, what you put in might not be what you get out at some later date.

The status register — SR — is better considered as a group of eight bits rather than just one byte. It contains seven flags and one unused bit. They appear as —

Bit number 7 6 5 4 3 2 1 0

Symbol N V — B D I Z L

Bit 7 is the sign bit. It is set whenever a result from Add instruction is a negative number in two's complement format. Translating this, it means that N bit will be the same as Bit 7 in the accumulator after many operations.

Bit 6 is the overflow flag used in two's complement subtraction when the result could be wrong due to a carry from Bit 6 to Bit 7. Bit 5 is unused.

Op-code	Operand	Mnemonic	Operand	Basic equivalent
A9	03	LDA#	03	A = 03
85	05	STA	05	Poke 5, A
60		RTS		Return

Figure 1.

Bit 4 is the Break flag and is set after the Brk instruction to let us know that it is a software, not hardware, break. Bit 3 is the Decimal flag and informs the processor whether to use BDC or binary representations of data. Bit 2 is the interrupt flag, when set, it will prevent any interrupts.

Bit 1 is my personal favourite. This is the zero flag and is used to indicate that the result of any particular operation equals zero.

Bit 0 is the carry flag which is used for a carry during additions. It can often be thought of as an eighth bit during additions. These flags form the basis of all the Conditional Jumps in 6502 assembly.

We get the following branches:

Branch	Status register
BCC — if carry clear	C=0
BCS — if carry set	C=1
BEG — if equal to 0	Z=1
BMI — if minus (negative)	N=1
BNE — if not equal to 0	Z=0
BPL — if plus (positive)	N=0
BVC — if overflow clear	V=0
BVS — if overflow set	V=1

These branches correspond to the If-Then-Goto sequence, except that one does not specify a branch and an address but a branch and a displacement between 127 and -126. This displacement is added to the program counter — PC, or two-byte register which contains the address of the instruction currently being executed — to send it either forward or backward by that displacement.

To illustrate this, here are two programs; the first clears the screen, the second zips up and down the music scales. The asterisks on the programs indicate a memory byte to be skipped in the branch instruction.

Assembly code	Mnemonics
A2 00	LDX # 0
A9 20	LDA # \$20
9D* 00* 1E*	STA \$1E00,X
9D* 00* 1F*	STA \$1F00,X
CA*	DEX

```

10 POKE 56, 26: POKE 52, 26: REM
RESERVE SPACE FOR THE
PROGRAM
20 COUNT = 0: REM POINTER TO
DATA
30 READ D$: IF D$ = "" THEN PRINT
"FINISHED" : END
40 D1$ = LEFT $(D$,1) : D2$ = RIGHT
$(D$,1) : REM CONVERT
HEXADECIMAL
50 V = (ASC (D1$) - 48 + ((ASC (D1$)
>64) *7)) *16 :
60 V = V + (ASC (D2$) - 48 + ((ASC
(D2$)>64) * 7)) : REM DECIMAL
70 POKE 6700 + COUNT, V : REM
STORE THE MACHINE CODE IN 6700
ONWARDS
80 PRINT (6700 + COUNT) : V : COUNT
= COUNT + 1 : GOTO 30 : REM
REPEAT FOR NEXT BYTE
99 REM : HERE IS THE DATA OF THE
PROGRAM
100 DATA 18, A5, 00, 65, 01, 85, 02, 60:
110 DATA * : REM END OF DATA.

```

Figure 2.

D0* F8* BNE \$F8
60 RTS

The Basic equivalent of this program would look like this:

```

10 X = 256
20 A = 32
30 POKE 7680 + X, A
40 POKE 7936 + X, A
50 X = X - 1
60 IF X <> 0 THEN 30
70 END

```

The F8 in the branch instruction is the displacement mentioned and is obtained thus: count how many bytes are needed to skip backward, in this case 89. Then this is converted to eight-bit binary. One's complement is then calculated in binary and 1 is added to obtain two's complement. The resultant sum looks like this:

```

= 89
= 00001001
= 11110110
= 11110110
      1+
= 11110111

```

The eight-bit binary is then converted to two-bit hex: F7 is the result. If a line 5 is added to the Basic program

5 FOR I=0 TO 512 : POKE 7680+I,160 : NEXT I and the rest entered and Run, this will show you what the machine-code program does. To enter the machine code, change line 100 in figure 2 to:

```

100 Data A2,00,A9,20,9D,00,1E,9D,00,1F,CA,
D0,F8,60

```

Do not forget to Save, then Run, just in case. To run the machine code try Sys 6700. The program should respond with a blank screen and a "Ready" plus cursor.

Here is the second program.

Op-code	Operand	Mnemonic
A9	0F	LDA # 0F
8D	0E 90	STA 90DE
A2	FF	LDX # FF
A0	00	LDY # 00
CA*		DEX
8E*	0A* 90*	STX 900A
8C*	0B* 90*	STY 900B
C8*		INY
F0*	F6	BEQ F6
60		RTS

The Basic equivalent looks like this:

```

10 A = 15
20 POKE 36878,A
30 X = 255
40 Y = 0
50 X = X - 1
60 POKE 36874,X
70 POKE 36875,X
80 Y = Y + 1
90 IF Y = 0 OR Y = 256 THEN 50
100 END

```

The F6 in the branch-if-equal-to-0 command is obtained by the same process as was used to obtain F7 previously.

To enter this program change line 100 to 100 Data A9,0F,8D,0E,90,A2,FF,A0,00,CA 102 Data 8E,0A,90,8C,0B,90,C8,F0,F6,60

When the program has been Saved, try Sys 8700. This will Run the program, but it may be a bit fast, so until next time, can you think of a machine-code routine to slow it down? ■

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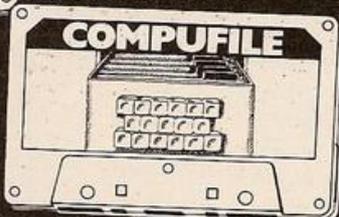
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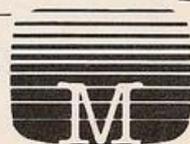
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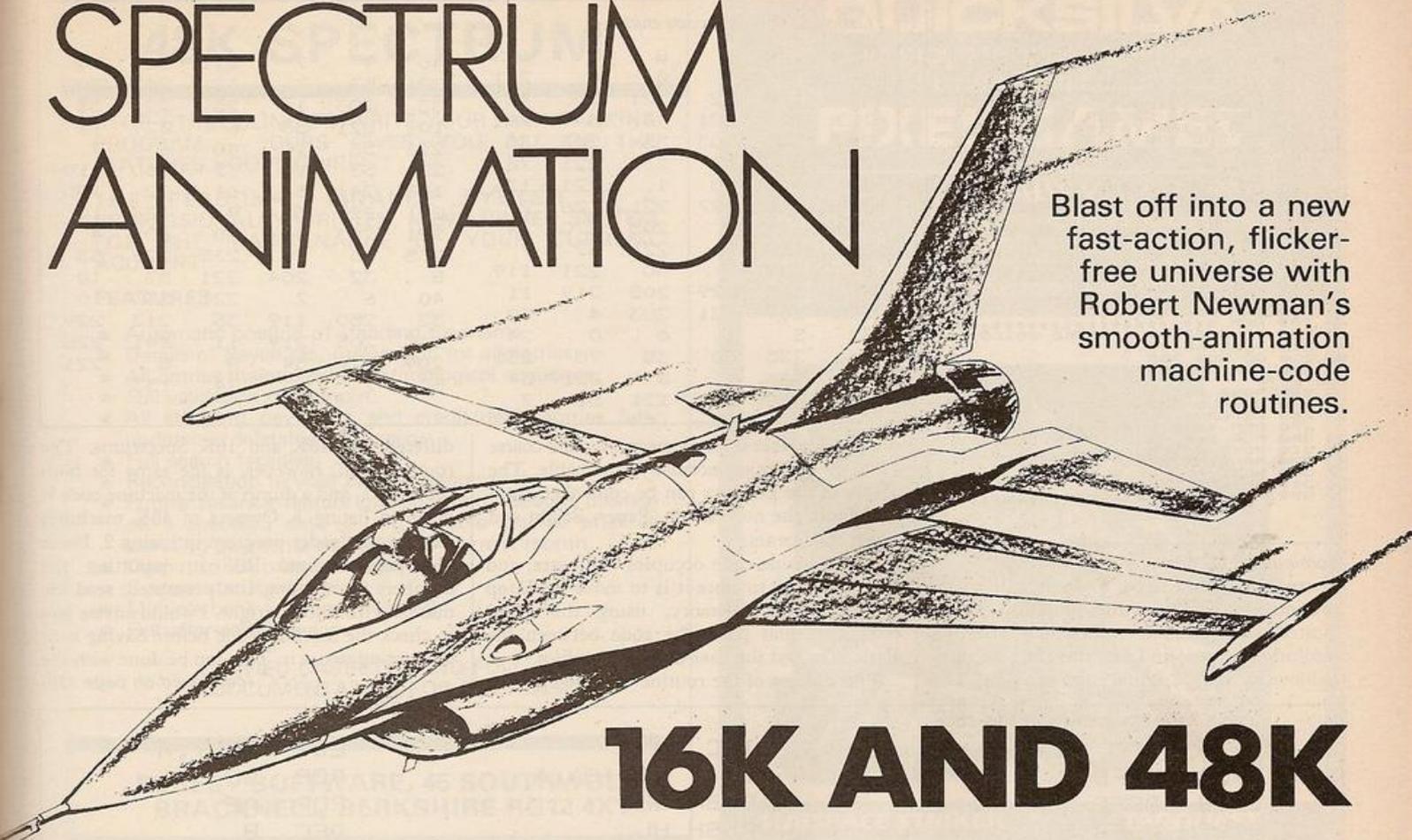
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16K AND 48K

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full and excitingly implemented on Spectrums. The usual method of producing the illusion of movement involves first printing an object at one position, and then erasing it and printing one character position further along the screen. This method is certainly fast

enough when used in Basic programs on the Spectrum if only one or two graphics characters require animation, but the movement has a jerky appearance, because the smallest distance that a character can be moved is one print position. There are only 32 positions across the screen, or 22 from top to bottom.

Another disadvantage of Basic is that the action slows down noticeably when several characters are required to move, or if the graphics are large, involving printing on a number of lines or across several columns. Most commercially-written software uses machine code in order to achieve the required speed and smoothness of movement, but writing an entire game in machine code is not a task that most home programmers would relish. It is therefore necessary to consider other methods for speeding up the action in Basic programs.

Smooth routine

On the ZX-81 it is possible to short-cut the Print statement by Poking characters directly into the display file, thereby getting slightly faster graphics. Unfortunately the Spectrum's display file is laid out in a very complicated fashion — see page 164 of the manual — and it is not really feasible to do the same thing on this computer.

For this reason I have written a machine-code routine especially for the purpose of enabling games programmers to obtain faster, smoother animation from Basic. It is intended to be used with user-defined graphics characters, which can be made as large as

(continued on next page)

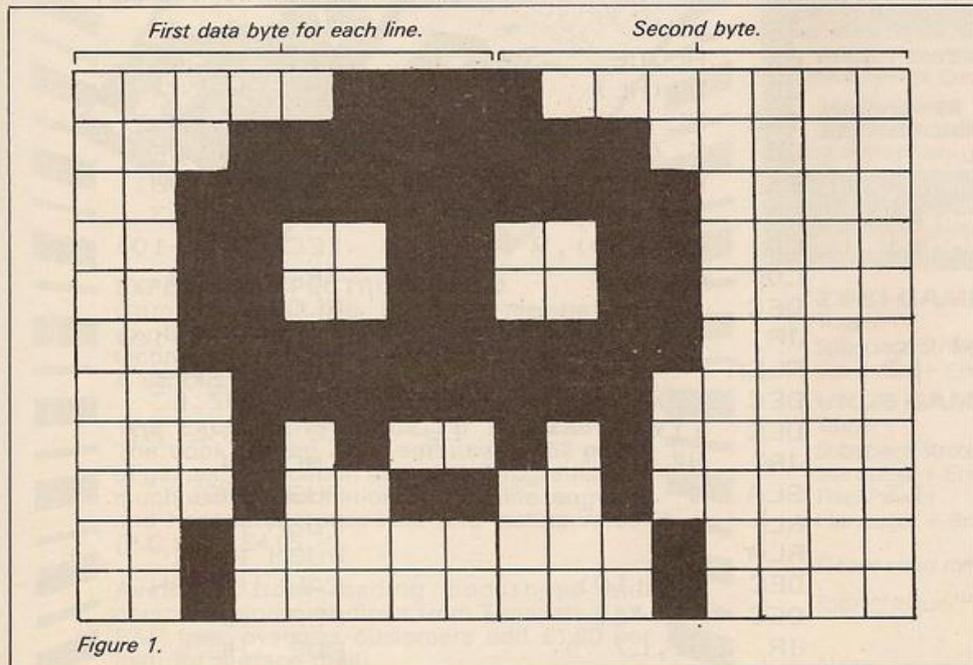


Figure 1.

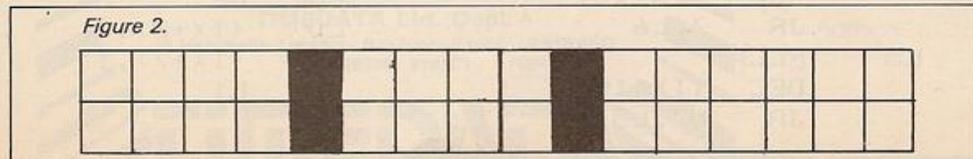


Figure 2.

Listing 5.

```

1 REM Multicoloured invaders
2 REM © R Newpad 1983
3 REM 48K ver510d
4 REM
5 CLEAR 65159
10 PAPER 7: BORDER 7: CLS
200 FOR y=160 TO 100 STEP -20
30 GO SUB 100
40 NEXT y
50 INK 0
60 STOP
70 REM *****
100 POKe 65162,14: POKe 65164,1
110 FOR x=0 TO 100 STEP 2: GO 5
UB 200: NEXT x
120 FOR x=100 TO 0 STEP -2: GO
SUB 200: NEXT x
130 POKe 65160,0: POKe 65161,y
140 POKe 65162,140: POKe 65163,
11
150 POKe 65164,0
160 RANDOMIZE USR 65171
170 RETURN
180 REM *****
200 POKe 65161,y: POKe 65160,11
210 POKe 65165,1
220 GO SUB 300
230 POKe 65161,y-9: POKe 65163,
0
240 POKe 65165,4
250 GO SUB 300
260 RETURN
270 REM *****
300 FOR c=0 TO 6: PRINT INK c;
310 POKe 65160,c:20+x
320 RANDOMIZE USR 65171
330 NEXT c
340 RETURN
350 REM *****

```

(continued from previous page)

desired and printed by a single call to the routine. In addition, the graphics can be located at any position on the 256 x 176 high-resolution screen, and can therefore be made to move by as little as one point at a time. This

Listing 1. Machine-code dump.

2	175	8	8	1	1	40	9	7	221	53	10
0	0	0	0	0	221	221	53	7	32	247	203
42	178	92	221	35	42	33	203	16	23	221	53
123	92	221	94	5	29	10	221	53	6	32	19
203	35	203	35	203	35	221	53	10	40	6	7
22	0	25	235	221	78	221	53	10	32	250	119
0	221	70	1	221	126	193	241	5	61	32	155
3	245	197	221	126	2	201	221	53	9	32	10
221	119	6	205	170	34	221	203	4	70	40	4
221	119	7	221	52	7	235	35	78	235	221	53
47	230	7	60	221	119	8	32	204	221	53	10
8	213	229	205	219	11	40	6	7	221	53	10
225	209	221	203	4	70	32	250	119	35	213	229
32	5	1	0	0	24	245	205	219	11	241	225
5	235	70	35	78	235	209	221	54	8	8	221
221	54	9	8	221	54	54	7	1	24	153	
10	9	126	221	53	7						

is a considerable improvement over the coarse 32 x 22 resolution normally obtainable. The colour of the graphics can be controlled from Basic with the normal Ink, Paper, Bright and Flash statements.

The machine code occupies 197 bytes, and the safest way to store it is to move RAMtop downwards in memory, using the Clear command, and place the code between the Basic area and the user-defined graphics.

The address of the routine will therefore be

different for 48K and 16K Spectrums. The routine itself, however, is the same for both computers, and a dump of the machine code is given in listing 1. Owners of 48K machines can use the loader program in listing 2. Enter this program and Run it, inputting the numbers from listing 1 as prompted: read the numbers from left to right. I would advise you to check the machine code before Saving it or attempting to use it. This can be done with the

(continued on page 115)

Listing 3. Disassembled machine-code.

ORG 65160	INC A	L6	LD (HL),A
XPOS DEFB 2	LD (IX+8),A		POP BC
YPOS DEFB 175	PUSH DE		POP AF
WIDTH DEFB 8	PUSH HL		DEC B
HT DEFB 8	CALL ODBBH		DEC A
MODE DEFB 1	POP HL		JR NZ,LINE
UDGCH DEFB 1	POP DE		RET
DEFB 0	BIT 0,(IX+4)	L7	DEC (IX+9)
DEFB 0	JR NZ,5		JR NZ,L4
DEFB 0	LD BC,0		BIT 0,(IX+4)
DEFB 0	JR LN1		JR Z,L4
DEFB 0	EX HL,DE		EX HL,DE
;	LD B,(HL)		INC HL
START LD IX,(23730)	INC HL		LD C,(HL)
INC IX	LD C,(HL)		EX HL,DE
LD HL,(23675)	EX HL,DE	L4	DEC (IX+8)
LD E,(IX+5)	LN1 LD (IX+9),8		JR NZ,L3
DEC E	L1 LD (IX+10),9		DEC (IX+10)
SLA E	LD A,(HL)		JR Z,L8
SLA E	DEC (IX+7)	L9	RLCA
SLA E	JR Z,L3		DEC (IX+10)
LD D,0	L2 RLCA		JR NZ,L9
ADD HL,DE	DEC (IX+10)		JR NZ,L3
EX HL,DE	DEC (IX+7)	L8	LD (HL),A
LD C,(IX+0)	JR NZ,L2		INC HL
LD B,(IX+1)	L3 SLA C		PUSH DE
LD A,(IX+3)	RL B		PUSH HL
LINE PUSH AF	RLA		PUSH AF
PUSH BC	DEC (IX+10)		CALL ODBBH
LD A,(IX+2)	DEC (IX+6)		POP AF
LD (IX+6),A	JR NZ,L7		POP HL
CALL 22AAH	DEC (IX+10)		POP DE
LD (IX+7),A	JR Z,L6		LD (IX+8),8
INC (IX+7)	L5 RLCA		LD (IX+7),1
CPL	DEC (IX+10)		JR L1
AND 7	JR NZ,L5	;	END

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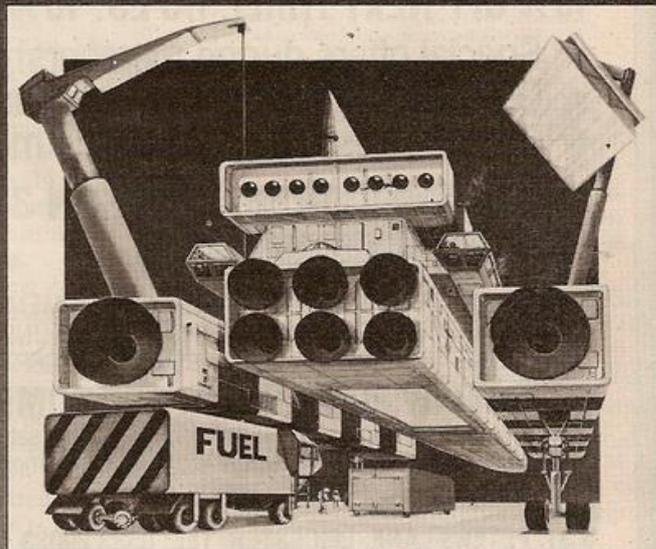
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(continued from page 112)

same loader program by deleting lines 20, 30, 70 and 90, and changing line 80 to:

```
80 PRINT TAB 10; PEEK i
```

If all is correct, you should Save the routine with the command:

```
SAVE "animate" CODE 65160,197
```

Owners of 16K computers need to make the following changes. In listing 2, change line 20 to

```
CLEAR 32389
```

and line 50 to

```
FOR i=32390 TO 32586
```

Save the routine with the command

```
SAVE "animate" CODE 32390,197
```

You can now test the routine by clearing the screen and issuing the command:—

```
RANDOMIZE USR 65171 48K  
RANDOMIZE USR 32401 16K
```

Whereupon the character in user-defined graphic "a" — usually a capital letter A — should appear at the top left-hand corner of the screen. If this does not happen you have made a mistake while entering the machine code.

If the computer has crashed you must remember to reset RAMtop by giving the appropriate Clear command before reloading your copy of the routine and checking it.

If all went as expected, here is how to use the routine from a Basic program. If you examine the disassembled routine in listing 3, you will see that the first 6 bytes are used as variables, XPOS, YPOS and so on. These names will not be recognised if you try to use them in a Basic program, but by Poking different values into these six bytes you can control the operation of the routine as follows.

Routine control

XPOS — address 32390 for 16K, 65160 for 48K — is the X co-ordinate of the top left-hand corner when the graphic character is printed on the screen. Possible values are the same as are allowed for the PLOT command, that is 0 to 255.

YPOS — address 32391 or 65161 — is the Y coordinate of the top left-hand corner of the graphic character when printed on the screen. It may take values from 0 — bottom of screen — to 175 — top of screen.

Width — address 32392 or 65162 — this is the number of points left-right in the character to be printed.

HT — address 32393 or 65163 — is the number of points top-bottom in the character to be printed.

Mode — address 32394 or 65164 — has the value 1 if you wish to print a character at the current position, or 0 if you wish to erase a block of Width × HT points at the current position.

UDGCH — address 32395 or 65165 — this must have a value from 1 to 21, and it tells the routine where to find the data for the character that you want to print. A value of 1 means that the first byte of data is held at address USR "a", that is, the first byte of the user graphic "a", while a value of 21 means that it is held in address USR "u".

Values Poked into these six bytes before calling the routine will be unchanged on exit, so, if printing more than one character, you may not need to update every byte. You will get strange results, or possibly cause a crash if

you attempt to set XPOS and YPOS to values which do not permit the character you wish to print to fit onto the screen, and so your Basic program may need to include a check to prevent this.

Different colours

The routine prints the graphic character in the colour defined by the current contents of system variable ATTR T — location 23695. If you want to print characters in different colours, you can set ATTR T from Basic without changing the current print position by using a dummy Print statement such as
PRINT PAPER 6; INK 1;
before calling the routine. The Flash and Bright statements can also be used.

If you use the routine to print user-graphics consisting of eight-by-eight points, then the method of storing the pattern is exactly the same as described in chapter 14 of the user manual. However, the routine can handle graphics of any size, and the method for larger characters is slightly different.

Firstly, design your character on a piece of squared paper. I am going to use the routine to move the character across the screen by two points at a time, and so it is best to leave a margin at left and right edges of two blank columns. The operation of moving left or right by two points and printing at the new position will then automatically print over the old space invader, saving the trouble of erasing it first. The character we want to use therefore consists of 14 by 11 points.

If the width is not an exact multiple of eight, you must add the required number of blank columns to the right-hand edge. The width of the character is then divided into eight-bit sections, which can be described by a Bin number as usual and stored in the user-defined graphics area. A program like that in listing 4 can be used for this. The first byte of data for the character is going to be stored in address given by Usr "a". When entering data for your own characters, remember that the data for the top line is stored first, then the second line and so on.

Since the space invader occupies 22 bytes, that is, all of graphics "a" and "b", plus most of "c", the next unused section begins at USR "d". This is where the four bytes of data needed for the character in figure 2 can be stored. When these two lines are printed over the bottom two lines of the space invader, its legs will appear to move while it moves across the screen. Enter and Run listing 4. You can save the user-graphics if you wish with
SAVE "chars" CODE USR "a",32

Erase listing 4 — you can do this with New

Listing 2.

```
10 REM listing 2 (48K)  
20 CLEAR 65159  
30 CLS : PRINT "enter numbers from  
listing 1"  
40 PRINT : PRINT "address contents"  
50 FOR i=65160 TO 65356  
60 PRINT i;  
70 INPUT n  
80 PRINT TAB 10;n  
90 POKE i,n  
100 NEXT i
```

16K users change lines 20 & 50
to:—

```
20 CLEAR 32389  
50 FOR i=32390 TO 32586
```

Listing 4.

```
10 REM character in figure 1  
20 FOR i=USR "a" TO USR "a"+21  
30 READ n: POKE i,n  
40 NEXT i  
50 DATA BIN 00000111,BIN 10000000,  
BIN 00011111,BIN 11100000,BIN 00111111,  
BIN 11110000,BIN 00110011,BIN 00110000  
60 DATA BIN 00110011,BIN 00110000,  
BIN 00111111,BIN 11110000,BIN 00011111,  
BIN 11100000,BIN 00010100,BIN 10100000  
70 DATA BIN 00010011,BIN 00100000,  
BIN 00100000,BIN 00010000,BIN 00100000  
BIN 00010000  
80 REM character in figure 2  
90 FOR i=USR "d" TO USR "d"+3  
100 READ n: POKE i,n  
110 NEXT i  
120 DATA BIN 00001000,BIN 01000000,  
BIN 00001000,BIN 01000000
```

since the routine and the user-graphics are safe above RAMtop — and enter the program in listing 5. This will make a row of seven multicoloured space invaders walk across and down the screen in the manner so familiar to all devotees of the arcade game. Note that all seven invaders can be erased with one call to the routine when moving down a line by setting Mode to 0, Width to 140 and HT to 11 — lines 130-160.

Other sections of the program are as follows: lines 300-340 print the row of seven characters in the seven different Ink colours. Lines 200-260 call the subroutine at line 300 to print first the row of space invaders at a certain position and then overprints their legs with the character in figure 2.

Lines 100-170 make the invaders move first left to right across the screen, and then walk back in the reverse direction. Lines 20-60 make the invaders move down the screen after walking across it.

Fast graphics

From this example, you should be able to see how the routine can be used to advantage in your own programs, producing spectacular, fast-action graphics.

Finally, should you find that the user-defined graphics area is not large enough to store the number or size of characters that you wish to print with this routine, you can relocate the routine and use a larger area of RAM for character storage.

This can be done very easily since the machine-code routine can be put anywhere, provided that its first byte, that is, XPOS, comes immediately after RAMtop. For example, if you wanted to use the routine to generate 40 characters per line printing, you would need to define your own six-by-eight character set, or copy the Sinclair one, missing out the left and right hand margins which give spaces between the letters. This would require a large area of memory — about 800 bytes — for storage, and so 48K owners would need to relocate the routine at, say, address 64000 by issuing a command

```
CLEAR 63999
```

and then loading with

```
LOAD "animate" CODE 64000
```

The user-defined graphics area can now be moved to start at address 64300 by Poking system variable UDG — location 23675/6 — accordingly. This gives ample space for an alternative character set or for any other user-graphics.

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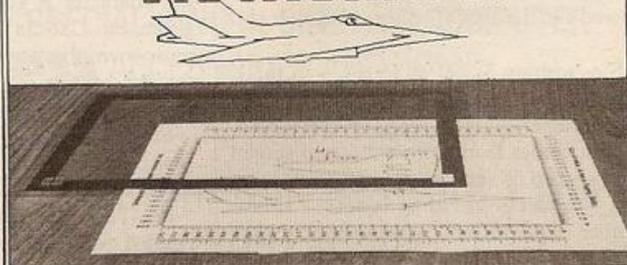
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THIS PROGRAM produces a variety of sounds at the same time as executing instructions of a program completely separate from it. It is self-contained, so that a program written with it can run on any 48K Spectrum.

To do this I used the Z-80 interrupt mode 2. First of all, prepare a tape ready to record the program on, and then type in the listing in figure 1. This is the editor which creates the sounds used in a program. There is an extra line to be inserted in the program missing from the listing printed. It is:

755 SAVE "Specsound" CODE 65002,271 :

PAUSE 50

It is important that you check your typing against the listing again when you have finished, to make sure there are no Poke errors, which could crash the program. Do not run the program at this stage, as it contains calls to a machine-code routine you have not yet put in. When you are satisfied with your typing save a copy of the program by typing in

SAVE "Specsound 2" LINE 1

and Verify it. Leave the tape in position after Verifying.

Now clear the machine by typing

PRINT USR 0

and input the listing in figure 2. Again when you have finished, check each number against the listing.

Now Run the program. The location and contents of the addresses Poked into will be scrolled up the screen. When it is finished, before Saving it, look at location 65271 on the left and check that it holds the number 251. If there is anything other than that there, you have probably put an extra number in the Data statements, or left one out. Go back and check it again.

Now press a key to save this code straight

From laser explosions to ducks quacking, Ronald Seniscal's complex sound generator provides the special effects — without interrupting your games program and without special circuitry.

after the Basic editor. You have now finished the entire program. After doing that, use as a command

PAUSE 50:PRINT USR 65002

One second later, the number nine should appear and there will be a slight clicking noise. If anything else happens, there is an error.

Clear the machine again — after verifying the code — and load the entire program in from the beginning. The second part will be automatically loaded after the first, and then it will auto-run.

You will see nine numbers, with their names, and a cursor. The cursor is moved by the up and down cursor keys. While the cursor is pointing to a number, that number can be changed. This is done by pressing the left cursor to decrement, and the right cursor to increment. To change more quickly use the 4 key to decrease by 10 and 9 to increase by 10. You cannot go beyond the values 0-255, and the program protects against this.

These numbers actually form a part of the machine code and it is by changing these that you change the sound. To hear a sound at any time, press P. You can do this while another sound is still being put out without danger of crashing.

Now the names to which the numbers are related. First is the starting point. If you think of a complete sound as having a value of 255, changing it to 127 would mean that you would hear it from halfway through compared to the first version.

Second is speed. 0 is the fastest here, and higher values mean the same sound is produced, but more drawn out.

The next four values act against each other inside the routine. The first two control the length and frequency of the click being produced, and the second the gap between the clicks. To find out more about these, experiment with them, but the second number of each pair is usually set to 255. To avoid doing this manually, press T.

The next two should be set either to 1 or 0 as anything over 1 will be taken to mean 1. The first one, if set to 0, causes the pitch to rise. Setting this to 1 does the opposite. The second variable does the same for the silences between the clicks.

The last variable determines the actual quality of the sound, as balanced against the speed penalty. A program requiring high-quality sound will run more slowly than one which is not as critical. Setting 1 is awful, and should not be used; 6 is highest and sounds like a custom-built generator but runs at only 10 percent of normal speed so should only be used in machine-code programs. A useful compromise is 2. Anything over 6 is for special effects. Try it and see.

Technically this number is used as the high byte of a number which is decreased by one when a sound or gap is put out, returning when zero, so six times 256+255 or 1,791 clicks can be put out every interrupt. This is

(continued on page 119)

COMPLEX SOUNDS

Figure 1. The sound editor.

```

1 REM data for interrupt sou
nd driver
10 CLEAR 64980
25 POKE 23692,255
30 FOR a=65002 TO 65273
40 READ z: POKE a,z: PRINT a,P
EEK a: NEXT a
45 SAVE "Specsound"CODE 65002,
271
50 DATA 58,162,254,60,33,247,9
0,1,9
70 DATA 0,9,61,32,252,195,174,
254,0,0
80 DATA 0,0,3,254,0,0,245,197,
213,229
90 DATA 205,191,2,42,165,254,1
24,181,40,24
100 DATA 229,33,255,2,58,167,25
4,71,58,169
110 DATA 254,87,58,47,254,95,58
,168,254,14
120 DATA 254,201,0,0,33,255,2,1
4,254,30
130 DATA 14,22,1,123,246,0,230,
255,253,203
140 DATA 71,70,40,1,47,71,58,72
,92,203
150 DATA 63,203,63,203,63,246,2
4,237,121,45
160 DATA 204,132,254,16,248,123

```

```

,246,0,230,255
170 DATA 253,203,71,78,40,1,47,
71,58,72
180 DATA 92,203,63,203,63,203,6
3,237,121,45
190 DATA 204,132,254,16,248,21,
32,191,29,32
200 DATA 186,235,34,165,254,225
,209,193,241,237
210 DATA 86,251,201,0,0,37,192,
225,34,165
220 DATA 254,50,168,254,120,50,
167,254,122,50
230 DATA 169,254,123,50,47,254,
225,209,193,241
240 DATA 251,237,77,0,0,0,0,0
,0
250 DATA 10,31,1,0,0,0,0,243,25
3,54
260 DATA 71,0,126,60,50,47,254,
35,126,60
270 DATA 50,49,254,35,126,50,52
,254,35,126
280 DATA 50,54,254,35,126,50,84
,254,35,126
290 DATA 50,86,254,35,126,183,4
0,4,253,203
300 DATA 71,198,35,126,163,40,4
,253,203,71
310 DATA 206,35,126,183,32,2,62
,5,50,20
320 DATA 254,50,43,254,62,253,2
37,71,237,94
330 DATA 251,201,0

```

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(continued from page 117)

why everything slows down so much when using this number in the length of interrupt variable. 0 is not really useful so the routine sets it to 5.

Of course, one sound is not much good on its own, so room has been made for 28 of them. The red number in the top left of the screen is the field number — 0 to 27 — and is changed by pressing C and then the number of the field you want to work on. A field is unchanged when you are not actually working on it, so you can go back to it at any time. Pressing M moves one field to another. Give the startfield and the destination; the field will be copied and the one put on the screen for you to work on will be the new copy.

To make more copies of this program use Goto 1000. Both parts of the routine will be automatically Saved. Dot not use any Print

commands, as the numbers are stored in the printer buffer.

It is recommended that you play around with this routine for a while before actually incorporating any sounds into a program of your own. When you are ready to do this, use the following as guidelines.

Calculate how many sounds you want in a program, and write down the number — starting at 0 — and a description of the sound, that is, what it is meant to represent. Write your game with this in mind.

Inside your program, when you want a sound to be produced at a particular point, just Poke the field number into 65186 and then use the instruction LET sd=USR 65002 While writing these put a Rem in front of them so that if you accidentally Run it, it will not try and execute these instructions. Remember to remove them when the machine-

code routine is in place. At the start of your program put these commands

```
CLEAR 64980: LOAD "Specsound" CODE:  
LOAD "" CODE
```

and then Save the program, keeping the tape positioned after the item you have just saved.

Load the editor and create the sounds you want as shown above. When you have finished, press S and then the first field number you want Saving, then the last and finally the name. The machine-code routine will then be copied on to tape, followed by the sounds, and that is all there is to it.

It is possible to Save and Load before a sound has finished. The sound will stop for the duration of these commands, but resume where it left off afterwards. List and Edit can all be performed during sound production. To stop a sound, select a field which is blank and make it produce that sound

Figure 2.

```
1 REM This program is  
  @ R Seniscal 1982  
2 RESTORE : CLEAR 64980  
3 BORDER 0: PAPER 0: INK 7: C  
LS  
4 PRINT INK 6; "wait a moment"  
5 LOAD "Specsound" CODE  
6 REM run 10 if stopped  
10 BORDER 7: PAPER 7: INK 0: C  
LS : POKE 65186,0  
12 DIM a(9)  
15 LET pres=23295: LET se=0: L  
ET b=12  
16 FOR z=1 TO 9: READ x: LET a  
(z)=x: NEXT z  
17 DATA 5,6,8,9,11,12,14,15,17  
19 PRINT INK 4; "↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑"  
↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑"  
20 PRINT INK 1; TAB 6; "Spectrum  
sound fx"  
30 PRINT INK 2; TAB 6; "@ AS 25/  
26.12.1982"  
45 PRINT INK 4; "↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑"  
↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑↑"  
47 PRINT  
50 PRINT TAB b; "starting point  
60 PRINT TAB b; "speed"  
65 PRINT  
70 PRINT TAB b; "lowest pitch (  
1) "  
80 PRINT TAB b; "highest pitch  
(1) "  
85 PRINT  
90 PRINT TAB b; "lowest pitch (  
2) "  
100 PRINT TAB b; "highest pitch  
(2) "  
110 PRINT  
120 PRINT TAB b; "reverse (1) "  
130 PRINT TAB b; "reverse (2) "  
135 PRINT  
140 PRINT TAB b; "length of inte  
rrupt"  
150 PRINT INK 2; TAB b; "(if 0 th  
en length=5)"  
160 PRINT  
170 PRINT TAB 3; INK 7; PAPER 3  
; " press ""p"" to hear sound "  
190 PRINT AT 5,0; " ": PRINT A  
T 5,0; INK 2; se; " "  
200 FOR a=1 TO 9: PRINT AT a(a)  
,6-(LEN STR$(PEEK (pres+a))); I  
NK 1; PEEK (pres+a)  
210 NEXT a  
230 LET pos=1  
240 IF INKEY$="7" AND pos>=2 TH  
EN LET pos=pos-1  
250 IF INKEY$="6" AND pos<=0 TH  
EN LET pos=pos+1  
255 FOR z=1 TO 9: PRINT AT a(z)  
,7; " ": NEXT z  
260 PRINT AT a(pos),7; INK 4; "<  
": INK 2; "--"; INK 1; ">"  
270 IF INKEY$=" " THEN GO TO 270  
280 IF INKEY$="p" OR INKEY$="P"  
THEN LET l=USR 65002  
290 IF INKEY$="c" OR INKEY$="C"  
THEN GO TO 600  
295 IF INKEY$="s" OR INKEY$="S"  
THEN GO TO 700  
300 LET pe=pos+pres  
310 IF INKEY$="9" AND PEEK pe<=  
245 THEN POKE pe,(PEEK pe)+10  
320 IF INKEY$="4" AND PEEK pe>=  
10 THEN POKE pe,(PEEK pe)-10  
330 IF INKEY$="8" AND PEEK pe<=  
254 THEN POKE pe,(PEEK pe)+1  
340 IF INKEY$="5" AND PEEK pe>=  
1 THEN POKE pe,(PEEK pe)-1  
350 IF INKEY$="t" OR INKEY$="T"  
THEN BEEP .5,1: POKE (pres+4),2  
55: POKE (pres+6),255: GO TO 190  
360 IF INKEY$="m" OR INKEY$="M"  
THEN GO TO 800  
480 REM  
490 PRINT AT a(pos),3; " ": P  
RINT AT a(pos),6-(LEN STR$(PEEK  
pe)); INK 1; PEEK pe  
500 GO TO 240  
600 INPUT PAPER 2; INK 7; " numb  
er? "; se  
605 IF se>27 THEN GO TO 600  
610 LET pres=9*se+23295  
620 FOR a=1 TO 9: PRINT AT a(a)  
,3; " ": NEXT a  
625 POKE 65186,se  
630 GO TO 190  
700 REM  
710 INPUT PAPER 4; INK 7; "From  
which number (inc.)? "; from  
720 INPUT PAPER 3; INK 7; "To wh  
ich number (inc.)? "; to  
730 LET start=23295+9*from: LET  
to=(to-from)*9+9  
740 INPUT "name? "; t$  
750 IF t$="" OR LEN t$>10 THEN  
GO TO 740  
760 SAVE t$CODE start,to  
770 GO TO 190  
800 REM move  
810 INPUT INK 2; "move from? "; s  
ta:  
820 IF sta<0 OR sta>27 THEN GO  
TO 810  
830 INPUT INK 2; "move to? "; sta  
2:  
840 IF sta2<0 OR sta2>27 THEN G  
O TO 810  
850 IF sta=sta2 THEN BEEP 1,-10  
: GO TO 810  
855 LET se=sta2  
860 LET sta=23295+sta*9  
870 LET sta2=23295+sta2*9  
880 FOR z=0 TO 8: POKE (sta2+z)  
,PEEK (sta+z): NEXT z  
890 BEEP .6,-20  
895 GO TO 610  
999 REM  
1000 CLEAR : BEEP 1,-10: BEEP 1,  
-20: SAVE "Spexsound2" LINE 1: S  
AVE "Specsound" CODE 65002,280
```

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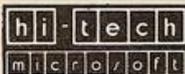
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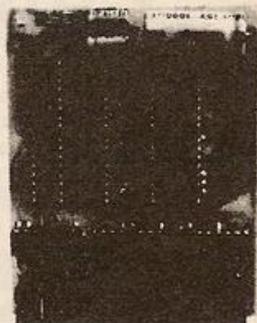
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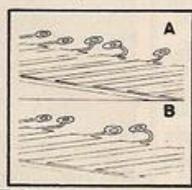
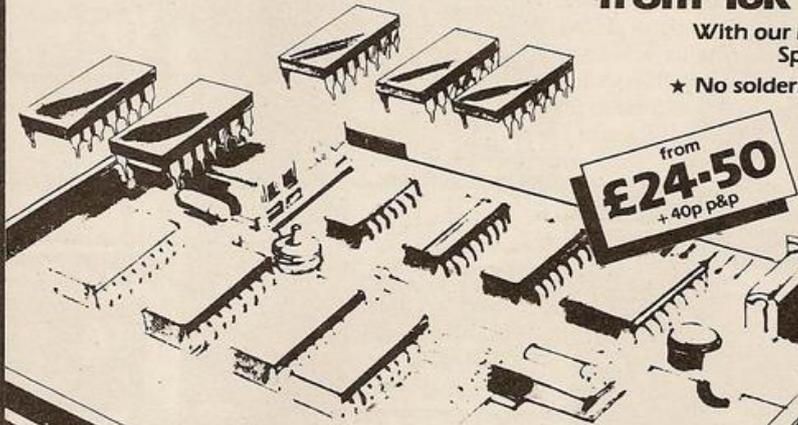
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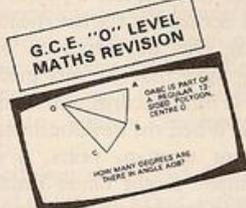
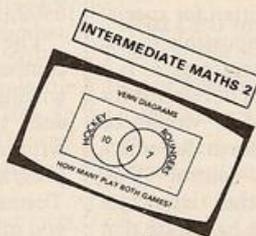
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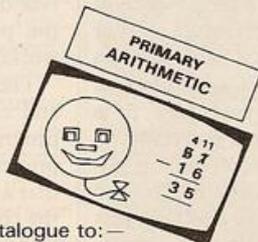
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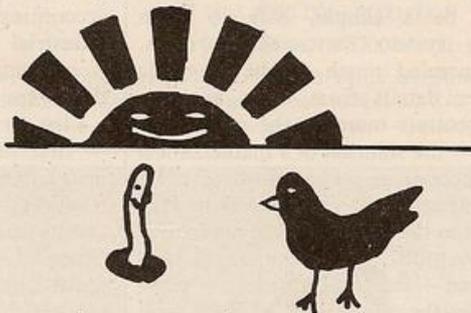
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John Dawson looks back at the days when every byte mattered, in his history of software.

THE EFFORT required to write software has been a matter of concern since 1946. At that time, M V Wilkes built EDSAC — Electronic Delay Storage Automatic Computer — with a team of helpers at Cambridge University primarily to permit program development. After 1949 this work concentrated on the construction of a library of mathematical subroutines. Wilkes said that “there would be almost as much capital sunk in the library of subroutines as in the machine itself, and builders of new machines in the future might wish to make use of the same order code — machine-code operations — as an existing machine in order that the subroutines could be taken over without modification.”

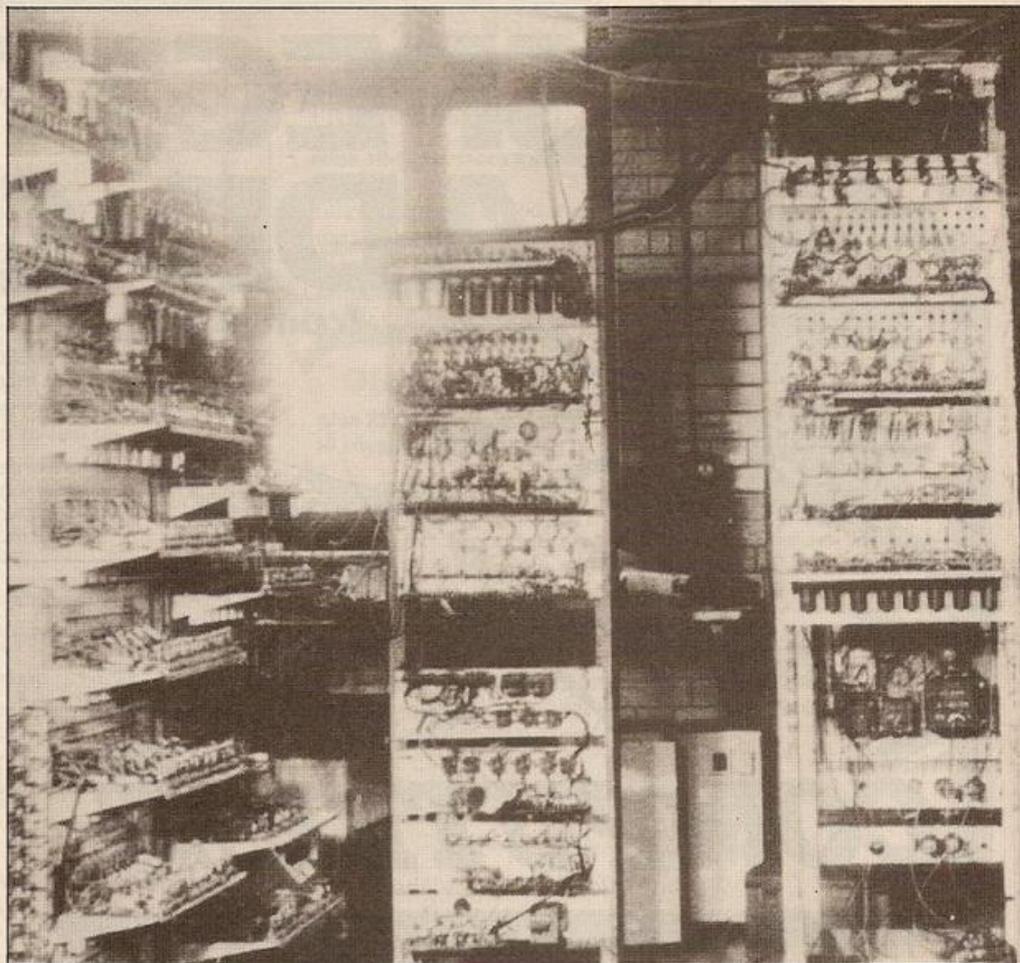
Like the first Manchester and Cambridge computers some early microcomputers had so little memory that hardware was used to start the machine from the first instruction. These front panels allowed the operator to load binary values into the accumulator and other registers. Switches were set to identify the address in the memory and the data which was to be placed at that address. The address switches were then incremented and the new data placed at the next location. By this laborious method it was possible to place a short program into the computer's memory.

In *Faster than Thought* — B V Bowden, Pitman 1953 — it is said “In previous machines the input to the machine had been directly to the cathode-ray tube store from a binary keyboard, and output had been by inspection of a cathode ray tube monitor. For this machine — the second 1949 computer — input and output routines were developed which enabled teleprinter equipment to be controlled by the machine.”

This was a great gain in productivity. Remember that the original input looked like figure 1 and you will have no doubt that high-level languages are a great boon to any computer programmer.

At Manchester University, R A Brooker developed the Autocode system which was intended to be a simple, easy to learn programming system for scientific users. Autocode concealed much of the magnetic drum transfer details from users allowing them to concentrate more on the purpose of the program — the solution of a mathematical problem. Autocode provided floating point operations and standard instructions to take information into the machine from a punched paper tape, outputting the result to a teleprinter. Fortran — formula translation — often referred to as the granddaddy of high-level languages did not appear until 1956, two years after the introduction of the Autocode system.

All high-level computer languages translate the instructions that you or I can understand easily into a long series of machine-code instructions which appear to the computer as ones and zeroes. However different the high-level language looks, the translation produces the same machine code and the operation of the central processor unit is precisely the same.



SOFTWARE

Why are there literally hundreds of high level languages? Some were written for special purposes and are difficult or impossible to use for anything else. Graforth, for example, is a special purpose version of Forth developed for drawing pictures and graphs. It would be almost impossible to use Graforth for office accounting or the continuous control of an industrial chemical plant. Other languages were cramped or limited by the hardware that they were designed for.

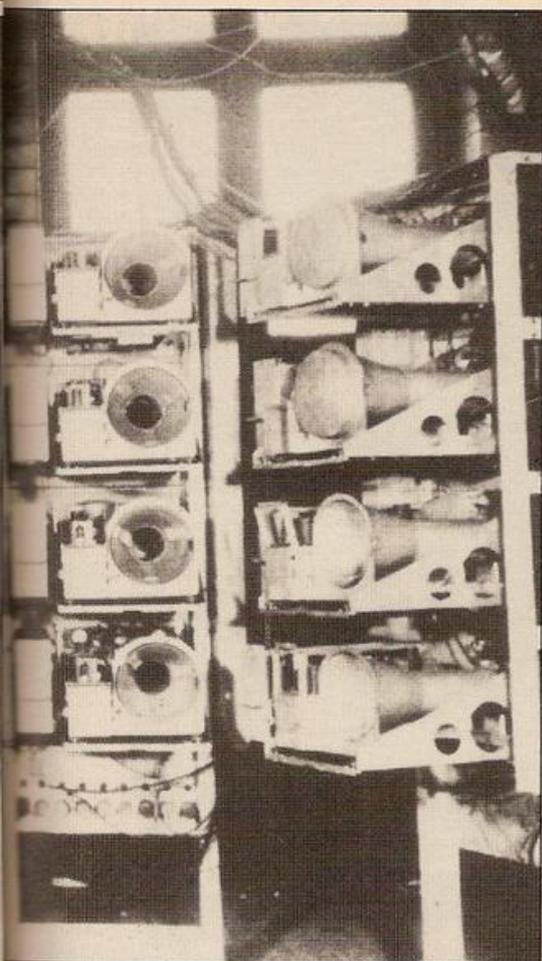
Lisp was made to work — or implemented — first on an IBM 704 and some of the instructions in the language take their names from registers inside the computer where the results were to be found — CAR and CDR for example — contents of the address part of register and contents of decrement part of register. You might reasonably have come to the conclusion by now that a great deal of software and many of the languages it is written in are primitive. This is correct.

It is true that the technical revolution has continued with the development of 16- and 32-bit microprocessors but it is also true that there is, at present, no significant software written specifically for these new CPUs and in the microcomputer world we are only beginning to scratch the surface of what can be

done using old faithful processors such as the 6502, the 8085 and the Z-80.

The reason for the failure to advance at a comparable rate in software is merely that writing programs is labour intensive, difficult and very time consuming. Programs are written either by one person or by a team of programmers working to a common plan. Teams take longer to complete a project than you might expect because of the overhead time lost in managing the development of the program, making sure that various pieces fit and each section is built according to common design principles. When the development time runs into man, or woman, years, a single designer/programmer might never finish the task or might fail to appreciate some aspect of the program that will prevent it from ever working correctly.

The permutations of the various branches and choices that are made in any significant program are so numerous as to effectively prevent comprehensive testing. Remember that at a microcode level even the designers of the chips themselves make mistakes. The Z-80 CPU made by Zilog contains a number of unlisted instructions which were dropped from the final specification and may or may not work on the chip you possess.



the name was shortened to Forth — another good example of hardware dominance.

Forth is a threaded interpretive language — TIL — and this means that the program that you execute consists of a succession of calls to addresses of lower level instructions. Those instructions may, in turn, call other instructions at the same level or at a lower level until machine code instructions are reached.

Forth has given birth to a family of languages. Stoic is a CP/M version with some advantages, the source program takes up less space and CP/M files are fully supported, while BCPL — Basic Common Programming Language — is an austere TIL with a high degree of flexibility and little error checking. Program development tends to be faster than average using TILs because the nature of the language leads to a modular programming style which, in turn, allows easier debugging of sections of the program as you proceed.

The ease of descent into assembly language and the high level constructions such as If-Then-Else and Repeat-While often provided in TIL assemblers make Forth and its relatives suitable for on-line as opposed to batch processing. Programming in a TIL is a matter of extending the dictionary by building new words out of words that already exist and this, I believe, makes the language ideal for programming by people who are disabled. A microprocessor-based aid for a disabled person could be easily customised to suit the particular requirements of that person and could be altered from day to day by the owner.

Some people believe that as Forth becomes

more popular so the need for assembly language programming will disappear. While it is true that Forth has a wide dynamic range — it allows you to move from a very high-level program to naked machine code entirely at will — there is a time penalty to be paid each time a new Forth word is executed. For words containing short sections of machine code the time overhead may be greater than the execution time for the actual operations that you wish to carry out.

A macro-assembler, on the other hand, bridges the gap between a straight assembler producing one machine-code instruction for each line of assembler code and high-level interpreters that will initiate several hundred machine code instructions for each line of the source program. A macro-assembler allows you to define a group of machine code instructions by a name. You may then use the name in your program as a single line and when the source code is assembled to produce an object program that will run on the computer all the instructions that were included in the group are inserted into the object program.

The advantages of this facility are immense. If you make a mistake in the method you use to multiply two numbers then you need only correct the instructions in the macro and wherever that macro-instruction is used in the program it will be put right when you re-assemble the program. A good macro-assembler will allow you to “nest” macro-instructions so that one macro can call another. This feature allows you to build higher and higher level macro-instructions. ■

E AND ALL THAT

The 6502 CPU actually contains a mistake in one of the listed instructions — JMP (xxFF) where the xx represents any page number, does not work correctly. If 'xxFF' is '50FF', for example, the instruction should obtain the address to jump to from 50FF and 5100. In fact, the 6502 chip uses the values in 50FF and 5000 to form an incorrect address combination.

Assemblers are used widely by programmers who need detailed control over the operation of the computer because the application they are working on is time critical or because they need to control sophisticated peripheral devices.

Forth was written by Charles Moore over a period of several years, although the language is dated formally as originating in 1969. Working at the National Radio Astronomy Observatory, Charles Moore wanted a new high level language to allow easy communication between the observatory instruments, the computer and the astronomer, the computer user. The IBM 1130 machine used in the observatory was a third generation computer and Charles Moore was so impressed with the results of his work that he called it a fourth generation language. The IBM 1130 permitted only five-character identifiers and

Figure 1.

6502 CPU Instruction

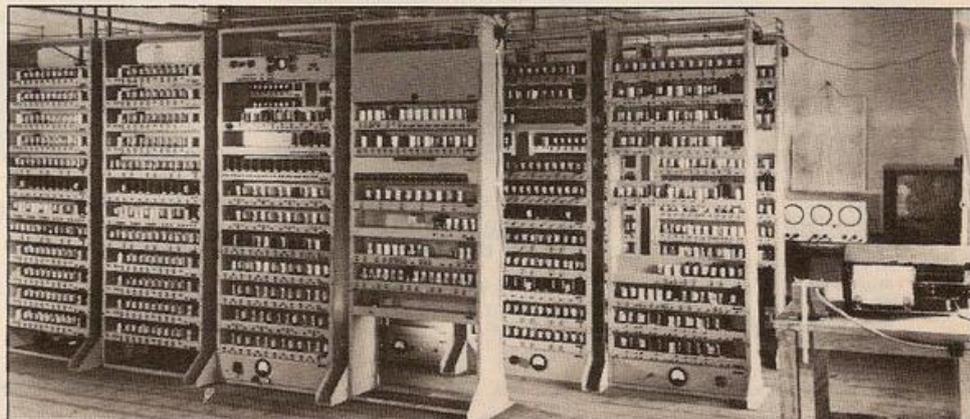
Decrement Register X
Load Accumulator with Zero
Load Accumulator with 1
Load Accumulator with the contents of Address 1000 Hex.
Jump to Subroutine at 4040 Hex.

Binary representation

1100 1010
1010 1001 0000 0000
1010 1001 0000 0001
1010 1101 0000 0000 0000 0001
0010 0000 0000 0100 0000 0100

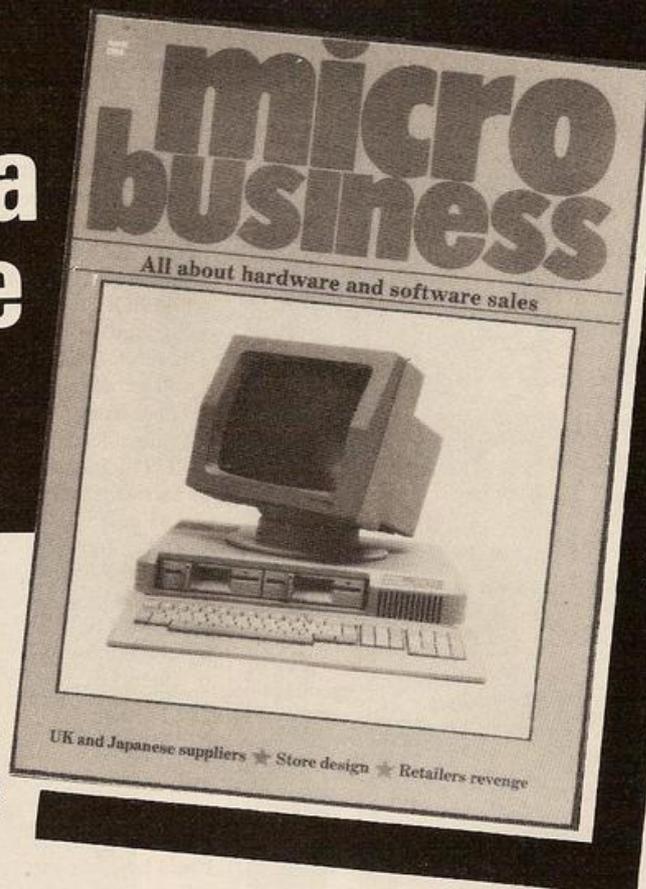
Expressed in hexadecimal notation the long strings of ones and zeros become more easily manageable — the instruction to decrement register X is expressed simply as CA.

Below: EDSAC in 1949. Above left: the Manchester Mark 1.



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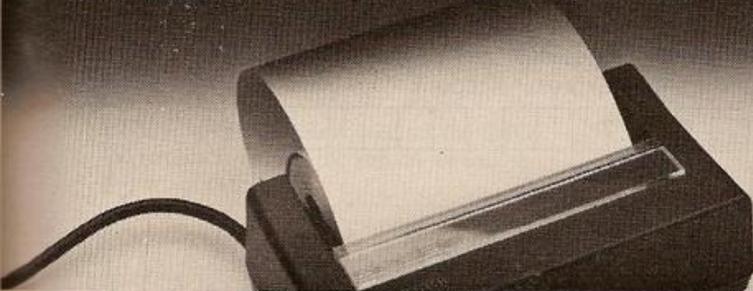
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BASIC DICTIONARY

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

BASIC DICTIONARY

TAN The function which returns the tangent of its argument. The argument is usually expressed in radians. A standard ANSI word.

TEXT The Apple II command or statement which changes from graphics mode to text mode.

THE The PDP-8E abbreviation for THEN.

THEN Part of the IF . . . THEN statement which is used to indicate the next operation scheduled, once the IF condition is satisfied. A standard ANSI word.

TI The Commodore Pet abbreviation for TIME.

TIM Another common abbreviation for TIME.

TIME A command and function used to return the elapsed time in seconds from some reference point. Not to be confused with TIMES.

TIMES A function which returns the actual time of day. Not to be confused with TIME.

TIS The Commodore Pet abbreviation for TIMES.

TO Part of the FOR . . . TO . . . STEP statement.

TOP A function used in BBC Micro Basic to return the address of the first free location after the end of the current program.

TRACE An Apple II command or statement which causes the computer to print out line numbers as each one is executed. It is normally used during debugging only.

TRACE OFF The command or statement which switches off the TRACE Command. See also NOTRACE.

TRACE ON A command or statement similar to TRACE.

TROFF A common abbreviation for TRACE OFF.

TRON A common abbreviation for TRACE ON.

TRUE A special function used on the BBC Micro which returns the logical true value (-1) when called.

U

USR A function which transfers control from a Basic program to a machine-code program resident elsewhere in the memory.

UNTIL Part of the REPEAT . . . UNTIL statement.

V

VAL A function which returns the numerical value of a number expressed as a string.

VLIN AT An Apple II statement which draws a vertical line at the specified column position. The arguments after VLIN designate the start and end points and the argument after the AT designates the column.

VPOS A function which returns the vertical position of the cursor. The screen top is numbered 0.

VTAB An Apple II command which specifies the line on which the next output will commence.

W

WAIT A command or statement which causes the computer to halt execution for a specified period of time.

WIDTH A command or statement used to pre-select the printer carriage or VDU screen width.

WRITE The Apple II command or statement used to output on to disc or cassette storage material.

Non-alphanumeric characters

As well as the use of reserved words, computers also use non-alphanumeric characters as operators or abbreviations. To conclude this dictionary these are listed — in no particular order.

" (quotes). The almost universal use of quotes is to delimit the range of a string. It is an ANSI standard operator. The Atom uses a single quote for this purpose.

, (comma) An ANSI standard operator used as a delimiter in lists. The TRS-80 uses it as an abbreviation for THEN and to separate otherwise ambiguous lists. Palo Alto Tiny Basic uses the comma to allow the placing of more than one statement on a line.

. (full stop) An operator used by the TRS-80 level 1 to identify abbreviated commands, statements and functions. It can be used in level 2 as the argument of a List or Edit command and in this case means "last line operated upon". It is also used as the decimal point.

BASIC DICTIONARY

; (**semicolon**) A standard ANSI operator which allows several output sections to be joined together on one line.

(. . .) (parenthesis) The operator used to determine the order in which operations are performed. The innermost pair of parentheses are performed first.

[. . .] (square brackets) In many computers square brackets are interchangeable with parenthesis. The BBC Micro uses square brackets as delimiters for assembler statements. A single left square bracket sometimes represents the exponentiation operator.

= (equals) The ANSI standard mathematical equal sign. It is also widely used as an assignment operator, sometimes with a preceding LET. Most computers also use it as a relational operator to compare numerical values or strings.

^ (caret) The standard ANSI symbol for the exponentiation operator.

↑ (up arrow) Another symbol sometimes used as the exponentiation sign.

< (less than) The standard ANSI symbol for "less than". Used when comparing to numeric values. Many computers can use this to compare strings and, in this case, each character in turn is compared from the left to assess alphabetic order. As each character is compared individually and the order is decided by the first non-identical character, the length of the string is not a factor. Can be used with a "+" to represent equal to or more than.

> (greater than) The standard ANSI symbol for "greater than". Used when comparing numerical values or strings. Can be used with a "=" to represent equal to or more than.

<> (not equal to) The standard ANSI symbol for "not equal to". Used when comparing numerical values or strings.

× (not equal to) A symbol sometimes used instead of <>.

≤ (equal to or less than) An alternative to <= used on some computers.

≥ (equal to or greater than) An alternative to >= used on some computers.

≠ (not equal to) An alternative to <> used on some computers.

' (apostrophe) used on many computers as an abbreviation for REM. Used on the Atom to enclose strings and on the BBC Micro to produce new lines in PRINT or INPUT statements. Sometimes called a "single quote". ■

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BLANK STARE

■ I cannot get my Spectrum to recognise the difference between a blank space — either as CHR\$ 20, 1, 32 or CHR\$ 143 — and an unprinted character. The Screen\$ function treats them all as 32. If an Ink is specified beforehand, then I can differentiate between them using Attr. However, if I just print up an Inv Video or G-shift t-8 black square, Attr treats it as if it were blank. What can I do?

*Julian Vincent,
Earley, Reading.*

IT IS UNFORTUNATE that it is impossible to detect user-graphics or blanks with Screen\$. It seems an oversight when designing the ROM, as it is probable that Screen\$ would find its widest application in moving graphics programs when you need to detect whether two objects have run into each other or have, say, run off the edge of a track or road. I get around the problem by using something other than a blank, which still prints up as a satisfactory object. You will find that the capital X very well for walls and things that you otherwise would print as a series of inverse spaces. Use Inverse 1 in the line that is printing the Xs, and detect them just looking for the X. The full stop can also be used, or the slash. Experiment with the letters of the alphabet and the symbols, to find one which does not look too much out of place in your program.

ATOM TOOLBOX

■ I have a 12K plus 12K Atom and am contemplating an expansion of its facilities. Would you advise me to buy a programmer's toolbox ROM, considering the availability of the disc pack for the Atom, or to upgrade it by inserting a BBC ROM, considering the further expansion of the BBC computer? If I choose the latter, is it possible to upgrade it further to BBC model B?

*W Luk,
Oxford.*

YOU DO NOT explain the main purposes for which your computer is used, and this has some bearing on the answer to your question. The "BBC upgrade" does not turn an Atom into a BBC Micro, but simply gives it access to a large part of BBC Basic, but not at the same speed as the BBC Micro. If you are sufficiently advanced in programming the Atom to contemplate purchasing a utility ROM such as you describe, it is likely that you would be best advised to stick with

the Atom, and continue to develop your skills on that, rather than convert it to a machine which is neither one computer nor the other, and have to relearn many of the techniques you have acquired to date.

PLUG BUG

■ I am 12 years old and own a 1K ZX-81 which works perfectly, except sometimes when first switched on. I have found that I can correct its odd behaviour by fiddling with the power input plug to the computer. Can you tell me what is wrong?

*Michael Rabbett,
Huntingdon.*

THE SOCKET for the power supply — and indeed for Mic and Ear as well — tends to work loose, as you move the plugs in and out a lot. The answer is simple. Get an electrician, or a friend who knows how to do such things, to bend the metal inside the plug socket slightly, so it grips the plug firmly. As a general rule, you should not remove the plugs more than you have to. I suggest leaving them in place all the time, to minimise wear on the sockets.

SLEEP NO MORE

■ I won a ZX-81 and have recently been writing a games program which involved, in part, negotiating a two-dimensional maze. The maze is randomly generated, with its only record being in the display file. By using the command

PEEK(PEEK 16398 +
256*PEEK 16399)

I thought that I could prevent the Inkey\$ operated figure 1 from passing through — and erasing — the walls, which are made up from graphic spaces. For a while, I thought this had been successful, then discovered that by rapidly pressing and releasing the controlling key it was possible to pass through the wall with ease. I have tried in vain to solve the problem but it seems to be beyond me. The above is the only Peek routine I know. It works perfectly if I just want the program to stop when a wall is hit. All progress on what I hoped would be one of my best games has been halted because of this bug. I am desperate and without sleep. Can you help?

*Marcus Harvey,
Chipping Sodbury.*

YOUR PEEK routine is correct. The most likely explanation for its failure under certain circumstances is that

you are not checking the result of this Peek every time you cycle through the program, because there are two routes through it. Perhaps you are jumping some of it when the Inkey\$ is not one of the vital readings, and one of the routes misses the routine. Check this by including it in another part of the program, and make sure the line which is needed as well — the Print At ending with a semicolon — is always immediately before the Peek/Peek.

CHEAP MEMORY

■ I would like to expand the memory of my Vic-20, but it is very expensive. Commodore charges over £70 for its unit. While looking through a recent edition of *Your Computer* I saw an advert for a 16K unit for the Vic-20 for less than £40. Does this unit do the same job as Commodore's unit? Are there any catches in buying the cheap memory?

*Ricky Pedelty,
Sheppy.*

I BOUGHT ONE of the cheaper memory units in August last year, and was unable to get it to work. I returned it, and asked to see the replacement working before I accepted it. I was happy with the demonstration in the shop, and since then, have had no problems with the unit at all. There is no indication, in terms of performance, that the cheaper memory is not doing everything the Commodore unit would provide. I suggest the dud unit I got the first time was just luck of the draw. Perhaps I would have been just as unfortunate with a Commodore expansion.

PICK A MICRO

■ Please help! I often read your magazine, which I find fascinating, particularly the evaluations of micros. However, there now seems to be a bewildering range of micros available. I should be very grateful for any advice on the most appropriate one for my own needs, which are at least 32K of memory, expandable; high-resolution colour graphics, with the possibility of 3-D graphics; scientific use — I am not particularly interested in games; real typewriter keyboard; ability to turn a cassette player on and off from the computer; usable with UHF TV; a good, clear user manual; good colour; and under £400.

*S J Pearson,
Leeds.*

IT SOUND as if you are talking about the BBC Micro model B. Check out the Electron before you make your final decision. The highest graphics resolution on the model B demands a monitor to see the graphics at their best, and would be vital for any 3-D graphics work.

MAKING A DIN

■ I have just ordered a 48K Spectrum. The tape recorder I wish to use is a Philips EL-3302 which has DIN input/output sockets. As the Spectrum is only supplied with jackplug leads, I would like some information on how to connect up the Sinclair leads to DIN leads.

*A R Smith,
Torquay.*

IT IS LIKELY that you will not be able to make the conversion satisfactorily. The Spectrum demands a high output from the cassette recorder, such as that which would be used to power an external speaker, rather than the reduced output for headphones. Secondly, the output from the Spectrum when Saving is designed for a socket with the sensitivity of an ordinary microphone socket. Speak to an electrician about tapping into the extension speaker output, and getting into the microphone, rather than ancillary, input.

LOWLAND SCROLL

■ I recently received a 16K Spectrum and am still discovering new possibilities. My only question so far is about Poke 23692 which — according to the manual — will let the screen roll on and on. I have tried this, but it does not work on my machine. Do other Spectrum owners have problems with this?

*B R Smit,
Maarsse,
The Netherlands.*

THIS POKE is designed to stop the Spectrum printing up Scroll? every-time the screen is full, and needs to be positioned within the program in such a way that it is triggered fairly regularly. I usually use it within the master loop of a program. If you still get Scroll? from time to time, scatter the line throughout the program a few more times. The form I use is Poke 23692, -1.

DRAGON LORE

■ I have recently bought a Dragon 32 computer and would like to know if you could recommend a book on programming in extended Basic. Also, could you tell me which other computer software is compatible with the Dragon?

*Mrs J Begg,
Abergavenny,
Gwent.*

It is rare that Tandy Colour Computer programs will run on the Dragon 32 even in cassette form. About the only way to convert Tandy software for the Dragon is to get someone with a Tandy to CSAVE PROGRAM NAME "A" This will save your Tandy program in ASCII form. Then you will be able to load it into the Dragon. If it is in machine-code you will not be able to run it at all. ■

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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.

THIS MONTH I risk the invective of readers who tell me the Sharp PC-1211 should not feature in this column. "It's not a real pocket calculator", they say. Well, here goes anyway with a program called *Treasure Quest* by J V Moss of London.

Fantasy games are increasing in popularity, and also variety, but it may surprise some people that it is possible to run such a game on as small a machine as the Sharp PC-1211 Pocket Computer.

In the game to be described, the player travels through a labyrinth of caves, the object being to find the treasure and bring it out of the caves within forty days.

The labyrinth is represented by a seven-by-seven square matrix of 49 caves. The caves may be empty, or they may be inhabited by fairies, trolls, giants or dragons. The player may move through the labyrinth cave by cave, using the commands N, S, E or W, representing the points of the compass. Alternatively he may rest or fight.

Initially, the player is in the most south-westerly cave, and he knows only that the treasure lies in a cave to the far north-east. On finding the treasure, he must bring it out by the most north-easterly cave.

The computer keeps a record of

the days — it takes one day to journey from one cave to the next — and tells you what, if anything, inhabits the cave.

Trolls, giants and dragons are the adversaries, in order of danger, trolls being the least dangerous. The player can decide there and then to fight, which gives him the advantage in the conflict. Alternatively, the player may try to move to another cave, to return the way he came, or to rest quietly for a day. If the adversary sees him, then he will fight, and in this case the opponent has the advantage. The adversary is less likely to see you if you rest, or return the way you came.

The outcome of a fight is determined using random numbers. Fighting uses up energy — as does moving about — which can be recovered by resting. If you are injured, it is best to rest in a fairy cave, and let the fairies attend to your injuries. However, the quest must be completed within forty days.

The program uses all the available memory of the PC-1211. Therefore there are no comments, and the program must be keyed in exactly as written.

The subroutine at line 2 is a random number generator which generates a positive integer in F less

Word processor for Sharp PC-1500.

```

10:"A":WAIT 0:
   CLEAR:DIM T$(
   120)*79:L=1
20:"C":INPUT T$(L
   ):LPRINT T$(L)
   ):CSIZE 1:
   LPRINT L:CSIZE
   2:L=L+1:LF 1
30:IF L<121THEN 2
   0
40:"B":L=L-1:D=L:
   LF 2
50:A=1:E=D:D=INT
   (D*.73+.5):
   PRINT STR$ E
60:FOR B=1+D TO L
70:G$=LEFT$(T$(A
   ),16):H$=LEFT$(
   T$(B),16)
80:IF G$>H$THEN 1
   00
90:GOTO 110
100:T$(0)=T$(A):T$(
   A)=T$(B):T$(B
   )=T$(0)
110:A=A+1:NEXT B
120:IF D<>ETHEN 50
130:"D":CLS:GRAPH
   :ROTATE 1:J=1
140:GLCURSOR(0,-9
   9):SORGN
150:FOR M=1 TO 61
   STEP 20
160:FOR K=1 TO 12
170:GLCURSOR
   K*18,0):LPRINT
   MID$(T$(J),M,
   20):J=J+1:NEXT
   K
180:GLCURSOR(0,-2
   40):SORGN:J=J
   -12:NEXT M
190:J=J+12:IF J<=L
   THEN 140
200:TEXT:END

```

Priority order of characters:-
SPACE
! @ # \$ % & () * + , - . /
0 1 2 3 4 5 6 7 8 9
: ; < = > ? []
^ _ ` { | } ~
A B C ... X Y Z
a b c ... x y z

than the initial value of F, using a fractional seed in E. It was positioned here because there was thought to be a speed advantage in executing a subroutine at the beginning rather than the end of the program area.

Line 100 fills the matrix with creatures for the new game. Line 110 sets up the initial values including the position of the treasure. Line 200 checks if the treasure has been brought to the north-eastern most cave. If not, lines 201 to 226 display the current situation and line 228 invites a response.

Lines 230 to 255 process the response, checking directions to ensure that the player can only move within the matrix. Line 260 checks for moving back the way you came, to alter the value of F so there is less chance of an adversary seeing you. Line 275 actions the move.

Lines 300 and 340 are concerned with "resting", and lines 350 and 360 determine whether you are spotted by an adversary. Lines 400 to 445 determine the result of a fight. Lines 600 to 800 are self-explanatory.

The program could easily be adapted to run on other computers using other dialects of Basic. On the PC-1211, Beep merely sounds a buzzer, Pause displays a line for about half-a-second before going to the next line.

Variable memory is handled in a slightly strange way, in that each of the first twenty-six variables, A to Z, may be referenced in four different ways. Thus A, A\$, A(1) and A\$(1) all refer to the first variable, B, B\$, A(2) to the second, and so on. The use of variables is listed in table 1.

In playing the game, it will be found helpful if a seven-by-seven grid is drawn, and the inhabitant of each cave marked as it is visited, in case it is wished to return to, or avoid, a particular cave. It is quite difficult to complete the quest in 40 days. Happy hunting.

Table 1: memory utilisation.

A\$(1) — A\$(4) are set up before running. E and F are used by random number generator.

A\$(1) = "FAIRY"
A\$(2) = "TROLL"
A\$(3) = "GIANT"
A\$(4) = "DRAGON"
E = decimal fraction
F
G = energy of player
H = strength of adversary
I = working variable
J\$ = interactive response
K = co-ordinate within matrix
L = previous response
M = count of days
A(14) — A(62) = matrix
A(64) = treasure found indicator.

The second program by A E Cox of Sussex, is a very interesting indexing program written for the Sharp 1500. It can sort up to 120 character strings of 79 characters each into alphabetical order and then prints them out as shown. Could it be the first genuine useful word-processing program for a pocket-sized calculator?

Each item is printed immediately after it is entered, taking up to about 4.5 lines of print. The items are then sorted out into alphabetical order — ASCII priority — and printed out lengthwise in blocks of 12 items.

The user should first check that there is adequate paper and Text mode is Csize 2. Now press Def A. Next, write first item and Enter. Write each subsequent item in the same way. To sort, press Def B. Print-out follows automatically.

To amend items, note the tally number at the end of the item to be amended. Press Break. Write L=n — tally number and Entry. Press Def C. Write the new text and Enter, then press Break. Write L=m, where m=1 + last tally number on the print-out. Enter. Press Def C; continue.

Items already entered may be printed out lengthwise without sorting, by pressing Def D.

Adventure game for PC-1211.

```

1 A(64)=0:GOTO 100
2 E=EXP(LN(E+.5)*5):E=E-INT(E):F=INT(E*F):RETURN
100 FOR I=14 TO 62:F=5:GOSUB 2:A(I)=F:NEXT I
110 L=0:M=0:K=14:O=25:F=3:GOSUB 2:H=F:F=3:GOSUB 2:
   A(48+F*7-H)=6
200 IF K=56 IF A(64)>0 THEN 700
201 H=A(K):IF H=6 THEN 600
202 IF H=0 BEEP 1:PAUSE"EMPTY CAVE":GOTO 225
220 BEEP 1:PAUSE"CAVE CONTAINS A ".A$(H)
225 M=M+1:PAUSE"DAY":M:IF M=40 PAUSE"YOUR TIME IS UP":
   STOP
226 IF K<6 PAUSE"YOU ARE TIRED"
228 INPUT"WHAT DO YOU DO?":J$
230 IF J$="FIGHT" THEN 400
235 IF J$="REST" LET F=3:GOTO 300
240 I=0:IF J$="N" LET I=7
241 IF J$="S" LET I=-7
242 IF J$="W" LET I=-1:IF K-INT(K/7)*7=0 THEN 290
243 IF J$="E" LET I=1:IF K-INT(K/7)*7=6 THEN 290
245 IF I=0 GOTO 228
250 IF K+I<14 THEN 290
255 IF K+I>62 THEN 290
260 G=G-1:IF I=-L LET F=3:GOTO 270
265 F=6
270 IF H>1 THEN 350
275 L=I:K=K+I:GOTO 200
290 BEEP 2:PAUSE"NO EXIT TO ":J$:GOTO 228
300 G=G+2:IF H=0 THEN 225
305 I=0:IF H>1 THEN 350
310 F=12:GOSUB 2
320 IF F<11 IF G<16 PAUSE"FAIRY TENDS YOUR WOUNDS":
   G=G+8:GOTO 225
330 IF F=11 PAUSE"FAIRY GIVES YOU":PAUSE"A MAGIC SWORD":
   G=G+18
340 GOTO 225
350 GOSUB 2:IF F<2 THEN 275
360 BEEP 3:PAUSE"HE SEES YOU":PAUSE"YOU MUST FIGHT":
   I=4:GOTO 410
400 I=0:IF H=0 THEN 225
410 F=2:GOSUB 2
415 IF EXP(LN(H*(F+1)))>I>G THEN 800
420 H=H*2
430 BEEP 4:PAUSE"YOU KILLED THE ".A$(H):A(K)=0:H=0
435 IF G>15 THEN 228
440 J$="":IF G<8 LET J$="BADLY "
445 PAUSE"BUT YOU ARE ".J$:INJURED:GOTO 228
600 BEEP 5:PAUSE"YOU FOUND THE TREASURE!":A(K)=0:H=0:
   A(64)=1:GOTO 228
700 BEEP 8:PAUSE"TASK DONE IN ".M:" DAYS"
710 PRINT"YOU MARRY THE PRINCESS!":STOP
800 BEEP 5:PRINT"YOU ARE KILLED!"

```

1107 STEPS

SOFTWARE FILE

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Search and destroy

C Stewart,
South Shields,
Tyne and Wear.

ZX-81

THIS SHORT machine-code routine produces a missile on line 18 on the display. It proceeds upwards searching for an alien as it goes. The missile leaves the display if no obstruction is found, or blots it out if an obstruction is found. The machine code is stored in a Rem in line 1 containing 75 bytes. After entering:

1 REM (75 Xs)

enter the hex loader in figure 2. Run the program in the fast mode and enter the codes given in figure 1. They can be entered individually — 2A Newline 0E Newline — or in batches of as many as you like — 2A 0E 40 06 Newline. To operate the routine the print position must be set to:

PRINT AT 18, A;

immediately before calling the routine, where A is the column you wish the missile to appear in. To increase speed, Poke 16549 — less than 255 — and for the missile character, Poke 16520 — code character — and Poke 16533 — code character.

Input the program in figure 3, which demonstrates the routine. Run the program and move using the 5 and 8 keys. Try missing the alien and then hitting it. Line 70 keeps the score and line 30 must be within the main loop. Line 0 on the display is left untouched by the missile for scores and titles, however more can be left by Poke 16518. The routine is ideal for invader-type games.

Figure 1.

Address	Hexadecimal
16514	2A 0E 40 06 11 36 05 0E 21
16523	2B 0D 20 FC 5E 1C 1D 20 22 36 05 0E
16535	21 23 0D 20 FC 36 00 0E 21
16544	2B 0D 20 FC 0E FE 0D 20 FD
16553	0E FE 0D 20 FD 10 D7 36 00 01 00 00
16565	C9 2B 2B 2B 0E 05 23 36 00
16574	0D 20 FA 0E 1F 23 0D 20 FC

36 00 01
0C 08 C9

Figure 2.

```

1 Rem [75 Xs]
10 Let A$=""
20 For X=16514 To 16588
30 If A$="" Then Input A$
40 Poke X,16xCode A$+Code A$(2)-476
50 Scroll
60 Print X;"(3 spaces)"; A$(To 2)
70 Let A$=A$(3 To)
80 Next X
    
```

Figure 3.

```

1 Rem [machine code]
5 Let score=0
10 Print At 4,6;"■■■"
20 Let A=10
30 Let L=0
40 Let A=A+(Inkey$="8" And A<29)-
(Inkey$="5" And A>2)
50 Print At 19,A-2;"□□□□"; At 18,A;
60 If Inkey$="0" Then Let L=Usr 16514
70 If L<>0 Then Let score=score+1
80 Goto 30
    
```

Space chase

Tahir Abbas,
Edinburgh.

SPECTRUM

IN THIS GAME for the 48K Spectrum, you shoot down 10 alien craft before they reach the safe zone. You are looking out of your cockpit window and have to line them up in your sights and fire your lasers. If they reach the safe zone then you have failed. The bottom of the screen displays time left and craft shot down.

To fly your ship use these keys:

Up 7
Down 6
Left 5
Right 8
Fire 0

This program uses three machine-code routines. The first of these copies the screen into another part of the memory. It acts as a kind of CLS but it recalls the saved screen only, clearing everything else on the screen.

Space Chase program construction.

10 TO 195--SCREEN CONSTRUCTION.
200 TO 202--LOAD DATA FOR SOUND AND SCREEN ROUTINES.
300 TO 305--VARIABLES.
500 TO 560--PRINT ALIEN CRAFT & MOVEMENT OF YOUR CRAFT.
605 TO 700--FIRE LASER.
800 TO 860--EXPLOSION & SOUNDS.
905 TO 980--PRINT STARS.

1000 TO 9020--END OF GAME ROUTINE & DATA.

Space Chase graphics.

◆----ABCD LINES 505 & 605
:----E. CHR# 148
●----F. LINE 965
●----G. LINE 967

Register HL holds the location where the copy starts. Register DE holds location where screen is moved to. Register BC holds the amount of bytes to be transferred. LDir carries out the task of moving the block of memory.

The next machine-code routine enhances the Spectrum's sounds. It uses the Spectrum's sound routine in the ROM. Register DE holds duration of the note; register HL holds pitch of the note; and register B controls the loop.

The final machine-code routine prints out the

explosion. The data for the explosion is held in location 40051 onwards. All the machine-code routines are held in Data statements within the program. So there is no need to load them separately in the Spectrum. The sound routine used in this program was developed from the sound routine printed in November's *Your Computer*.

Once you have mastered the game as it stands, you can make it more difficult by reducing the time variable "ti" in line 300.

```

1 REM *****SPACE CHASE*****
2 REM WRITTEN BY TAHIR ABBAS.
3 REM FOR THE
4 REM 48K SPECTRUM.
5 REM SCREEN CONSTRUCTION.
10 REM
11 INVERSE 0: OVER 0: BRIGHT 0
: BORDER 3: PAPER 0: INK 9: CLS
20 INK 6: PLOT 112,64: DRAW 0,
15,-PI: DRAW 15,0: DRAW 0,15: DR
AW 1,0: DRAW 0,-15: DRAW 15,0: D
RAW 0,-15,-PI: DRAW -15,0
30 DRAW 0,-15: DRAW -1,0: DRAW
0,15: DRAW -15,0
40 PLOT 105,92: DRAW -15,0: DR
AW 0,-1: DRAW 15,0: PLOT 151,92:
DRAW 15,0: DRAW 0,-1: DRAW -15,
0
50 INK 7
70 PLOT 30,0: DRAW 15,15: DRAW
1,0: DRAW 5,5: DRAW 1,0: DRAW -
5,-5: DRAW 1,0
80 DRAW -5,-5: DRAW 20,-10
90 PLOT 225,0: DRAW -15,15: DR
AW -1,0: DRAW -5,5: DRAW -1,0: D
RAW 5,-5: DRAW -1,0: DRAW 5,-5
100 DRAW -20,-10
105 REM
106 REM COPY SCREEN
110 FOR f=40000 TO 40050: READ
a: POKE f,a: NEXT f
120 DATA 33,0,64,17,80,195,1,19
2,26,237,176,201,33,80,195,17,0,
64,1,192,26,237,176,201,0,0,17,1
0,0,33,10,0,6,10,197,213,229,205
    
```

(continued on page 135)

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SOFTWARE FILE

(continued from page 133)

```

181,3,1,100,0,225,237,74,209,19
3,16,240,201
130 PRINT INK 4; AT 21,10; "TIME=
140 PLOT 75,0: DRAW 0,9: DRAW 7
6,0: DRAW 0,-9: PLOT 170,0: DRAW
0,9: DRAW -18,0
195 LET L=USR 40000
196 RESTORE 8500
197 REM
198 REM USR GRAPHICS
200 FOR g=144 TO 150: FOR f=0 T
O 7: READ a: POKE USR CHR$ g+f,a
: NEXT f: NEXT g
202 FOR f=40051 TO 40169: READ
a: POKE f,a: NEXT f
210 POKE 40027,10: POKE 40033,1
0: POKE 40041,100
230 LET L=USR 40012: PAUSE 30
300 LET ti=500: LET sh=10
305 LET x=INT (RND*15): LET y=I
NT (RND*27)
310 GO SUB 500
330 GO TO 900
500 PRINT AT x,y;"███"
505 PRINT AT 21,15;ti: LET ti=t
i-1
510 LET x=x+INT (RND*3)-1+(INKE
Y$="7")-(INKEY$="6")
520 LET x=x+2*((x<0)-(x>16))
530 LET y=y+INT (RND*3)-1+(INKE
Y$="5")-(INKEY$="6")
540 LET y=y+2*((y<0)-(y>28))
550 LET L=USR 40012
560 RETURN
600 REM
605 PRINT AT x,y;"███"
610 INK 3: PLOT 54,22: DRAW 72,
67: PLOT 201,22: DRAW -72,67: LE
T L=USR 40026: INK 7
620 IF POINT (128,90)=1 THEN GO
TO 800
660 GO SUB 500
700 RETURN
800 REM
801 LET L=USR 40012
803 PRINT AT 21,15;ti
804 POKE 40027,5: POKE 40033,20
: POKE 40041,30
805 FOR f=1 TO 2: LET L=USR 400
26: POKE 40033,60: NEXT f
806 PRINT AT 0,0:
810 POKE 40027,1: POKE 40033,1:
POKE 40041,0: POKE 40159,0
815 POKE 40150,INT (RND*2)+148
820 PRINT : LET L=USR 40135
825 POKE 40150,32
830 POKE 40027,1: POKE 40033,1:
POKE 40041,0: POKE 40159,12
832 PRINT : LET L=USR 40135
834 LET L=USR 40012
835 POKE 40027,10: POKE 40033,5
: POKE 40041,250: FOR f=1 TO 10:
LET L=USR 40026: NEXT f
845 POKE 40027,10: POKE 40033,1
0: POKE 40041,100
850 LET sh=sh-1: PRINT AT 21,20
;sh: IF sh=0 THEN GO TO 2400
860 FOR F=1 TO 20: NEXT F: GO T
O 305
905 LET v=INT (RND*4)+1
910 IF ti<23 THEN GO TO 1000
920 RESTORE 7000+v
930 LET a$=""
940 FOR f=1 TO 6
950 GO SUB 500
960 READ j,k
965 IF j<6 OR j>11 THEN LET a$=""
967 IF j<4 OR j>15 THEN LET a$=""
970 PRINT BRIGHT 1; AT j,k;a$
975 IF INKEY$="0" THEN GO SUB 6
00
980 NEXT f

```

```

990 GO TO 905
1000 LET z=85: LET g=85: LET l1=
85: LET l2=5
1010 PLOT z,g: DRAW l1,0: DRAW 0
,l2: DRAW -l1,0: DRAW 0,-l2
1020 GO SUB 500
1030 LET z=z-5: LET g=g-5: LET l
1=l1+10: LET l2=l2+10: IF z=0 TH
EN GO TO 2000
1050 GO TO 1010
2000 POKE 40027,10: POKE 40033,1
0: POKE 40041,100: LET L=USR 400
12: FOR f=1 TO 20: LET L=USR 400
26: NEXT f: FOR f=1 TO 100: NEXT
f: CLS
2005 LET TI=0
2010 BORDER 2: PAPER 3: INK 9: C
LS: PRINT : PRINT "YOU
HAVE FAILED IN YOUR MISSION."';
sh;" ENEMY CRAFTS REACHED THE SA
FE"."ZONE."
2015 GO SUB 2700
2020 INPUT "DO YOU WISH TO PLAY
AGAIN? (y/n)";A$
2030 IF a$="y" OR a$="Y" THEN BO
RDER 3: PAPER 0: INK 9: CLS: PA
USE 50: RUN 205
2040 PRINT "THANK YOU FOR PLAY
ING." : STOP
2410 POKE 40027,5: POKE 40033,20
: POKE 40041,200: LET L=USR 4001
2
2420 FOR F=1 TO 5: LET L=USR 400
26: NEXT F
2500 PAUSE 100: INK 1: BORDER 4:
PAPER 6: CLS: PRINT AT 0,0;"UE
LL DONE"'"YOU HAVE COMPLETED YO
UR MISSION SUCCESSFULLY."
2510 PRINT "ALL 10 ENEMY CRAFT
ARE DESTROYED"
2520 GO SUB 2700
2600 GO TO 2020
2700 PRINT "YOUR SCORE IS ";TI
*10+((10-SH)*10): RETURN
7001 DATA 10,15,9,14,8,13,7,11,4
,6,0,0
7002 DATA 10,16,9,17,8,18,7,20,4
,25,0,31
7003 DATA 10,15,11,14,12,13,13,1
1,16,6,21,0
7004 DATA 10,16,11,17,12,18,13,2
0,16,25,21,31
8000 DATA 0,24,60,63,63,63,60,24
,17,35,71,141,255,255,127,9,136,
196,226,177,255,255,254,144,0,24
,60,252,252,252,60,24
8620 DATA 0,BIN 10000000,0,BIN 0
000010,0,BIN 01000000,0,BIN 000
01000
8630 DATA 0,0,56,124,124,124,56,
0,60,126,255,255,255,255,126,60
9000 DATA 10,15,10,16,8,17,12,14
,12,17,6,14,12,16,8,13,8,18,12,1
3,9,12,11,19,11,12,9,19,7,13,13,
18,7,18,13,13,13,12,7,19,13,19,7
,12,6,14,14,17,6,17,14,14,12,11,
8,20
9010 DATA 8,11,12,20,14,15,6,16,
14,16,6,15,9,21,11,10,11,21,9,10
,10,22,10,9,15,16,5,16
9020 DATA 33,115,156,6,42,62,22,
215,126,215,35,126,215,35,62,32,
215,197,229,205,90,156,33,232,4,
43,124,181,32,251,225,193,16,227
,201

```

Sound enhancer.

Screen copy.

```

40000 LD HL,16384
40003 LD DE,50000
40006 LD BC,6335
40009 LDIR
40011 RET
40012 LD HL,50000
40015 LD DE,16384
40018 LD BC,6335
40021 LDIR
40023 RET

```

```

40026 LD DE,5
40029 LD HL,10
40032 LD B,20
40034 PUSH BC
40035 PUSH DE
40036 PUSH HL
40037 CALL 949
40040 LD BC,200
40043 POP HL
40044 ADC HL,BC
40046 POP DE
40047 POP BC
40048 DJNZ 40034
40050 RET

```

Dream machine

Tim Goldingham,
Maidenhead,
Berkshire.

DRAGON

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It is strongly recommended that you run the program a few times without attempting to understand how it works; if possible, have a friend key it in for you.

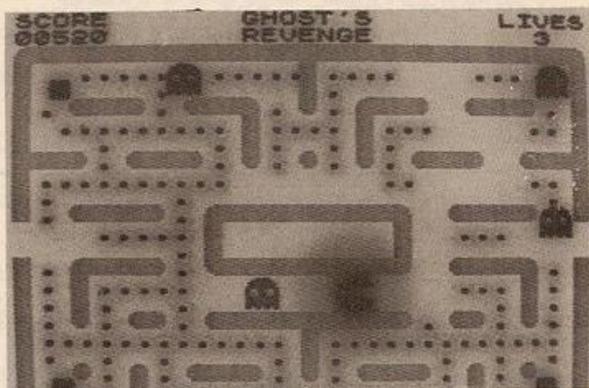
The program is based on a party game, in which one of the players who does not know the rules is sent out of the room. The other players ostensibly concoct a dream; but in fact the simple rule is that they answer "Yes" to any question ending in a vowel, while questions ending in a consonant get a "No" response. Y is treated as ambivalent.

This simple algorithm has some limitations. In practice, very few words end in vowels other than "e"; and the game is inclined to get stuck

(continued on page 137)

ZX SPECTRUM

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SOFTWARE FILE

(continued from page 135)

if the questioner ends most of his questions with "me". The computer program overcomes these limitations by selecting five letters at random at the beginning of each run. If a question ends in any of the selected letters, it is given one of a choice of affirmative answers, picked at random. Similarly, a further three letters are selected which produce "maybe" answers. Even when you know the rules you will still find the game addictive, because you do not know what choice of letters has been made for the current run.

To increase the variety of responses, questions beginning "Had I", "Did I" are answered "Yes, you had" or "No, you didn't"; sometimes the remainder of the question is repeated, sometimes not.

Looking at the program in more detail, lines 80 to 150 produce a suitably scientific-looking

"brain scan": any similar graphics pattern could be substituted, or this section omitted.

As there are some letters which very rarely end a word, line 200 lists those from which the selection will be made. Lines 210 to 280 then set up two variables, C\$ and D\$, containing respectively five and three letters. The Instr function is used to ensure that no letter is selected twice. Any question ending in a letter that appears in C\$ will receive a "yes" answer, while the three letters in D\$ will produce a "maybe".

The question is read at line 300, and stripped of its question mark by line 340. Also, line 360 removes a final "s", so that a succession of plurals does not produce the same answer. The last letter of the question is then compared with C\$ and D\$, by lines 380 and 390.

Responses are selected at random from the appropriate set. Lines 600-630 and 710-740

transpose pronouns and auxiliary verbs. Notice line 760, which prevents the question "Was I with my aunt?" from receiving the answer "Yes, you were with my aunt".

To introduce some variety, questions are counted by line 330, and the first "No" answer after 25 questions prompts the possibly misleading response "Haven't you forgotten something?"

If you want a recap, an asterisk will print all the questions that received the answer "yes" — lines 810-850. Finally, if you must cheat, a hash sign will show you which letters are currently being used to make the selection — line 320.

You can experiment with variations of the program by altering the letters from which the selection is made — line 200; by adding extra responses; or by altering the probability of any particular one being selected — lines 420 and 470.

```

10 'THE DREAM MACHINE
20 'COPYRIGHT T P GOLDINGHAM 1982
30 CLEAR 2000
40 DIM A$(300)
50 CLS:PRINT"THE COMPUTER WILL MONITOR YOUR UNCONSCIOUS MIND. HOLD THE LEAD TO
THE TELEVISION SET, AND RELAX COMPLETELY."
60 PRINT:PRINT"PRESS THE SPACE BAR WHEN YOU ARE READY."
70 IF INKEY$(*)=" " THEN 70
80 'chart
90 PHODE 4,1:SCREEN 1,0:PBLS
100 N=4
110 FOR J=0 TO 252 STEP N
120 R=RND(96):X=J+N:Y=115-R
130 LINE(J,70)-(X,Y),PSET: SOUND R,1:LINE(X,Y)-(J+N,70),PSET
140 NEXT J
150 SCREEN 0
160 'set parameters
170 CLS:PRINT"THE COMPUTER HAS NOW STORED THE DREAM YOU HAD LAST NIGHT. YOUR C
ONSCIOUS MIND IS NOT AWARE OF THIS: YOU HAVE TO GUESS IT BY A SERIES OF YES/NO
QUESTIONS."
180 PRINT:PRINT"PRESS THE SPACE BAR TO START."
190 IF INKEY$(*)=" " THEN 190
200 A$="ADDEGHKLNOPTW"
210 FOR J=1 TO 5
220 B$=MID$(A$,RND(LEN(A$)),1):IF INSTR(1,C$,B$)=0 THEN 220
230 C$=C$+B$
240 NEXT J
250 FOR J=1 TO 3
260 B$=MID$(A$,RND(LEN(A$)),1):IF INSTR(1,D$,B$)=0 THEN 260
270 D$=D$+B$
280 NEXT J
290 CLS
300 LINE INPUT Z$:IF LEN(Z$)=1 THEN 300
310 IF Z$="+" THEN 810
320 IF Z$="*" THEN PRINT:PRINT"yes *C$, maybe *D$:PRINT:PRINT:GOTO 300
330 B#=#
340 X=ASC(RIGHT$(Z$,1)):IF X(65 THEN Z$=LEFT$(Z$,LEN(Z$)-1):GOTO 340
350 E#=#
360 IF K=93 THEN Z$=LEFT$(Z$,LEN(Z$)-1)
370 F#=#RIGHT$(Z$,1)
380 IF INSTR(1,C$,F#)=0 THEN 450:'yes
390 IF INSTR(1,D$,F#)=0 THEN 500:'maybe
400 'no
410 R=RND(5)
420 PRINT":::DN R GOSUB 560,570,580,590,610,610,610,610
430 GOTO 300
440 'yes
450 R=RND(5)
460 A$(A)=E#A+A+1
470 PRINT":::DN R GOSUB 560,570,580,590,700,710,710,710
480 GOTO 300
490 'maybe
500 R=RND(5)
510 IF R(4) THEN PRINT" WELL, MAYBE"
520 IF R(3) AND R(7) THEN PRINT" YOU COULD SAY THAT"
530 IF R(6) THEN PRINT" I SUPPOSE SO"
540 GOTO 300
550 'messages - no
560 PRINT"NO":IF B)25 THEN PRINT"HAVEN'T YOU FORGOTTEN SOMETHING?":B=-50:RETURN
ELSE RETURN
570 PRINT"DEFINITELY NOT":RETURN
580 PRINT"CERTAINLY NOT":RETURN
590 PRINT"NOT REALLY":RETURN
600 IF LEFT$(Z$,6)="DID I" THEN PRINT"NO, YOU DIDN'T":GOSUB 760:RETURN
610 IF LEFT$(Z$,6)="HAD I" THEN PRINT"NO, YOU HADN'T":GOSUB 760:RETURN
620 IF LEFT$(Z$,6)="WAS I" THEN PRINT"NO, YOU WEREN'T":GOSUB 760:RETURN
630 IF LEFT$(Z$,7)="WAS IT" THEN PRINT"NO, IT WASN'T":GOSUB 760:RETURN
640 GOTO 560
650 'messages - yes
660 PRINT"YES":RETURN
670 PRINT"THAT'S RIGHT":RETURN
680 PRINT"CORRECT":RETURN
690 PRINT"YOU'RE GETTING WARMER!":RETURN
700 PRINT"THAT'S IT":RETURN
710 IF LEFT$(Z$,6)="DID I" THEN PRINT"YES, YOU DID":GOSUB 760:RETURN
720 IF LEFT$(Z$,6)="HAD I" THEN PRINT"YES, YOU HAD":GOSUB 760:RETURN
730 IF LEFT$(Z$,6)="WAS I" THEN PRINT"YES, YOU WERE":GOSUB 760:RETURN
740 IF LEFT$(Z$,7)="WAS IT" THEN PRINT"YES, IT WAS":GOSUB 760:RETURN
750 GOTO 560
760 IF AND(S)1 AND INSTR(1,Z$,"MY")=0 THEN PRINT MID$(Z$,6) ELSE PRINT
770 RETURN
780 IF AND(S)1 THEN PRINT MID$(Z$,7) ELSE PRINT
790 RETURN
800 'print summary
810 FOR J=0 TO A
820 G#=#LEFT$(A$(J),5)
830 IF G#="DID I" OR G#="HAD I" OR G#="WAS I" THEN A$(J)=MID$(A$(J),7)
840 PRINT A$(J)
850 NEXT J
860 GOTO 300

```

Option

Peter Lewis,
Widnes,
Cheshire.

VIC-20

WHEN PROGRAMMING the sound registers on the Vic, there are only two ways to cut out the sound. The first is to Restore the computer, however this also clears the screen. The other alternative is to re-Poke all the registers.

This program introduces a third option. It allows the user to control the volume of sound by using the function keys. The program is called up 60 times a second by using the IRQ routine.

It is initiated by the command SYS 673 and can be switched off by restoring the Vic.

```

5 I=673
10 READ A
20 IFA= 999 THEN END
22 POKEI,A
24 I=I+1
26 GOTO 10
30 DATA 169,173,141,20,03,169,02,141,21,03,96,234
40 DATA 32,184,02,32,205,02,76,191,234,234,234
50 DATA 165,197,201,39,240,01,96,173,14,144
60 DATA 201,00,208,01,96,206,14,144,96,234,234
70 DATA 165,197,201,47,240,01,96,173,14,144
80 DATA 201,15,208,01,96,238,14,144,96
90 DATA 999
100 REM *** SYS673 TO START ***
110 REM *** RESTORE TO END ***

```

Lawn mower

Shingo Sugiura,
Putney,
London.

BBC

HAVING FAILED all your O-levels you could only get a job as a lawn mower, but the garden is not as calm as it seems. There are explosive

cricket balls which you must not run over and rocks which will blow you up if touched. On top of this if your oil runs out, you will be vaporised.

When you first run this game you will be greeted by a short instruction. Then you are asked to input your speed, level and the loudness. After this the game starts with a short burst of music. You must guide the mower

around the garden whilst avoiding the cricket balls and the rocks and gobbling up the oil cans, but this is not all. If you mow over an area already mowed, your oil will decrease but your score will stay the same. So the trick is to avoid areas that you have mowed.

All this furious action is accompanied by music in the background and a constant update

(continued on next page)

SOFTWARE FILE

(continued from previous page)

of the score and high score.

If you want to change the speed, level or loudness simply press Escape. This will start the program again without clearing the high score.

Lines 10 to 280, main program; lines 290 to 450, initialising procedure; lines 460 to 490,

introduction music; lines 500, 510, data for introduction music; lines 520 to 540, delay procedure; lines 550 to 650 set up the screen; lines 660 to 730, obstacles procedure; lines 740 to 790 print the oil cans; lines 800 to 850 print the mower; lines 860 to 900 check the colour in front of the mower; lines 910 to 940 print the readouts; lines 950 to 1010, ending procedure;

lines 1020 to 1060 go on to next screen procedure; lines 1070 to 1090, music at each new screen; line 1100, data for the music at the end of the screen; lines 1110 to 1180, music during the game; lines 1190 to 1390, instructions.

When typing the program in leave out line 10 and put it in after the program is running.

```

10 ON ERROR GOTO 38
20 hi%=@screen%1
30 MODE1:PROCinit:PROCinst
40 live=2
50 score=@screen%1
60 VDU23,10,32,0,0,0,17,130,12
70 PROCwall:PROCobst:PROCcans:PROCintro
80 PROCinit
90 REPEAT
100 PROCprint_mower
110 PROCwait(wait%)
120 PROCdisplay
130 PROCmusic
140 IF INKEY(-98)=-1 THEN R#="LEFT"
150 IF INKEY(-67)=-1 THEN R#="RIGHT"
160 IF INKEY(-73)=-1 THEN R#="UP"
170 IF INKEY(-105)=-1 THEN R#="DOWN"
180 VDU17,3,31,x%,y%,223
190 IF R#="LEFT" THEN x%=x%-1
200 IF R#="RIGHT" THEN x%=x%+1
210 IF R#="UP" THEN y%=y%-1
220 IF R#="DOWN" THEN y%=y%+1
230 VDU26,col%*POINT(x%*32+16,(31-y%)*32+16):IF col%<2 THEN PROCcheck
240 score=score+0.1:oil=oil-0.1:IF score>51:screen% THEN PROCupdate
250 IF oil<=3 THEN SOUND3,2,1:1 ELSE SOUND4,15,-0,0,0
260 IF oil<=0 THEN PROCend
270 UNTIL FALSE
280
290 *****
290 DEFPROCinit
300 RESTORE 1150
310 R#="RIGHT":x%=15:y%=15:oil=40
320 ENVELOPE1,1,6,6,6,255,255,255,126,-1,0,-10,126,80
330 ENVELOPE2,4,6,-3,-3,4,2,0,0,0,-1,0,63,58
340 VDU23,224,255,255,255,255,255,255,255,255
350 VDU23,225,126,129,255,129,126,24,24,60
360 VDU23,226,60,24,24,126,129,255,129,126
370 VDU23,227,112,168,169,175,175,169,168,112
380 VDU23,228,14,21,149,245,245,149,21,14
390 VDU23,229,60,126,255,255,255,126,60
400 VDU23,230,0,0,26,62,124,254,255,127
410 VDU23,231,24,24,24,255,126,126,126
420 VDU23,232,73,42,8,99,8,42,73,8
430 VDU23,233,238,219,179,153,245,158,109,170
440 VDU19,2,2,0,19,3,3,0
450 ENDPROC
460 DEFPROCintro:RESTORE 500
470 FOR music=1 TO 18:READ Pitch,duration:SOUND1,-(loudness%),Pitch,duration:
EXT music
480 PRINTTAB(16,15)," " PROCwait(3000)
490 ENDPROC
500 DATA101,5,121,3,137,5,121,2,129,2,121,4,117,3
510 DATA101,5,121,3,137,5,121,2,129,2,121,2,129,2,121,4,117,3
520 DEFPROCwait(T%)
530 FOR delay=1 TO T:NEXT delay%
540 ENDPROC
550 DEFPROCwall
560 VDU17,1,31,2,30:PRINT"OIL ",TAB(2,31)"SCORE "
570 PRINTTAB(15,30),"MOWERS LEFT ",live:TAB(30,31)"SCREEN ",screen%
580 PRINTTAB(15,31),"HI-SCORE ",TAB(15,0)"<<MOWER>>"
590 FOR wall=1 TO 38
600 VDU31,wall,1,224,31,wall,28,224
610 NEXT wall
620 FOR wall=1 TO 28
630 VDU31,1,wall,224,31,38,wall,224
640 NEXT wall
650 ENDPROC
660 DEFPROCobst:COLOUR1
670 FOR obst=1 TO screen%+4
680 VDU31,RND(34)+1,RND(26)+1,225
690 VDU31,RND(34)+1,RND(26)+1,230
700 IF loudness%>0 THEN SOUND8,-15,6,1
710 PROCwait(100)
720 NEXT obst
730 ENDPROC
740 DEFPROCcans:COLOUR8
750 FOR cans=1 TO level%:VDU31,RND(34)+1,RND(26)+1,231
760 IF loudness%>0 SOUND2,1,1,1
770 PROCwait(700):NEXT cans
780 VDU17,0,31,15,15,228,17,3,31,16,15:PRINT"READY!" PROCwait(800)
790 ENDPROC
800 DEFPROCprint_mower
810 IF R#="RIGHT" THEN VDU17,0,31,x%,y%,228
820 IF R#="LEFT" THEN VDU17,0,31,x%,y%,227
830 IF R#="UP" THEN VDU17,0,31,x%,y%,225
840 IF R#="DOWN" THEN VDU17,0,31,x%,y%,226
850 ENDPROC
860 DEFPROCcheck
870 IF col%=0:oil=oil+2:IF loudness%>0 SOUND2,1,1,1
880 IF col%=3 THEN score=score-.1
890 IF col%=1 THEN PROCend
900 ENDPROC
910 DEFPROCdisplay:COLOUR1
920 IF score>hi% THEN hi%=score
930 PRINT TAB(8,30)INT(col%); "TAB(9,31);INT(score);TAB(24,31)hi%
940 ENDPROC
950 DEFPROCend SOUND0,1,1,1
960 SOUND8,11,-0,0,0:SOUND13,-0,0,0:VDU17,0,31,x%,y%,232:PROCwait(3000)
970 live=live-1:IF live=0 THEN 60:ENDPROC
980 score=@screen%+15:0
990 VDU17,0,30:PRINT"DEAD!" PRINT"Press SPACE BAR to play again!"
1000 REPEAT UNTIL GET=32:GOTO40
1010 ENDPROC
1020 DEFPROCupdate
1030 SOUND11,-0,0,0
1040 PROCprint_mower:VDU17,0,31,11,14
1050 PRINT"SCREEN ",screen%;" COMPLETED!" PROCnewscreen
1060 PROCwait(5000):screen%=screen%+1:GOTO60:ENDPROC
1070 DEFPROCnewscreen:RESTORE1100
1080 FOR music=1 TO 6:READ Pitch,duration:SOUND1,-(loudness%),Pitch,duration
1090 NEXT music:ENDPROC
1100 DATA1,3,101,3,117,3,129,5,117,3,129,5
1110 DEFPROCmusic:IF R#<=-6:1 THEN ENDPROC
1120 READ Pitch,duration:IF Pitch=0 THEN volume=0 ELSE volume=-(loudness%)
1130 IF duration%>999 THEN RESTORE 1150:ENDPROC
1140 SOUND1,volume,Pitch,duration:ENDPROC
1150 DATA 101,5,121,5,0,0,121,5,117,3,109,2,117,4,121,5,101,4,0,1,101,4,0,1
1160 DATA 101,4,121,5,0,0,121,5,117,2,109,2,117,4,121,5,101,4,0,1,101,4,0,1
1170 DATA 101,4,89,5,0,0,89,5,81,5,0,0,81,5,73,6,0,7,101,5,89,5,0,0,89,5
1180 DATA 81,5,0,0,81,5,73,6,0,10,999,999
1190 DEFPROCinst
1200 VDU17,1,31,15,0,225:PRINT" MOWER ",CHR#225
1210 VDU17,2,31,10,3,231:PRINT" By Shingo Sugisawa ",CHR#231:COLOUR3
1220 PRINT"" Having failed all your '0' levels your only job was as a lawn mower of a rather Peculiar Garden..."
1230 PRINT"" There are many hazards to this job. For instance there are explosive cricketballs which you must obviously avoid and there are rocks which would blow you up if touched. On top of this your mower oil is limited."
1240 COLOUR2:PRINT"" To change levels Press ESCAPE."
1250 COLOUR1:PRINT"" Press SPACE BAR to continue!" REPEAT UNTIL GET=32:CLG
1260 VDU17,130,12,17,1,31,15,0:PRINT"CHARACTERS"
1270 VDU17,1,31,5,3,224:PRINT"-----Wall...."
1280 VDU17,0,31,5,5,228:PRINT"-----You...."
1290 VDU17,1,31,5,7,229:PRINT" -Explosive cricket ball...."
1300 VDU31,5,9,230:PRINT"-----Rock...."
1310 VDU17,0,31,5,11,231:PRINT"-----Oil can...."
1320 COLOUR1:PRINT"" CONTROLS-"
1330 PRINT"" 2 -----LEFT," PRINT" X -----RIGHT,"
1340 PRINT"" -----UP," PRINT" -----DOWN,"
1350 COLOUR8:PRINT"" Input speed (FAST) to 9(SLOW) ):REPEAT:INSTR("123456789")GET%:UNTIL%:PRINT:IN%:wait%:1:410
1360 PRINT"" Input level (HARD) to 5(EASY) ):REPEAT:INSTR("12345")GET%:UNTIL%:PRINT:IN%:level%:1:4+3
1370 PRINT"" Input loudness (SILENT) to 9(LOUD) ):REPEAT:INSTR("0123456789")GET%:UNTIL%:PRINT:IN%:loudness%:1:4+1
1380 PRINT"" Press SPACE BAR to play again!" REPEAT UNTIL GET=32
1390 ENDPROC

```

On the grid

Stephen Vine,
Redhill,
Surrey.

VIC-20

THIS PROGRAM for the Vic-20 plus a printer will create those puzzles in which a set of words are hidden in a grid of letters. All you have to do is to think of the actual words you want to be hidden, enter them and the program will randomly orientate them for someone to find.

Those of you who have no extra memory will have difficulties. It is possible to work the program but with these few changes: lines 310 to 360 should be left out. This is the alpha sort and is not essential. Also you will have to do away with the display and use up the screen RAM; do this by:

```

POKE 56,32
POKE 55,0
CLR
POKE 648,32 (return) (run/stop-restore)

```

Do this after entering and saving the program. After that you will not be able to see (continued on page 141)

```

10 INPUT"SIZE OF GRID":X,Y:DIMG$(X,Y)
20 INPUT"NUMBER OF WORDS":N:DIMW$(N+INT(N/3+1)):GOSUB600
30 DEFFNR(R)=INT(RND(1)*R)+1
35 FOR I=1 TO 8:READX(I),Y(I):NEXT
40 FOR I=1 TO N
50 W=LEN(W$(I)):R=0
60 GX=FNR(X):PX=GK
70 GY=FNR(Y):PY=GV
80 DR=FNR(8):XD=X(DR)
90 YD=Y(DR)
100 FOR J=1 TO W
110 IF G$(PX,PY)<>MID$(W$(I),J,1):AND G$(PX,PY)<>" THEN 200
120 PX=PX+XD:PY=PY+YD:IF PX<1 OR PX>X OR PY<1 OR PY>Y THEN 200
130 NEXT
140 FOR J=1 TO W
150 G$(GX,GY)=MID$(W$(I),J,1):GX=GX+XD:GY=GY+YD:NEXT
160 NEXT I:GOTO300
200 R=R+1:IF R>N THEN 250
210 GOTO60
250 POKE36878,15:POKE36876,220:POKE36879,26
260 POKE162,0:WAIT162,64:POKE36878,0
270 PRINT"NOT ABLE TO FIT IN "W$(I)" PLEASE ENTER
280 PRINT"ANOTHER (TRY A SHORTER ONE)."
290 INPUT"WORD":W$(I):POKE36879,27:GOTO50
300 REM
310 T=0
320 FOR I=1 TO N-1
330 IF W$(I)<W$(I+1):GOTO350
340 W$(I)=W$(I+1):W$(I+1)=W$(I):T=1
350 NEXT
360 IFT=1 THEN 310
370 TB$=CHR$(16)
380 CN=(80-2*W-2)/2:CN$=TB$+MID$(STR$(CN),2)
381 GR$=CHR$(8):TX$=CHR$(15):CR=CN+2*W
382 CR$=TB$+MID$(STR$(CR),2)

```

(listing continued on page 141)

A totally portable computer that runs on its own power supply for use anywhere.



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Drive through a giant maze, 9 times the size of the screen, picking up points as you go - but watch out for the other cars, rocks oil and ice. Superb machine code game. Highly recommended.

SPECTRUM 48K £4.95
ZX81 16K £3.95

KRAZY KONG

All machine code version of the popular arcade game. This program has all the features of the original and is every bit as fast. 3 different screens make it difficult to beat.

ZX81 16K £3.95

HOPPER

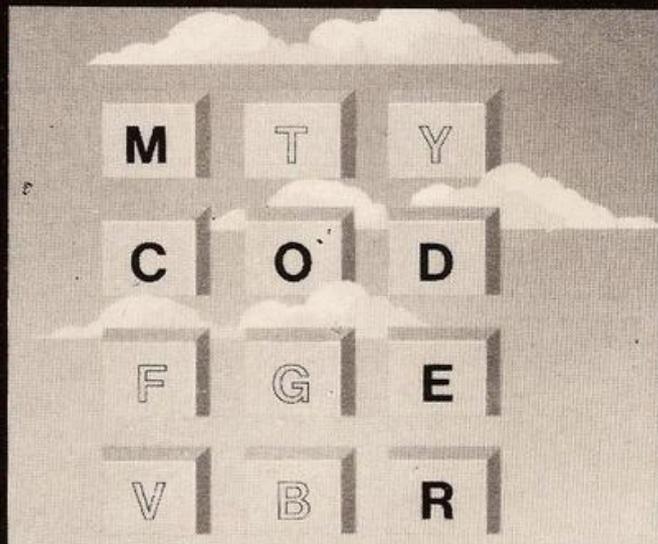
Entirely written in machine code. This excellent version of the arcade game is very addictive. See if you can get the frogs back to the lilly pond. (Available end of February 1983).

ZX81 16K £3.95

PSS makes Machine Code Redundant!

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WE ALSO GUARANTEE TO MARKET THE TWO WINNING PROGRAMS UNDER A ROYALTY AGREEMENT WITH THE AUTHOR. *CLOSING DATE 31st MAY. RESULTS WILL BE PUBLISHED IN SINCLAIR USER MAGAZINE. ENTRY FORM ENCLOSED WITH EVERY COPY OF MCODER.

SOFTWARE FILE

(continued from page 138)

what you are typing so go slowly. Now type Run and Return. Now you have to input the size of the grid — the number of letters in X and Y directions, try 18,18 and press Return.

Next you are asked for the number of words: 20 is a reasonable amount. Then you type in the words, be careful if you have no screen. You will have to wait a while as it fits them in, if the screen border goes red it wants you to enter a different, preferably shorter, word. When it wants another input this will be the title. After typing that it prints the solution plus the puzzle and list of words. Press Y for another copy of the puzzle or press N for entering a different one.

Those with expansion fitted will have no difficulties. The printer used was the Seikosha OP-100VC.

(listing continued from page 138)

```

385 OPEN3,4
387 INPUT"TITLE";TL$
388 CT=INT(40-LEN(TL$)):CT#="TB#"+MID*(STR$(CT),2)
389 PRINT#3,CHR$(14)"SOLUTION:";PRINT#3
390 FORJ=1TOY:FORI=1TOX:IFG$(I,J)=" "THENPRINT#3," ";
395 PRINT#3,G$(I,J);NEXT:PRINT#3:NEXT:PRINT#3:PRINT#3:PRINT#3
400 PRINT#3,CHR$(14)CT#TL$;PRINT#3,FX#
410 FORI=1TOX:FORJ=1TOY:IFG$(I,J)=" "THENG$(I,J)=CHR$(FNR(26)+64)
420 NEXTJ,I
425 PRINT#3,CN#"/";:FORK=2TO2#X:PRINT#3,"-";:NEXT:PRINT#3,"^"OR#
430 FORJ=1TOY:PRINT#3,FX#CN#"/";:FORI=1TOX-1
440 PRINT#3,G$(I,J);:NEXT:PRINT#3,G$(X,J)"|OR#";PRINT#3,FX#CN#"/";OR#";|OR#";NE
XT
441 PRINT#3,FX#CN#"/";:FORK=2TO2#X:PRINT#3,"-";:NEXT:PRINT#3,"^"
445 C1#="CHR$(16)+"25":C2#="CHR$(16)+"50"
446 PRINT#3:PRINT#3:PRINT#3,FX#
447 AB=INT(N/3+.5)+1
450 FORI=1TOAB:PRINT#3,W$(I)C1#W$(I+AB)C2#W$(I+AB#2):NEXT:PRINT#3:CLOSE3
460 PRINT"ANOTHER COPY (Y/N)";POKE198,0
470 GETA#;IFA#<"Y"ANDR#<"N"THEN470
480 IFA#="Y"THENOPEN3,4:PRINT#3:GOTO400
490 RUN
500 DATA1,0,1,1,0,1,-1,1,-1,0,-1,-1,0,-1,1,-1
600 FORI=1TON
610 INPUTW#;IFW#="CHR$(13)THEN610
620 W$(I)=W#;NEXT:RETURN
    
```

Drumbeat

David Squires,
St Andrews,
Fife.



THIS SHORT program, written for either version of the ZX Spectrum, expands the idea of machine-code sound effects to produce a rhythm generator.

It is deliberately not too long or elaborate as this would mean losing some of the speed so essential to the program. The program itself suffers from the Spectrum's usual lack of

volume but even without headphones or amplification, some fairly impressive rhythms can be produced.

You have two instruments at your command; the bass drum and side-drum with snare. When the program is run, it asks you for first the length of the note of the bass drum, then the length of the note of the snare drum. It then asks you for the number of bars the rhythm is to be played and finally the rhythm the machine is to play each bar. This is fed into the computer as a string of letters, with B for a note on the bass drum and S for a note on the snare

drum. The other letter that can be input is P, for pause. Two or more can be written for longer pauses. Therefore BBSSPPSBBP would be read as two notes on the bass, then two on the snare, a short pause, another on the snare, two more on the bass and finally a very short pause.

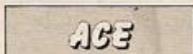
Incidentally, if you are using headphones or amplification, the Mic socket gives a more faithful reproduction of the sound you hear from the Spectrum's own speaker but the Ear socket gives a sharper, louder, more percussive sound.

```

10 REM ***Rhythm Generator***
20 REM *For 16/48k ZX Spectrum*
30 GO TO 60
40 POKE 32505,(lb*t)/2:POKE 3
2507,1:LET c=USR 32500:RETURN
50 POKE 32505,(ls*t)/2:POKE 3
2507,0:LET c=USR 32500:RETURN
60 CLEAR 32499
70 GO SUB 200
80 INPUT "Tempo (0-5)?" ; t
90 INPUT "Lenth bass drum ? (0-
5)";lb:INPUT "Lenth snare ? (0-5
)";ls:LET ls=ls*5:INPUT "No. b
ars?" ; b
100 INPUT "Rhtym " ; a$
110 FOR k=1 TO b
120 FOR v=1 TO (LEN a$)
130 IF a$(v)="b" THEN GO SUB 40
140 IF a$(v)="s" THEN GO SUB 50
150 IF a$(v)="p" THEN PAUSE t+(
t=0)
160 NEXT v:PAUSE t+(t=0):NEXT
k:STOP
200 FOR a=32500 TO 32528
210 READ n:POKE a,n:NEXT a
220 DATA 6,1,197,33,15,1,17,1,0
229,205,181,3,225,17,100,0,167,
237,90,125,254,255,32,237,193,16
230,201
230 RETURN
    
```

Millipede

M G Crossley,
Heywood,
Lancashire.



THIS PROGRAM is written in Jupiter Ace Forth. It is entitled Millipede and is based upon a program written by Andrew Weekes in Spectrum Basic published in *Your Computer*, February 1983. As there is a great shortage of Ace Forth software I hope Mr Weekes will not mind my using his algorithm.

I have tried to use descriptive colon definition names in an endeavour to make the coding

self-explanatory. However, this is at the expense of memory and is not strictly necessary. The program as it stands occupies approximately 2K, 4 bytes, and requires a memory expansion to the Ace — I use a converted ZX-81 RAM pack. It may be possible, by cutting out the frills, to reduce the memory requirement and still have a playable game using the standard RAM only.

In the colon definition Once-More the word Millipede is used. At the time Once-More is being defined Millipede does not exist in the vocabulary. Therefore, it is necessary to define Once-More omitting Millipede and then when

all the program has been typed in, edit Once-More putting Millipede in its correct position and then redefine Once-More. Anyone who has used the Ace for a short time will understand the procedure. A similar situation — recursion — is covered in the Ace manual chapter 3, exercise 7, page 53.

One interesting definition which I think is not covered in the Ace manual and which could be useful elsewhere is Screen-Peek. This colon definition expects the stack to contain the row, column print-head position and returns with the ASCII value of the character at the print-head position on top of the stack.

```

@ VARIABLE SEED
@ VARIABLE A
@ VARIABLE B
@ VARIABLE G
@ VARIABLE H
@ VARIABLE M
@ VARIABLE P
@ VARIABLE S
: SETUP
  7 A | 23 B | 0 G |
  0 M | 15 P | 0 S |
: RIGHT
  23 0 DO I DUP PRINT LOOP
: CENTRE
  23 0 DO I 11 PRINT LOOP
: LEFT
  23 0 DO I DUP 22 SWAP - PRINT LOOP
: TITLE
  10 0 DO CLS RIGHT SHORT-DELAY
  CLS CENTRE SHORT-DELAY
  CLS LEFT SHORT-DELAY
  LOOP CLS CENTRE
    
```

(continued on page 143)

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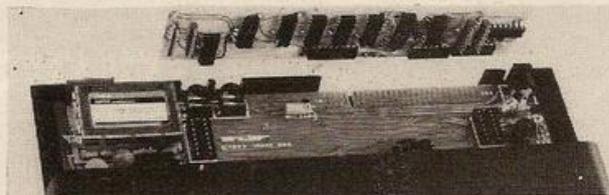
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SOFTWARE FILE

(continued from page 141)

```

HI-SOUND
30 100 BEEP

LOW-SOUND
60 100 BEEP

PAUSE
BEGIN INKEY UNTIL HI-SOUND LOW-SOUND

HARDNESS
CLS CR CR
" Enter The Hardness Level (2-10)"CR
QUERY LINE DUP DUP 11 < SWAP 1 > AND
IF H 1 1000 0 DO LOOP
ELSE DROP HARDNESS THEN

INSTRUCTIONS
CLS
" Hit any key to continue"CR CR
" Guzzle down the bugs"CR CR
" Without hitting the walls"CR CR
" Left 'Z' 0 SPACES " Right 'M'"CR
PAUSE

MIL
60 109 102 165 102
165 126 60 1

BUG
24 60 153 126 60
255 60 219 2

GRAPH
0 * 11263 + DUP 8 +
DO I CI -1 +LOOP

DEF-GRAPH
MIL GRAPH BUG GRAPH

WALL-PRINT
20 DUP A @ AT 46 EMIT
B @ AT 46 EMIT

RANDOMISE
SEED @ 75 UK 75 0 D+
2DUP UK - - 1- DUP SEED !

RND
RANDOMISE UK SWAP DROP

BUG-PRINT
10 RND 1+ 9 >
IF 20 A @ DUP B @ SWAP
- 2 / + AT 2 EMIT THEN

SCREEN-PEEK
AT 15368 @ CR

ONCE-MORE
CLS
" DO YOU WANT TO PLAY AGAIN"CR
BEGIN INKEY ?DUP UNTIL DUP 121 =
IF DROP MILLIPEDE
ELSE 110 =
IF CLS CR CR
" Bye for now."CR LONG-DELAY ABORT
ELSE ONCE-MORE
THEN THEN

ENDIT
CLS 9 0 DO
" YOU SNUBBED YOUR NOSE ON THE"CR
" TUNNEL WALL"CR LOOP LONG-DELAY CLS 6 0 AT
" You scored " S @ 10 / DUP
" Points."CR CR
" You ate " G @ DUP
" grubs"CR CR
" That's " +
" in total" LONG-DELAY ONCE-MORE

CHECK-OUT
SCREEN-PEEK 46 =
IF ENDIT THEN

NOSE-SNUB
15 P @ CHECK-OUT
16 P @ CHECK-OUT

G+
G @ 1+ G !

EAT-BUG
16 P @ SCREEN-PEEK 32 = 0=
IF G+ LOW-SOUND HI-SOUND THEN

MIL-PRINT
15 P @ AT 1 EMIT

SCROLL
22 32 AT 32 EMIT CR

SUPDATE
S @ 1+ S !

MUPDATE
H @ DUP RND SWAP 2 / - 7DUP
IF 3 RND + M !
ELSE MUPDATE THEN

AUPDATE
A @ DUP -1 >
IF M @ + THEN A !

BUPDATE
B @ DUP 31 <
IF M @ + THEN B !

A2UPDATE
A @ DUP 1 <
IF M @ ABS + A ! B @ M @ ABS + B !
ELSE DROP THEN

B2UPDATE
B @ DUP 20 >
IF M @ ABS - B ! A @ M @ ABS - A !
ELSE DROP THEN

UPDATE
SUPDATE MUPDATE AUPDATE BUPDATE
A2UPDATE B2UPDATE

MIL-CLEAR
15 P @ AT 32 EMIT

GETKEY
INKEY DUP 122 =
IF DROP P @ 1- P !
ELSE 109 =
IF P @ 1+ P ! THEN THEN

MILLIPEDE
SETUP TITLE HARDNESS INSTRUCTIONS
DEF-GRAPH BEGIN WALL-PRINT BUG-PRINT
NOSE-SNUB EAT-BUG MIL-PRINT SCROLL
UPDATE MIL-CLEAR GETKEY 0 UNTIL

```

Blitzkrieg

Martin Exall,
Drayton,
Norwich.

ATOM

WRITTEN FOR a fully expanded Acorn Atom, this program uses high-resolution graphics and

the characters which are defined are placed in the floating-point variable space. The program uses a machine-code routine to draw the characters on the screen. If you succeed in destroying all the buildings then the plane will land and then take off again for another go at a more difficult level. The program is written in subroutines and includes Rem statements so it

should be fairly easily converted to other micros. The height of the buildings depends on the difficulty level which is set in line 3120 — the higher the number is, the higher the buildings can be. There are buildings all across the screen and they all have to be destroyed before the plane can land. Only six sections of the building can be destroyed with any one bomb.

```

140 GOSUB 1000;REM MACHINE CODE
150 GOSUB 2000;REM DEFINE CHARACTERS
160 GOSUB 3000;REM INSTRUCTIONS
170 GOSUB 4000;REM DRAW BUILDINGS
180 GOSUB 6000;REM PRINT SCORE
190 B=#0000;V=0;W=0;E=0
200 IF ?#0001<128 OR E<>0 GOSUB 7000;
REM BOMB DROP
210 X=V;Y=W;C=9;GOSUB 5000
220 V=V+1;B=B+1;IF V<32 GOTO 240
230 W=W+1;V=0;B=#0000+W*256
240 IF B=#951E GOTO 8000;REM LAND
250 IF 7B<>0 GOTO 9000;REM CRASH
260 X=V;Y=W;C=6;GOSUB 5000
270 GOTO 200
999 END
1000 REM MACHINE CODE
1010 REM TO PLOT CHARACTERS
1020 PRINT #21
1030 DIM Z2(1),P(-1)
1040 C
1050 Z20 LDX @0;LDY @0
1060 Z21 LDA (#82),Y;STX (#80),X)
1070 INY
1080 LDR #00;CLC;ADC @#20;STX #80
1090 LDR #01;ADC @0;STX #81
1100 CPY @8;BNE Z21
1110 RTS
1120 J
1130 PRINT #6
1140 RETURN
2000 REM DEFINE CHARACTERS
2010 Z=#2000
2020 !Z=#7E5A7E5A;Z!4=#7E5A7E5A
2030 Z!8=#5A5A7E5A;Z!12=#7E5A5A7E
2040 Z!16=#7E667E66;Z!20=#7E667E66
2050 Z!24=#3C3C1818;Z!28=#7E5A7E24
2060 Z!32=#18183C3C;Z!36=#5A7E5A3C
2070 Z!40=#18181818;Z!44=#7E667E3C
2080 Z!48=#00000000;Z!52=#003F7FFE
2090 Z!56=#3C183C7E;Z!60=#183C7E7E
2100 Z!64=#7070391C;Z!68=#60707070
2110 Z!72=0;Z!76=0
2120 Z!80=#2A26221C;Z!84=#1C2232
2130 Z!88=#00081008;Z!92=#1C0008
2140 Z!96=#1C02221C;Z!100=#3E2020
2150 Z!104=#00C0221C;Z!108=#1C2202
2160 Z!112=#3E140C04;Z!116=#040404
2170 Z!120=#023C203E;Z!124=#1C2202
2180 Z!128=#3C20201C;Z!132=#1C2222
2190 Z!136=#0004023E;Z!140=#202010
2200 Z!144=#1C22221C;Z!148=#1C2222
2210 Z!152=#1E22221C;Z!156=#1C0202
2220 RETURN
3000 REM INSTRUCTIONS
3010 PRINT #12
3020 PRINT " BLITZ"
3030 PRINT "YOU ARE IN AN AEROPLANE FLYING "
3040 PRINT "OVER A LOT OF BUILDINGS. YOU "
3050 PRINT "HAVE TO FLATTEN THE BUILDINGS BY"
3060 PRINT "DROPPING BOMBS ON THEM SO YOU "
3070 PRINT "CAN LAND ON THE GROUND.""
3080 PRINT "YOU DROP THE BOMBS BY PRESSING "
3090 PRINT "THE shift KEY.""
3100 PRINT " PRESS ANY KEY WHEN READY"
3110 LINK #FFE3;REM WAIT FOR KEYPRESS
3120 D=5;REM DIFFICULTY
3130 S=0;REM SCORE
3140 RETURN
4000 REM DRAW BUILDINGS
4010 CLEAR 4
4020 FOR Z=2 TO 29
4030 C=ABS RND*3
4040 FOR H=21 TO (21-(ABS RND*0+1)) STEP -1
4050 X=Z;Y=H;GOSUB 5000;REM PLOT CHARACTER
4060 NEXT H
4070 C=C+3
4080 X=Z;Y=H;GOSUB 5000
4090 NEXT Z
4100 MOVE 0.15;DRAW 255.15
4110 RETURN
5000 REM PLOT CHARACTER
5010 ?#83=#28
5020 ?#82=C#8
5030 ?#81=#00+Y
5040 ?#80=X
5050 LINK Z20
5060 RETURN
6000 REM PRINT SCORE
6010 STR S,540
6020 Z=0
6030 DO
6040 C=540?Z;C=C-38
6050 X=10+Z;Y=23
6060 GOSUB 5000
6070 Z=Z+1
6080 UNTIL 540?Z="CH","
6090 RETURN
7000 REM DROP BOMB
7010 IF E=1 GOTO 7030
7020 E=1;F=W;G=W;I=B;J=0
7030 X=F;Y=C;C=9;GOSUB 5000
7040 G=G+1;I=I+256
7050 IF ?I<>0 AND ?I<>255 J=J+1;S=S+1;X=F;Y=G;
C=9;GOSUB 5000
7060 IF G=22 OR J=6;E=0;GOSUB 6000;RETURN
7070 X=F;Y=G;C=7;GOSUB 5000
7080 RETURN
8000 REM LAND
8010 FOR Z=0 TO 5
8020 PRINT #7
8030 NEXT Z
8040 DO

```

(continued on next page)

SOFTWARE FILE

(continued from previous page)

```

8050 X=V;Y=W;C=9;GOSUB 5000
8060 V=V+2;IF V>31 V=0
8070 W=W-1
8080 X=V;Y=W;C=5;GOSUB 5000
8090 UNTIL W=0
8100 0=D+2
8110 GOTO 170
9000 REM CRASH
9010 V=V-1;B=B-1;D0
9020 X=V;Y=W;C=8;GOSUB 5000
9030 FOR Z=0 TO 10;WAIT;NEXT Z
9040 X=V;Y=W;C=9;GOSUB 5000
9050 W=W+1;B=B+256
9060 UNTIL ?B<>0 OR ?(B+256)=255
9070 X=V;Y=W;C=8;GOSUB 5000
9080 FOR Z=0 TO 120;WAIT;NEXT Z
9090 PRINT #12
9100 PRINT "";" you crashed""
9110 PRINT "YOU SCORED "S;"
9120 INPUT "DO YOU WANT ANOTHER GAME"#540
9130 IF ?540<CH"Y";GOTO 160
9140 IF ?540<>CH"N";PRINT #11;LINK #FE22;GOTO 9120
9150 END
    
```

Multiline delete

Chris Dellarocas,
Athens,
Greece.

ZX-81

THE LACK of a Delete command in ZX-81 Basic has been in my opinion a major short-coming in a machine where the lack of Data/Read, the lack of a machine-code monitor and the limitations of memory have been forcing programmers to create and then line-by-line delete lengthy loaders and initialisers. Just think of the initialisation program of Simon Lane's Dog Race — *Your Computer* July 1982. It comprises 126 lines.

Such reasons have prompted me to write the Multiline Delete routine. It just takes 54 bytes and can be used without problem in both 1K and 16K systems, in Fast or Slow mode. The routine deletes any number of any program lines — including line 0 — contained between two given line numbers — Poked to locations FirstL and LastL, see programs. While — and this is most important — conserving all existing Basic variables.

The routine is relocatable with no changes to be made when moving it up or down in memory. The only point needed to be taken

into account is the locations of the two words FirstL and LastL. I consider it more useful to move it above RAMtop and have it sit there during Loads and Saves. That is why I have written an optional relocater occupying 12 more bytes. You can easily omit that if you wish to do so.

The routine is written around two very useful ROM routines. The first, starting at 09D8H, returns the starting address of a given Basic line in HL and is used to determine the limits of the block of memory that is to be deleted. The second, starting at 09ADH, changes all pointers — that is, system variables between DFile and STKend — that do not point lower than HL, by adding them to the value in BC.

I have written a short Basic program to load, lines 100-150, relocate, lines 10-20, drive the routine and also demonstrate some of its features.

Create a 1 Rem statement with 66 full stops, and then type POKE 16510,0

and key in the Basic program. Now type Run and enter the hex code. When you have finished and checked it, type Cont and start your cassette recorder. The program will be Saved under the name Vel and then automatically Run. Lines 10-20 will relocate the Del

routine to 7F00, while lines 30-70 will use the same routine to delete unwanted lines 0-199. When you now List, you will find yourself left with lines 900 onwards. Type Goto 9000 to discover that A\$ has been kept intact. You can now use the program through the Basic driver — lines 9988-9999 — and its operation should present no problems. However, you should note some of the following points: you do not have to enter the exact starting and finishing lines of the block you want deleted.

The routine usually — but not always — causes the Basic program from which it is called to halt the report code.

Under normal operation the program cannot crash. But never enter a first line number larger than the very last line of the resident Basic program. Also, avoid last line numbers larger than 16382. First line numbers should never be larger than last line numbers.

1K users will probably want to leave the routine sitting in the Rem statement. Also, they will have to change the locations of FirstL and LastL in memory by changing their references in the hex listing — locations 16523-24 respectively.

Calling addresses are:

USR 16514 for the Del routine if not moved
USR 16568 for the Relocator

```

START: 16514      LENGTH: 54
DEL:
LD HL, (FIRSTL) 2A BC 7F
CALL 09D8H      CD D8 09
PUSH HL        E5
PUSH HL        E5
LD HL, (LASTL)  2A BE 7F
INC HL         23
CALL 09D8H     CD D8 09
EX DE, HL     A7
LD HL, (DFILE) 2A 0C 40
AND A         ED
SBC HL, DE    ED 52
JR NC, NOLAST 30 04
LAST:
LD DE, (DFILE) ED 58 0C 40
NOLAST:
LD HL, (E-LINE) 2A 14 40
PUSH HL      A5
AND A       ED
SBC HL, DE  ED 52
PUSH HL     E5
POP BC      C1
EX DE, HL  EB
POP AF     F1
POP DE    D1
PUSH AF   F5
LD IR    EB
EX DE, HL EB
POP DE   D1
AND A   ED
SBC HL, DE ED 52
PUSH HL E5
POP BC  C1

POP HL  JP 09ADH      E1 C3 AD 09
FIRSTL=32700
LASTL=32702

RELOCATOR FOR ABOVE PROGRAM
START: 16568      LENGTH: 12
RELOC:
LD HL, 4082H     21 02 40
LD DE, 7F00H    11 00 7F
LD BC, 035H     01 36 00
LD IR           09 B0 00
RET            C9

(*) DESTINATION ADDRESS—CAN BE
CHANGED TO YOUR REQUIREMENTS.

REM ENGLN ** FAST FAST ENGLN
7LN ** FOR EERND GOSUB ?K* GOS
UB ?2RND=AND FAST GOSUB ? FAS
T AT FOR LET SGN PRINT GOSUB F
OR SGN GOSUB ? FAST AT LPRINT
?5RND) GOSUB TAN
1 REM (C) CHR. DELLAROCAS
ATHENS GREECE
3 LET A$="54 BYTES OF M/CODE
ARE ENOUGH TO ALLOW YOU DELETE
ANY NUMBER OF PROGRAM LINES WH
ILE >>NOT<< DESTROYING THE EXIS
TENT BASIC VARIABLES."
4 REM *****
5 IF PEER 16514<>42 THEN GOTO
100
10 POKE 16369,127
20 LET 0=USR 16568
30 POKE 32700,0
40 POKE 32701,0
50 POKE 32702,200
60 POKE 32703,0
70 LET 0=USR (127+256)
99 REM *****
100 FOR X=16514 TO 16579
110 INPUT A$
120 POKE X, CODE A$+16+CODE A$(2
)-476
130 PRINT A$;" ";
140 NEXT X
150 STOP
198 SAVE "DEL"
199 RUN
9988 REM *****
9988 LET FL=32700
9989 LET LL=32702
9990 PRINT "DELETE FROM ";
9991 INPUT A
9992 POKE FL,A-256*INT (A/256)
9993 POKE FL+1,INT (A/256)
9994 PRINT A;" TO ";
9995 INPUT B
9996 POKE LL,B-256*INT (B/256)
9997 POKE LL+1,INT (B/256)
9998 PRINT B
9999 LET 0=USR (127+256)
    
```

Sound editor

J W Harrison,
Wigan,
Lancashire.

ATARI

SOUND EDITOR for the Atari 400/800 runs in 16K and uses the variables: V, N, D, L, where

V is the Voice or sound channel selected, N the note, D the distortion factor and L the loudness or volume. A green pointer is used to indicate the last selection keyed in. The program allows for either one voice or all four to be used singularly or together.

To switch off any voice, key in:

V,0,0,0

where V is the voice to be switched off: for

example

Sound 1,0,0,0

switches off voice 1.

Atari users can refer to the hardware manual for further guidance in the use of distortion as some combinations of V, N, D, L will cancel out to produce silence. The program is self-explanatory as it runs and Rem statements in the listing help explain how it is put together.

```

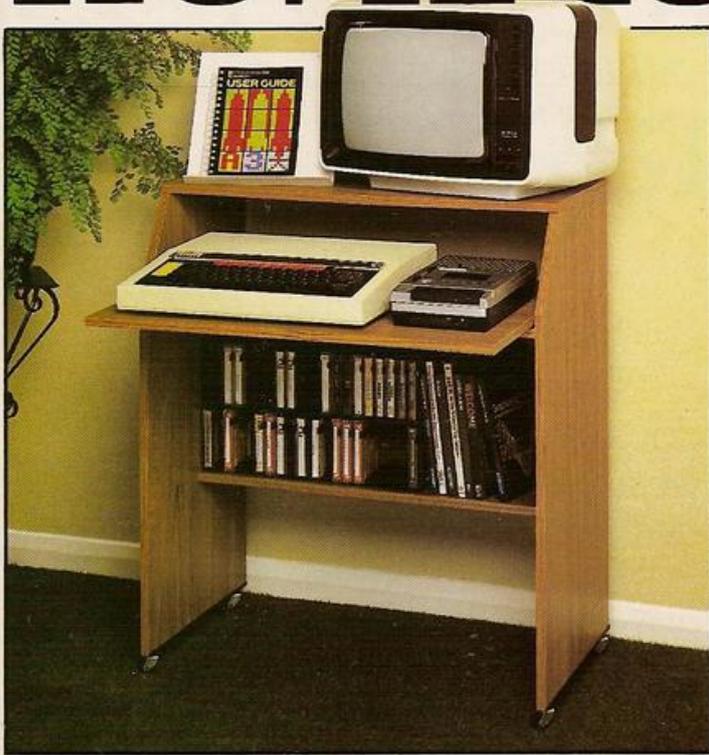
10 REM << SOUND EDITOR >>
15 REM * by J.W.Harrison *
16 REM ** SET UP TITLE PAGE **
20 GRAPHICS 17
30 POSITION 3,4
40 ? #6;"*** SOUND ***"
50 POSITION 3,8
    
```

```

60 ? #6;"*** EDITOR ***"
70 POSITION 3,12
80 ? #6;"PRESS [START]"
90 POSITION 5,14
100 ? #6;"TO BEGIN"
110 SOUND 0,66,12,8;SOUND 1,60,12,8
    
```

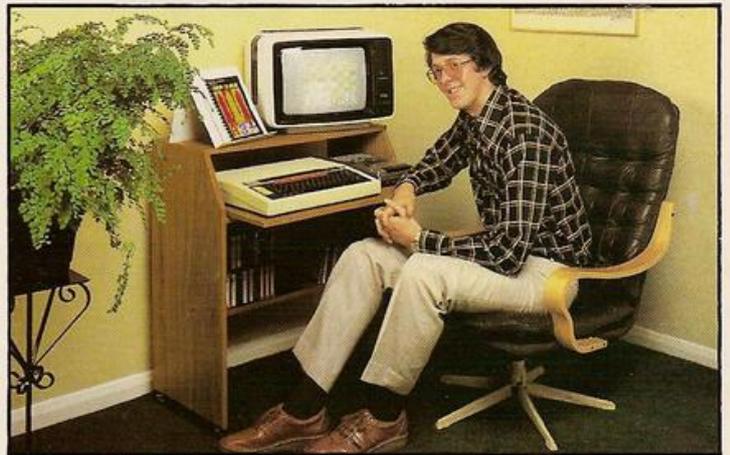
(continued on page 149)

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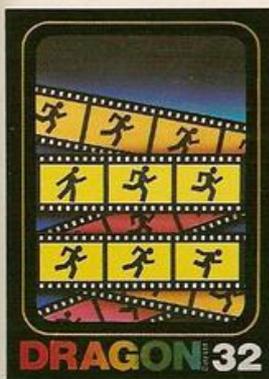
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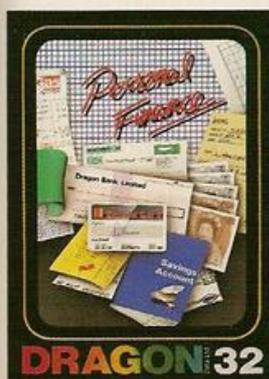
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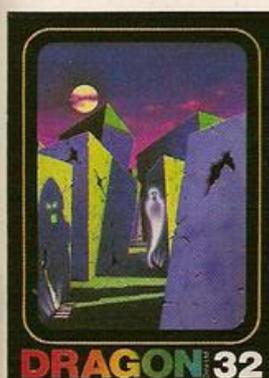
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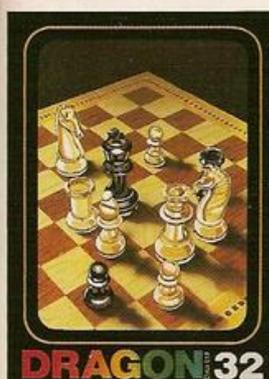
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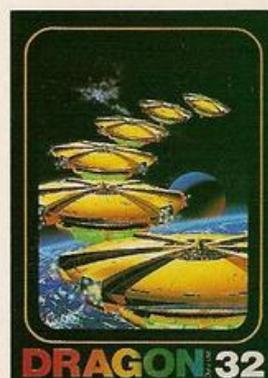
Typing Tutor. Only a keyboard as sophisticated as the Dragon's could allow you a program like this. You use the Dragon's own keyboard to learn to type. On cassette.



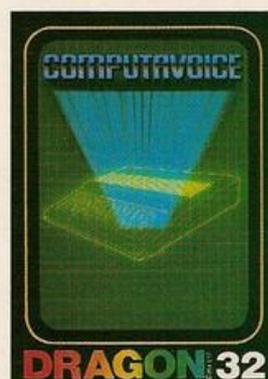
Cave Hunter. Finding the hidden gold is hard. But surviving the attacks of malevolent creatures may well prove to be impossible. Cave Hunter is on cartridge.



Dragon Selection. A cassette of utility programs, allowing you to create your own database. Write your own tunes - or learn other language vocabularies.



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SOFTWARE FILE

(continued from page 144)

```

115 REM ** CHECK FOR [START] BEING PRESSED **
120 IF PEEK(53279)<>6 THEN 120
130 SOUND 0,0,0,0:SOUND 1,0,0,0
135 REM ** SET UP GRAPHICS 1 WITH TEXT **
140 GRAPHICS 1
150 ? "SELECTION WILL BE DISPLAYED ABOVE----"
160 ? "WHICH VOICE (0-3)";:INPUT V
170 IF V>3 THEN 160
175 REM ** CLEAR TEXT: PRESS [ESC], THEN
176 REM PRESS [CTRL] AND [CLEAR] TOGETHER **
180 ? "":REM ** CLEAR TEXT **
190 ? "NOTES GO FROM HIGH(0) TO LOW(255)--"
200 ? "WHICH NOTE (0-255)";:INPUT N
210 IF N>255 THEN 200
220 ? "":REM ** CLEAR TEXT **
230 ? "DISTORTION EFFECTS VARY (EXPERIMENT)--"
235 ? "EVEN NUMBERS ONLY----"
240 ? "WHAT DISTORTION (0-14)";:INPUT D
245 IF D>14 THEN 240
250 ? "":REM ** CLEAR TEXT **
260 ? "VOLUME RUNS FROM OFF(0) TO LOUD(15)--"

```

```

270 ? "HOW LOUD (0-15)";:INPUT L
280 IF L>15 THEN 270
285 REM ** DISPLAY SELECTION TO GRAPHICS SCREEN **
290 IF V=0 THEN POSITION 0,0
300 IF V=1 THEN POSITION 0,4
310 IF V=2 THEN POSITION 0,8
320 IF V=3 THEN POSITION 0,12
329 REM ** TYPE sound IN INVERSE VIDEO **
330 ? #6;"sound ";V;";";N;";";D;";";L;"; "
331 REM ** 4 SPACES BETWEEN LAST QUOTE MARKS **
340 SOUND V,N,D,L
345 REM ** COLOR 28 SELECTS GREEN POINTER
346 REM ** COLOR 0 ERASES IT. POINTER USED
347 REM ** TO INDICATE LAST SELECTION KEYPED
350 COLOR 0:PLOT 18,0:PLOT 18,4:PLOT 18,8:PLOT 18,12
360 IF V=0 THEN COLOR 28:PLOT 18,0
370 IF V=1 THEN COLOR 28:PLOT 18,4
380 IF V=2 THEN COLOR 28:PLOT 18,8
390 IF V=3 THEN COLOR 28:PLOT 18,12
400 ? "":REM ** CLEAR TEXT **
410 GOTO 160:REM ** RETURN FOR NEXT SELECTION **
420 END

```

Memory display

I K Biddle,
Nuneaton,
Warwickshire.

BBC

A J HYND'S program, December *Your Computer*, is quite a useful idea for memory display but has two distinct disadvantages. First, it requires about a page of user memory, and secondly Page must be altered in order to prevent the initial program being overwritten. I wrote this machine-code program with these

considerations in mind. The program uses no memory allocated to the user since it is located in disc space at &D00. The assembled program requires about 225 bytes in &D00 and five bytes at &70.

To use the program type
RUN <CR>
and wait until the prompt returns. Then type
CALL 5% <CR>

The program should then wait until a four-digit hex number is input. If it does not, recheck the listing.

In order for the program to operate, all leading zeros must be input. Scrolling is

achieved by pressing Shift and to exit, press Escape. The program can be called from Basic and trapped with the statement:

ON ERROR GOTO . . .

when the user presses Escape. The display format can be changed by altering line 820 to read

JSR &FFE7

All error checking has been made and will not accept alphanumerics outside the range 0-9 and A-F. Incidentally, the location at &D7 returns a non-ASCII value of a keyboard input and Escape is the value 240.

40FORI=0TO1:PX=&D00:	220.CH2	CHP#47	410	BNE LP3	600	JSR &FFE7	790	LDA#&20
SX=PX:DOPTI*3	230	BCC LP3	420.MUL	CLC	610	LDX &73	800.LP7	JSR &FFEE
50.INP LDX#0	240.CH3	JSR &FFEE	430	CLD	620	LDY &73	810	LDA#&20
60.LP1 LDA MZ,X	250	STA &70,X	440	LDX#&0F	630	STY &81	820	JSR &FFEE
70	260	LDA &70,X	450	LDA &70	640	LDY &74	830	LDA &D7
80	270	CHP#&40	460.LP4	ADC &70	650	STY &80	840	CHP#&F0
90	280	BCS SUB	470	DEX	660.LP5	TXA	850	BEQ LP8
100	290	CLD	480	BNE LP4	670	JSR &8570	860	INY
110	300	SEC	490	ADC &71	680	TYA	870	BNE LP5
120.get	310	SBC#&30	500	STA &73,Y	690	JSR &856A	880	INC#81
130.LP2 LDX#0	320	STA &70,X	510	CPY#&01	700	LDA(&80),Y	890	IN#
140.LP3 JSR &FFEE	330	JMP OK	520	BEQ PNT	710	JSR &856A	900	BNE LP5
150	340.SUB	CLD	530	CLD	720	LDA(&80),Y	910.LP8	RTS:J
160	350	SEC	540	BNE LP2	730	CHP#&20	920MZ=PX+1:MX=CHR#12+	
170	360	SBC#&37	550.PNT	LDA#14	740	BCS LP6	"Type in start	
180	370	STA &70,X	560	JSR &FFEE3	750	LDA#&20	address (Hex.) "	
190.CH1	380.OK	CPX#&01	570	LDA#12	760	JMP LP7	930NEXT	
200	390	BEQ MUL	580	JSR &FFEE3	770.LP6	CHP#&7E		
210	400	INX	590	JSR &FFEE7	780	BCC LP7		

Forth connection

P Sharp,
Maidstone,
Kent.

ATOM

THIS IS Connect Four for the Acorn Atom in 2K - 0.5K of this is graphics. The object is to get a row of four counters in a grid. This is done by using the Repeat key to move across the top and Shift to drop the counter. There are

sound effects, a score of each game won and alternate goes.

The computer tells you whose move it is and inverts two counters on the winning line when a person has won.

```

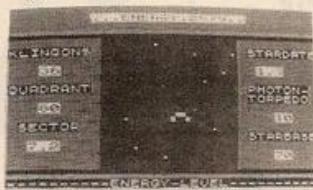
10E=0;L=0;@=0;F=1
20CLEAR0
30IN."INSTRUCTIONS Y/N"V;IFV=Y GOS.X
40DIMAA14;I=0
50I=I+1;AA(I)=0;IF I<13 G.50
60CLEAR0;A=0;D=0;H=0;G=0;T=#0F;U=#18;S=#40;Z=0;I=0
70P.#12" 0 WINS "E" : X WINS "L";?#01B=S;?#01C=S
80I=I+1;AA11=#001F+I;?AA11=#F0;IFI<32 G.80
90I=0
100 I=I+1;A=A+1;B=#0064+A;?B=#F0;IFI<14 G.100
110A=A-20;D=D+64;A=D;IFD<>448 I=0;G.100
120I=0
130I=I+1;H=#0064+G;?H=#FF;G=G+32;IF I<16 G.130
140Z=Z+2;G=Z;IFG<>16 I=0;G.130
150IF F=1 X=U;G.170
160AX=T;O=#8F
170AA12=AA12+1;IFAA12=43 G.W
180?#0043=X;?#8134=X;?#8136=#14
190?#8137=T;?#8139=#0D;?#813A=T;?#813B=#16;?#813C=#05
200I=0
210I=I+1;AA13=#8155+I;IF I<8 G.210
220bI=0
230IF(?#8002)&64<>64G.260
240IF?#8001<>#FF G.C
250G.230
260IFQ=2;?C=S
270C=#8045+I;I=I+2;?C=X;Q=2;WAIT;IFI=14G.B
280G.230
290cIFC=#8043G.B
300 IF C=#8045 M=6-AA2;AA2=AA2+1;G.H
310 IFC=#8047 M=6-AA3;AA3=AA3+1;G.H

```

(continued on page 151)

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SOFTWARE FILE

(continued from page 149)

```
320 IFC=#8049 M=6-AA4;AA4=AA4+1;G.h
330 IFC=#804B M=6-AA5;AA5=AA5+1;G.h
340 IFC=#804D M=6-AA7;AA7=AA7+1;G.h
350 IFC=#804F M=6-AA8;AA8=AA8+1;G.h
360 IFC=#8051 M=6-AA9;AA9=AA9+1;G.h
370G.160
380hIFM<1G.230
390I=0;A=0;A=A+M
400I=I+M;?C=S;C=C+64;?C=X;P.#7;A=A-1;IF A=0G.u
410G.400
420C=#8043;IFX=U;G.a
430X=U;O=#98;G.170
440XP.#12" CONNECT 4"" "-----"
450P.""TO WIN GET A LINE OF o \ x.IN A "
460P.""VERTICAL,HORIZONTAL OR DIAGONALLINE"
470P.""CONTROLS""rept TO MOVE"
480P.""shift TO DROP COUNTER""two Players only";A=0
490A=A+1;WAIT;IFA<530G.490
500R.
510W?#8134=#93;?#8135=#94;?#8136=#81;?#8137=#8C;?#8138=#85
520?#8139=#8D;?#813A=#81;?#813B=#94;?#813C=#85
530L.#FB7D;IN.""ANOTHER GO Y\N\R;IFR=N;G.570
540IFAA14=0 F=1;AA14=1;G.40
550IFF=1 AA14=0;F=0;G.40
560F=1;G.40
```

```
570E.
580IF X=T AA14=1
590IF X=U AA14=2
600U?C=X;I=0
610I=I+1;W=C;Y=0
620IF I=1 N=62
630IF I=2 N=66
640IF I=3 N=2
650IF I=4 N=64
660W=W+N
670IF ?W=X A.Y<>3 Y=Y+1;G.660
680IFY=3 G.r
690 IFW<>X G.710
700G.660
710N=-N;W=C
720W=W+N
730IF?W=X A.Y<>3 Y=Y+1;G.720
740IFY=3 G.r
750IFI<5G.610
760G.420
770W=W-N;I=0
780 ?W=0;?C=0;A=#8139
790I=I+1;?A=S;A=A+1;P.#7;IFI<9G.790
800?#8136=#17;?#8137=T;?#8138=#0E
810IFX=T E=E+1;G.530
820IFX=U L=L+1;G.530
```

Bone idle

W A Googe,
Stevenage,
Hertfordshire.

ZX-81

THIS is a program for a 16K RAM ZX-81. It is widely recognised that the prime function of a computer is to make life easier for us all, but to program one to play Patience for you must be the ultimate in laziness. My excuse is that the computer can play faster than me, and it does not cheat. The game is Clock Patience, and the program should be entered and Run.

In reply to the L cursor the following data should be input, one number at a time, reading the data across the page. Follow each entry with Newline, and if correctly done, the last entry will produce a message 9/10.

Data: 3, 20, 2, 21, 1, 22, 0, 23, 6, 23, 5, 24, 4, 25, 3, 26, 10, 24, 11, 24, 10, 26, 11, 26, 15, 23, 16, 24, 17, 25, 18, 26, 18, 20, 19, 21, 20, 22, 21, 23, 18, 15, 19, 15, 20, 15, 21, 15, 18, 10, 19, 9, 20, 8, 21, 7, 15, 7, 16, 6, 17, 5, 18, 4, 10, 6, 11, 6, 10, 4, 11, 4, 6, 7, 5, 6, 4, 5, 3, 4, 3, 10, 2, 9, 1, 8, 0, 7, 3,

15, 2, 15, 1, 15, 0, 15, 12, 15, 11, 15, 10, 15, 9, 15, End of data.

List the program and delete lines 1 to 10 inclusive, by typing Line Number Newline. Do not use Run or Clear, or you will lose the data you have just entered, which is a list of the print positions for the cards.

You will need a copy of this exciting program, so get your recorder into a recording mood, type Goto390, start the recorder, and press Newline, the program will Autorun.

The computer will shuffle the cards and set them out in a clock-face pattern on the screen — it deals at random from a new pack each time which amounts to the same thing. Should the computer succeed in getting the game to come out, it will stop with message 9/380 and Cont Newline will start it off again.

If it fails, it will display the Ace that stopped it in the bottom left of the screen, and after a pause try again. Remember this is a program with hidden data stored within it, so to restart from a listing use Goto 11.

The computer plays at about two games per minute, and if such haste makes you dizzy, an extra line:

265 PAUSE 100

will slow things down a bit, or if you dislike the screen jump caused by Pause there is room for a dummy loop at that part of the program. On the other hand, if your patience is limited delete line 175, and insert:

222 SLOW

This will speed things up by not displaying the cards until after they have been set out.

The computer starts play with the top card from the one o'clock pile. If you wish it to start in the centre, change line 230 to read:

LET X = 13

and alter the first subscript of the arrays in line 370 to read 13 also.

If desired, the program can be altered to delete line 335. Replace it with:

```
235 PRINT AT (20+1**1),0;D$
236 PRINT AT (20+1**1),0;" " (two spaces)
```

This will cause the card in the bottom left of the screen to flash, and demonstrate a novel use of the ** function to cause a slight delay — a good idea gleaned from somebody else's program, and deserving to be more widely known.

```
1 DIM C$(13,4,2)
2 DIM A(13,4,2)
3 DIM T(13)
4 FOR N=1 TO 13
5 FOR M=1 TO 4
6 INPUT A(N,M,1)
7 INPUT A(N,M,2)
8 NEXT M
9 NEXT N
10 STOP
11 FAST
12 RAND
13 LET A=1
14 LET K=13
15 LET O=12
16 LET J=11
17 LET T=10
18 LET B$="AS2535455565758595T
19 LET B$="AD203D4D5D6D7D8D9DTDJDDK
20 LET B$="AC2C3C4C5C6C7C8C9CTCJCCKCAH2H3
21 LET B$="H4H5H6H7H8H9HTHJH0KH"
22 FOR N=1 TO 13
23 LET T(N)=4
24 FOR M=1 TO 4
```

```
90 LET P=INT (RAND*LEN B$)+1
100 IF P/2-INT (P/2)=0 THEN GOT
110 LET C$(N,M)=B$(P TO P+1)
120 LET B$=B$( TO P-1)+B$(P+2 T
130 GOTO 160
140 LET C$(N,M)=B$(P-1 TO P)
150 LET B$=B$( TO P-2)+B$(P+1 T
160 NEXT M
170 NEXT N
175 SLOW
180 FOR N=1 TO 4
190 FOR M=1 TO 13
200 PRINT AT A(M,N,1),A(M,N,2);
210 NEXT M
220 NEXT N
225 LET R=0
230 LET X=1
240 LET Y=T(X)
250 PRINT AT A(X,Y,1),A(X,Y,2);
```

```
260 LET D$=C$(X,Y)
270 LET T(X)=T(X)-1
280 LET X=VAL C$(X,Y,1)
285 LET Y=T(X)
290 IF Y=0 THEN GOTO 330
300 PRINT AT A(X,Y,1),A(X,Y,2);
310 LET R=R+1
315 IF R=51 THEN GOTO 370
320 GOTO 260
330 FOR N=1 TO 100
335 PRINT AT 21,0;D$
340 NEXT N
350 CLS
360 GOTO 11
370 PRINT AT A(1,4,1),A(1,4,2);
380 STOP
385 GOTO 11
390 SAVE "LOCK"
400 GOTO 11
```

Music maestro

Roger Keatley,
Wolverhampton.

DRAGON

THE PROGRAM allows the user to enter, modify, insert, play, load and save a piece of music. The standard Dragon music symbols are entered into a line where each symbol may

be separately addressed. Music is entered using the E command in the form:

E(START)/(TEXT)

Where Start is the first position to place a symbol and Text the string to use — can be more than one symbol. If you enter on an existing symbol Modify is effected. Symbols can be inserted into the line using the I command in the form:

I(START)/(TEXT)

Where Start is the position to start on and Text the symbols to be inserted there are no default values for these commands. They should be entered in full. The music string can be played using the P command as follows:

P(LINE NUMBER)

Where Line Number is the line to play — 20
(continued on next page)

SOFTWARE FILE

(continued from previous page)

lines are available. Leaving the line number off will cause the Dragon to play all the lines entered.

The L command changes the line number which music is entered into. Use:

L=(LINE NUMBER)

Do not leave the line number off. The command New removes all the symbols from the lines. Use this to start again. When you

have completed your masterpiece you can save it on to tape using the Save command:

SAVE/(FILENAME)

Where Filename is the name you want to call the piece. Similarly Load can be used to get the file back from tape:

LOAD/(FILENAME)

As the program does not test the symbols entered you must make sure what you enter is a

valid Dragon symbol. If it is not the program will halt when you try to play the symbol. If this does happen you can recover by entering Goto 50 — this will restart the program. You can then change the offending symbol.

If you have been running a high-resolution graphics program before using this one, switch the Dragon off, then on again before loading this one, as the program uses PClear1 to save memory.

```

10  DRAGON32 MUSIC WRITER
20
30  PCLEAR1: CLEAR2000: DIM M$(20)
40  CL=1
50  CLS
60  PRINT: PRINT: PRINT
70  PRINT@72,1: PRINT@82,2: PRINT@92,3
80  FOR T=1 TO 3
90  FOR C=1 TO 9
100 PRINTUSING "#";C;
110 NEXT C
120 PRINTUSING "#";0;
130 NEXT T
140 PRINTUSING "###";12;
150 PRINT@10,"LINE:";CL
160 PRINT@120,M$(CL)
170 PRINT@288,STRING$(30," ")
180 PRINT@192," "
190 PRINT
200 PRINT"INPUT COMMAND STRING"
210 LINE INPUT ">";C$
220 IF LEFT$(C$,1)<>"P" THEN 290
230 F=0
240 IF LEN(C$)>1 THEN F=1: PN=RIGHT$(C$,LEN(C$)-1)
250 IF F=1 THEN PN=VAL(PN$): PLAY M$(PN): GOTO 150
260 FOR C=1 TO 20: MX$=MX$+M$(C): NEXT C
270 PLAY MX$: MX$="": GOTO 150
280 ..... ENTER .....
290 IF LEFT$(C$,1)<>"E" THEN 400
300 PC=INSTR(2,C$,"/")
310 PN=VAL(MID$(C$,2,PC-2))
320 IN$=RIGHT$(C$,LEN(C$)-PC)
330 B$=LEFT$(M$(CL),PN-1)
340 B$=B$+IN$
350 IF PN=LEN(M$(CL)) THEN 370
360 B$=B$+(RIGHT$(M$(CL),LEN(M$(CL))-(PN+LEN(IN$)-1)))
370 M$(CL)=B$
380 GOTO 150
390 ..... CHANGE LINE .....
400 IF LEFT$(C$,2)<>"L" THEN 450
410 CL=VAL(RIGHT$(C$,LEN(C$)-2))
420 IF CL>20 THEN PRINT: PRINT" 20 LINES ONLY !!": CL=1: SOUND180,17
430 PRINT@352,STRING$(32," ")
440 GOTO 150
450 ..... SAVE .....
460 IF LEFT$(C$,4)<>"SAVE" THEN 570
470 F$=RIGHT$(C$,LEN(C$)-5)
480 PRINT: PRINT"PRESS ENTER WHEN RECORDER READY"
490 IF INKEY$="" THEN 490
500 PRINT: PRINT"OUTPUT OF "F$" IN PROGRESS"
510 OPEN "O",#-1,F$
520 FOR C=1 TO 20
530 PRINT #-1,M$(C)
540 NEXT C
550 CLOSE #-1
560 GOTO 40
570 IF LEFT$(C$,4)<>"LOAD" THEN 690
580 F$=RIGHT$(C$,LEN(C$)-5)
590 PRINT: PRINT"PRESS ENTER WHEN RECORDER READY"
600 IF INKEY$="" THEN 600
610 PRINT" INPUT IN PROGRESS"
620 OPEN "I",#-1,F$
630 PRINT"FILE: "F$" FOUND AND LOADING"
640 FOR C=1 TO 20
650 INPUT #-1,M$(C)
660 NEXT C
670 CLOSE #-1
680 GOTO 40
690 IF C$<>"NEW" THEN 710
700 RUN
710 ..... INSERT .....
720 IF LEFT$(C$,1)<>"I" THEN 810
730 PC=INSTR(2,C$,"/")
740 PN=VAL(MID$(C$,2,PC-2))
750 IN$=RIGHT$(C$,LEN(C$)-PC)
760 B$=LEFT$(M$(CL),PN-1)
770 B$=B$+IN$
780 B$=B$+RIGHT$(M$(CL),LEN(M$(CL))-PN+1)
790 IF LEN(B$)>32 THEN GOSUB S20: M$(CL)=LEFT$(B$,32) ELSE M$(CL)=B$
800 GOTO 150
810 SOUND180,19: GOTO 150
820 PRINT: PRINT" >> TRUNCATION <<": SOUND180,20
830 PRINT@352,STRING$(15," ")
840 RETURN
    
```

Box spin

W Meadowcroft,
High Crompton,
Oldham.

LYNX

THE EXCELLENT graphics capabilities of the 48K Lynx are demonstrated by this program, which draws the visible sides of a rotating 3-D box. If lines 230, 250, 270 and 290 are omitted,

then a skeleton frame of the box is drawn. If line 180 is omitted, geometrical patterns are built up. Here is a list of the variables:

- A = Maximum width of sides
- B = Maximum width of ends
- T = Angle of turn
- D = Current width of sides
- P = Current width of ends
- S = Perspective
- W = Reduction in width of sides
- F = Reduction in height of ends

```

100 LETA = 100
110 LETB = 25
120 FORT = 0 TO 360 STEP 10
130 LETD = A * COS (RAD(T))
140 LETP = B * SIN (RAD(T))
150 LETS = 2 * P/3
160 LETW = ABS(S/4)
170 LETF = D/25
180 CLS
190 INK2
200 MOVE 128,70
210 DRAW 128,180
220 INK7
230 IFP<0 THEN GOTO 250
240 PROC ENDA
250 IF D-W<D THEN GOTO 270
260 PROC SIDEA
270 IF P>0 THEN GOTO 290
280 PROC ENDB
290 IF D+W>-(D+W) THEN GOTO 310
300 PROC SIDEB
310 PAUSE 5000
320 NEXT T
330 RUN
340 DEFPROC SIDEA
350 MOVE 128+D-P-W, 150+S+F
360 DRAW 128-D-P+W, 150-S+F
370 DRAW 128-D-P+W, 100+S-F
380 DRAW 128+D-P-W, 100-S-F
390 DRAW 128+D-P-W, 150+S+F
400 ENDPROC
410 DEFPROC ENDA
420 MOVE 128+D-P-W, 100-S-F
430 DRAW 128+D+P+W, 100-S+F
440 DRAW 128+D+P+W, 150+S-F
450 DRAW 128+D-P-W, 150+S+F
460 DRAW 128+D-P-W, 100-S-F
470 ENDPROC
480 DEFPROC SIDEB
490 MOVE 128+D+P-W, 100+S+F
500 DRAW 128+D+P+W, 100-S+F
510 DRAW 128+D+P+W, 150+S-F
520 DRAW 128-D+P-W, 150-S-F
530 DRAW 128-D+P-W, 100+S+F
540 ENDPROC
550 DEFPROC ENDB
560 MOVE 128-D+P-W, 100+S+F
570 DRAW 128-D-P+W, 100+S-F
580 DRAW 128-D-P+W, 150-S+F
590 DRAW 128-D+P-W, 150-S-F
600 DRAW 128-D+P-W, 100+S+F
610 ENDPROC
    
```

Extra colours

Patrick Hill,
Walsall.

DRAGON

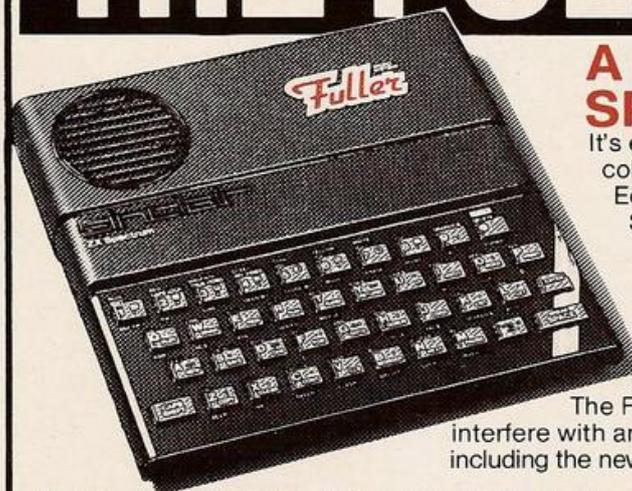
THIS PROGRAM was devised to produce more colours on the Dragon 32. It forms colours by drawing alternate lines of two colours, the numbers of which are contained in C and C1. This gives about 30 usable background colours which will support the usual graphics commands. I have used Draw for the alternate lines though Line works equally well.

```

10 CLS0
20 FOR A = 0 TO 1
30 PMODE3,1: SCREEN1,A:PCLS
40 FOR C = 1 TO 4
50 FOR C1 = 1 TO 4
60 P = 1
70 IF P + C1 = C THEN P = P + (C
  1 + 1) ELSE P = P + C1
80 FOR J = 1 TO 196 STEP 2
90 DRAW "BM0," + STR$(J)
100 DRAW "C" + STR$(C) + "M252
  ," + STR$(J)
110 DRAW "BM0," + STR$(J + 1)
120 DRAW "C" + STR$(C1) + "M25
  2," + STR$(J + 1)
130 NEXT J
140 CIRCLE(128,96),75,P
160 PA INT(128,90),P,P
170 FOR X = 1 TO 1000: NEXT K
180 PCLS1
190 NEXT C1
200 NEXT C
210 NEXT A
    
```

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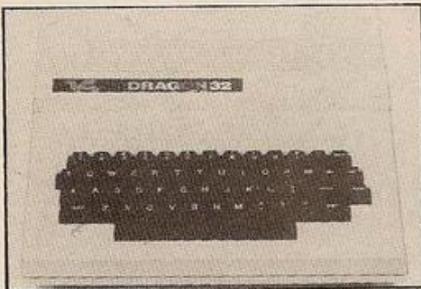
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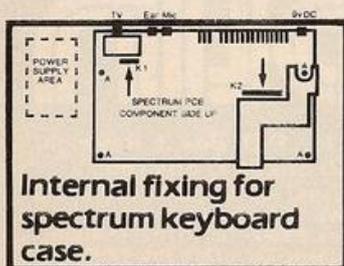
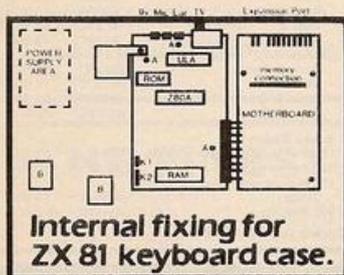
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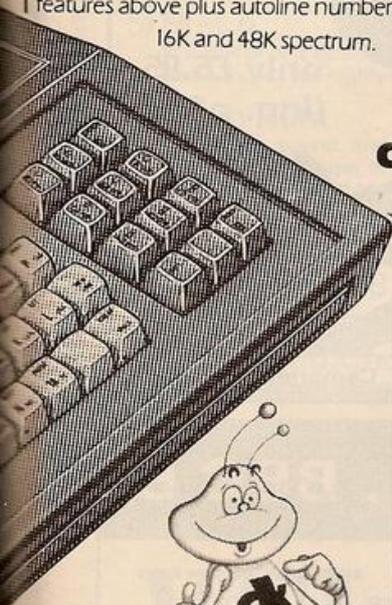
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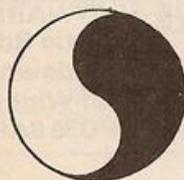
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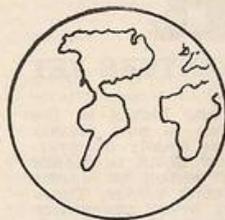
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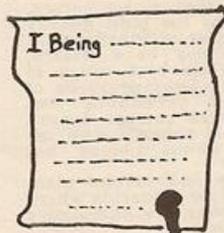
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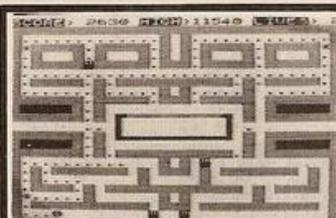
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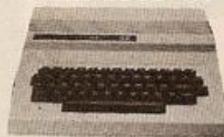


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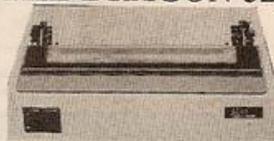
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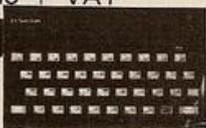


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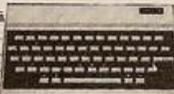
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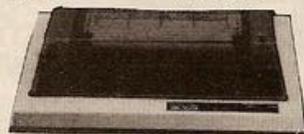


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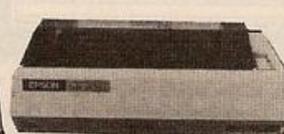


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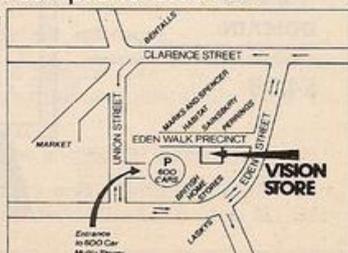
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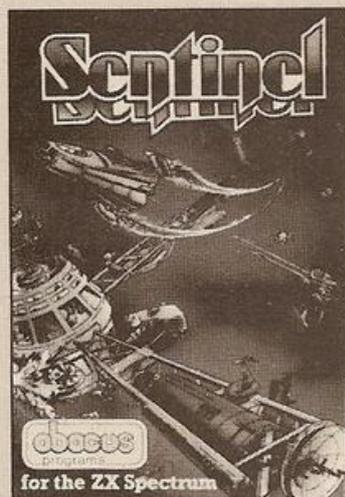
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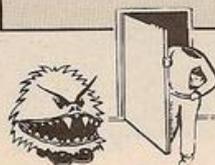


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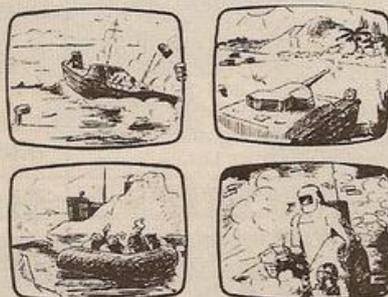
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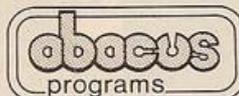
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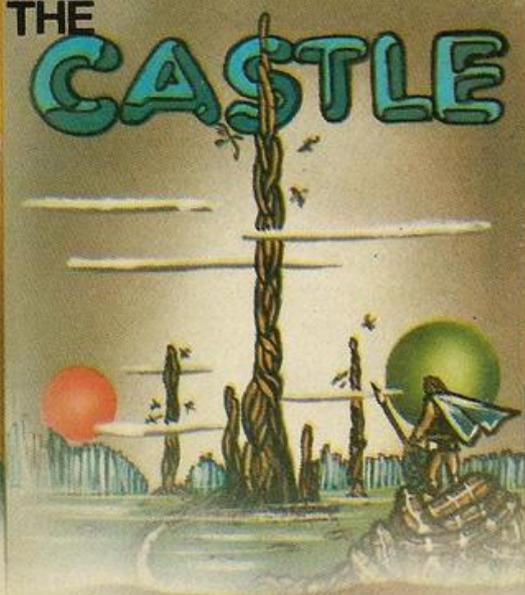
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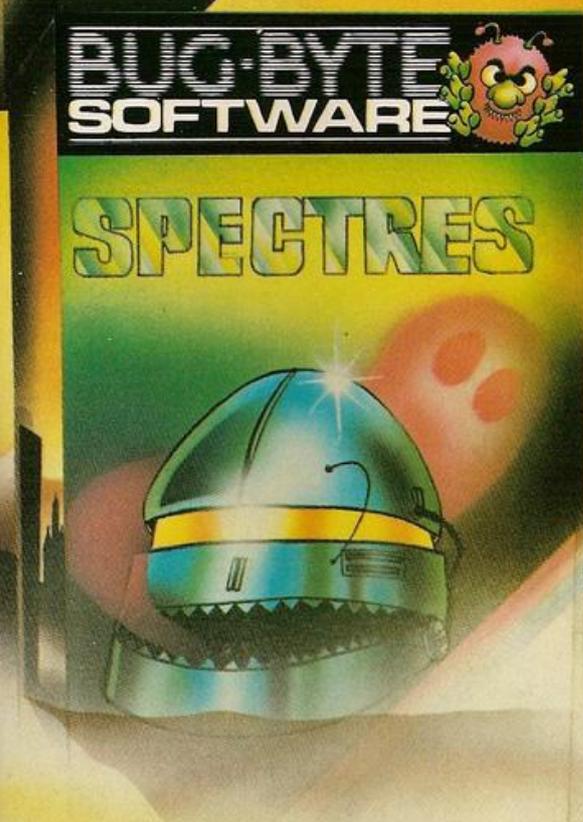
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All about me was darkness. Tens of thousands of screens stared blankly into space. Minds drifted aimlessly, dulled by lack of stimulation. The world was grey, drab, lacking . . .

Then suddenly it happened. First one, then another, then tens, hundreds, thousands of tired screens felt a surge of power and flickered back into life. They were much as I had seen on my own planet's microcomputers – the ZX 81, ZX Spectrum, Vic 20, BBC Micro and ORIC-1.

The minds paused to take stock. They clustered round the screens, their nimble fingers excitedly flicking the controls back and forth. At last they had found a challenge . . . action and adventure with cunning tests of dexterity and reaction. Everywhere, conversation was of Asteroids, Mazogs, Panic, Another Vic in the Wall.

Unable to resist, I too had a closer look. There before me was vivid colour, high resolution graphics. I could practically feel the spine-tingling



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sound effects as whole battle fleets of Cosmiads swarmed out of nowhere and attacked. I should have known. As my fingers raced over the controls, and I prepared to stand and fight with only a single laser bolt for protection, I realised I was trapped!

Too late now, I remembered this was no ordinary software. I'd been warned, as I now warn anyone buying from Laskys, W.H. Smith, Currys Micro C, Spectrum and larger

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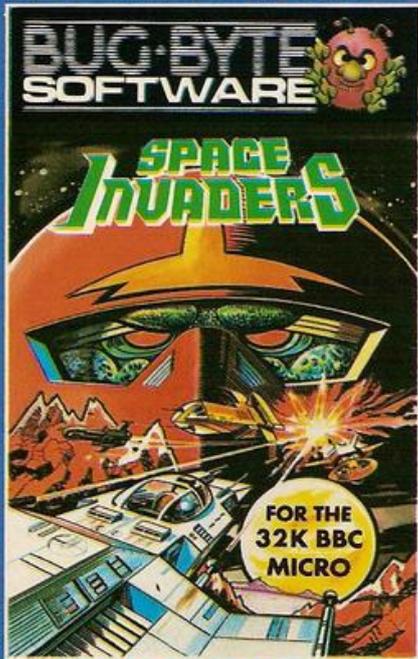
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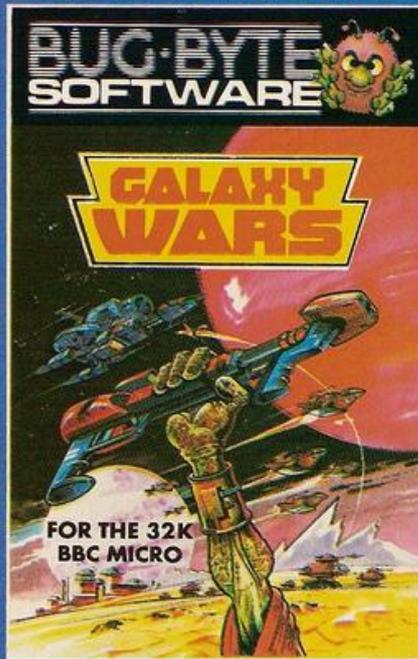


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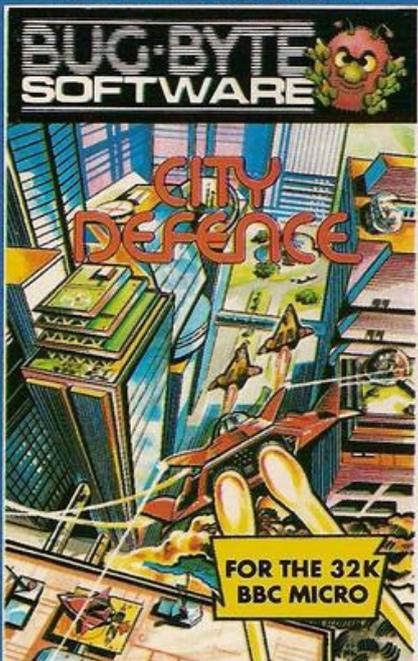
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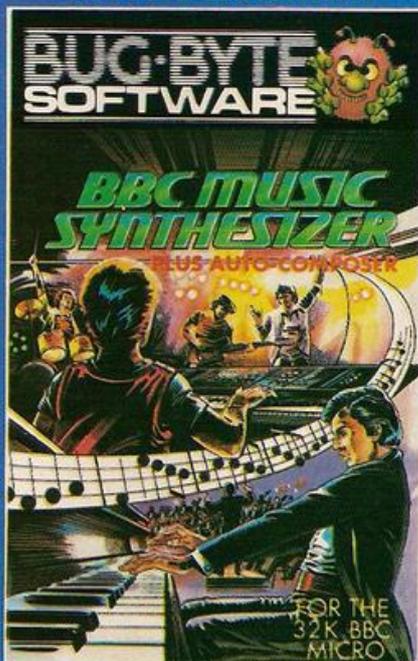


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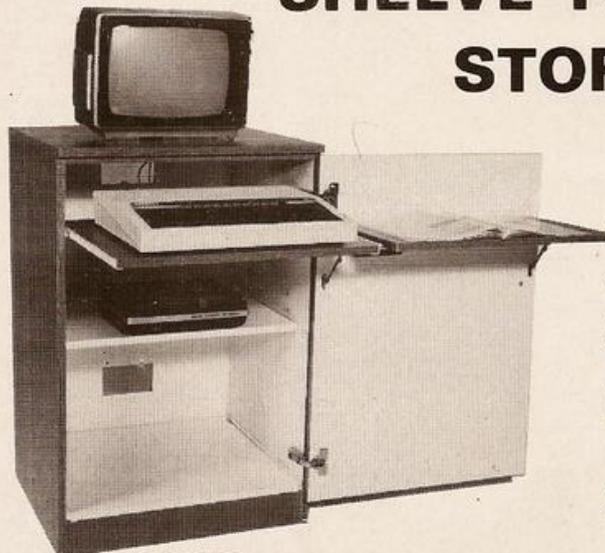
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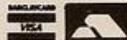
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It was like a nightmare. Trapped in Hell, the all

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MILLIPEDE

Milli the Millipede seemed indestructible; no matter how much of her body I shot away she kept coming! But then Sid the Spider appeared from nowhere, and Scorpi zoomed across dropping her indestructible fleas on me! A quite astounding version of the arcade favourite. £5.95. By Andrew Blake.

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COSMIC SWARM

OK, I accept I'm to blame. I disregarded orders and entered the Altair sector. Eggs, eggs, everywhere I shoot, two fantastical alien types appear, whose touch is deadly! They join, seemingly by chance, into a mutant which chases me! Probably the most original new space 'shoot-em-up' game to appear. Any ZX Spectrum. By Andrew Beale.

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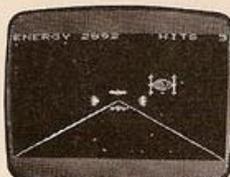
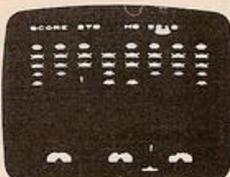


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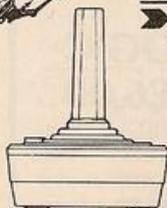
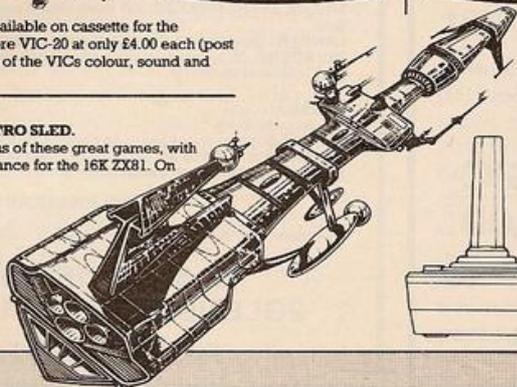
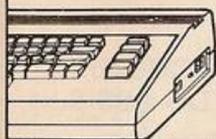
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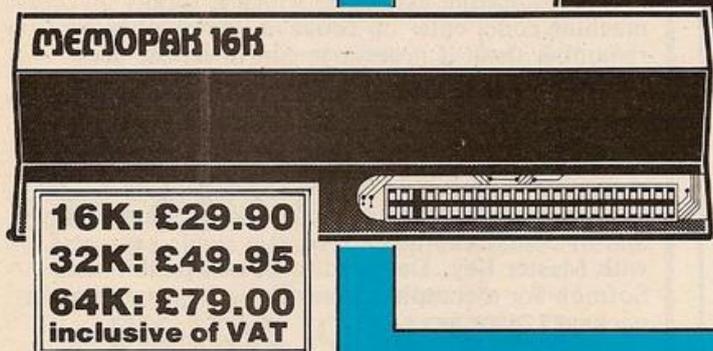
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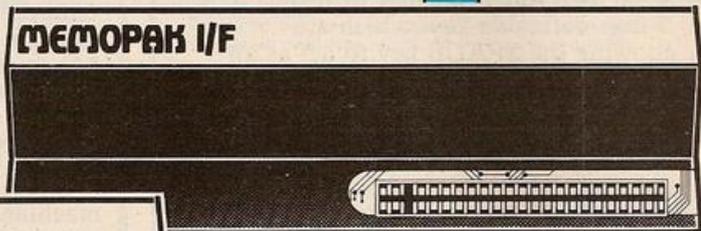
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ZX81

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To ensure that your expectations are realised, care is taken at every stage to design features into the system to anticipate your needs. For example:

1) Memories are cumulative e.g. 16K and 32K can be added

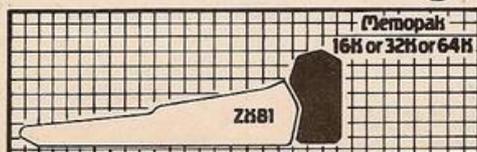
to the Memopak 16K or even to the Sinclair 16K RAM pack. 2) The HRG firmware allows commonly used constructions (such as scrolling, shading and labelling graphs), to be called by a few simple commands. 3) The Centronics I/F converts ZX81 character codes into ASCII and extends the print line to the width of the printer, still using the LLIST, LPRINT and COPY commands.

As one example, a system with 16K of memory and Memocalc is all that is required to perform the same sophisticated numerical projections as a computer at 10 times the price. The problem may be as complicated as a cash flow or production schedule, or as simple as household accounts or pocket money budgeting. If your bank manager wants to see cash flow, then a single print instruction to the Centronics I/F will give a printout which is more than acceptable.

The example system which is shown, on the other hand, would satisfy the needs of someone who wanted to enter data

How it all fits together

You can see from the diagrams how various Memotech/Sinclair units can be combined.



Memotech, the potential of your ZX81...

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MEMOPAK HRG This pack breaks down the constraints imposed by operating at the ZX81 character level and allows high definition displays to be generated. All 248 x 192 individual pixels can be controlled using simple commands, and the built in software enables the user to work interactively at the dot, line, character, block and page levels. Scrolling, flashing and animation are all here.

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Keyboard Buffer

KEYBOARD BUFFER PAK

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via a light-touch keyboard, construct and label graphs, and then copy the screen to an 80-column printer. Only 16K of memory is shown here but with additional memory, more than one video page can be stored. Up to 7 pages can be displayed in rapid succession to give animated displays.

Looking forward, Memotech will continue to back the ZX81 through 1983 with fast storage devices, pressure sensitive electronic drawing boards and more software packs including a Wordprocessor, an RS232 Interface and a Z80 Assembler.

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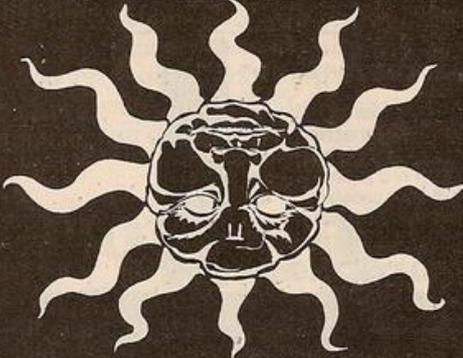
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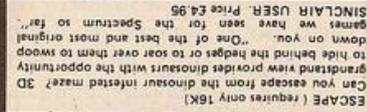
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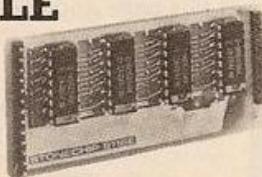
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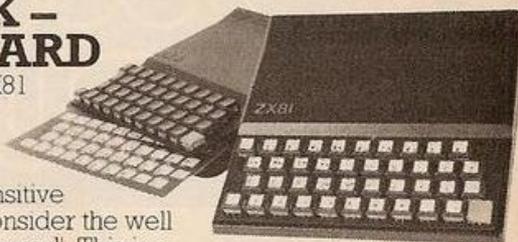
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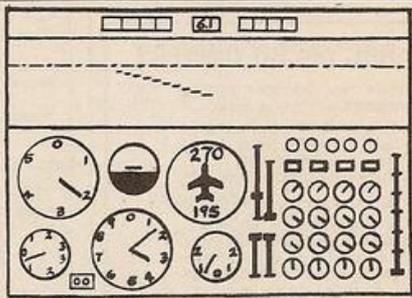
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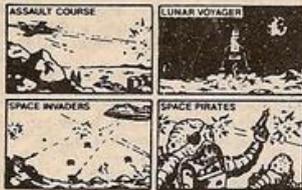
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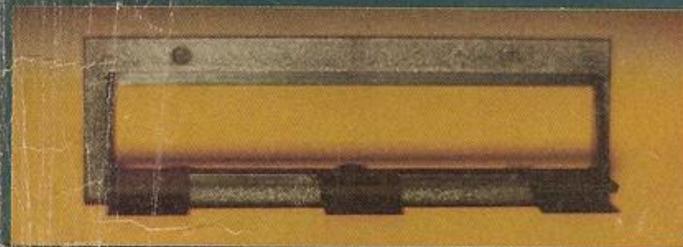
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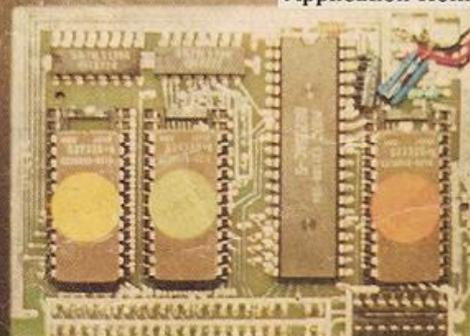
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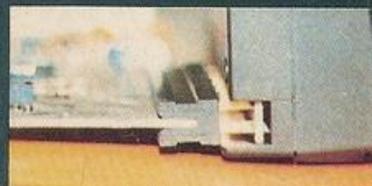
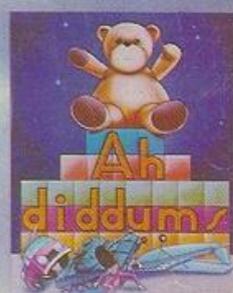
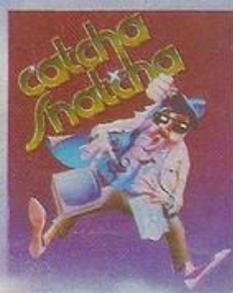
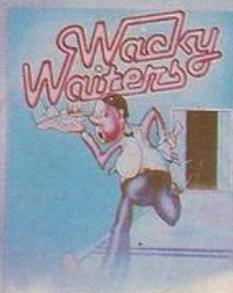
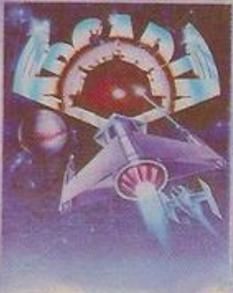


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