LW Rock

POPULAR Computing WEEKLY

35p 18 November 1982 Vol 1 No 31

This Week

Exclusive
Tim Langdell reviews the 48K Lynx from Camputers — a low-cost micro to rival the Spectrum, Dragon and BBC machines. See page 12.

BBC assembler
Can you assemble machine code? Gareth Jones shows you how to make the most of your BBC assembler on page 26.

Spectrum unifile
A utility program that enables you to store and manage data. See page 30.

Dragon Data
The future of the Dragon. David Kelly travels to Swansea to talk to Tony Clarke, managing director of Dragon Data. See page 10.

Vic20 Starfighter
How many enemy starships can you destroy before being overwhelmed? Find out in Terence Wilson's new game for the Vic20 on page 8.

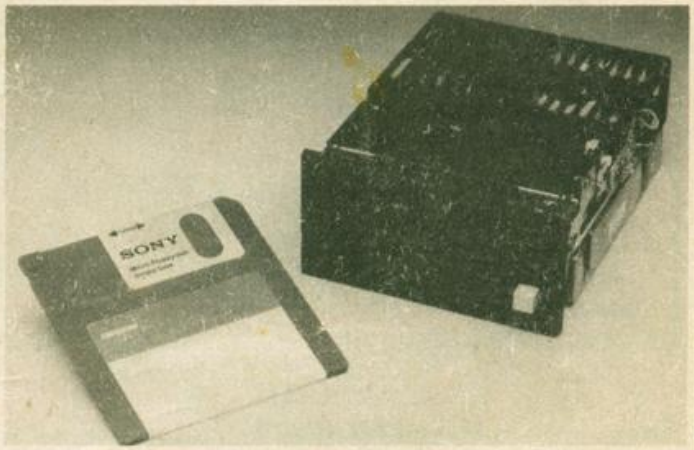
News Desk

Sony launches micro-drive

SONY has launched its new 3½-inch micro-floppy disc drive in the UK.

Priced at £235, the new drive could become an industry standard. It operates with two new single-sided 3½-inch discs developed by Sony in Japan. The single-density disc has a storage capacity of 218.8K at 135 tracks per inch. The double-density disc has a capacity of 437.5K.

The Sony micro-floppy disc goes part of the way towards providing the sort of cheap mass-storage promised by the Sinclair micro-drive. Quite how successful the Sony disc drive will be depends on development of the necessary disc controllers to enable it to be used with a range of personal computers.



Sony's new 3½-inch microfloppy disc drive.

Micro-drive awaits application

THE new Sony £235 micro-floppy disc drive is capable of storing approximately four times as much data as a typical 5¼-inch unit.

However, before the Sony system can be applied to any of the big-selling microcomputers, controllers must be developed.

These disc interfaces allow the computer to access information from, and control the operation of, the disc drive.

Already Hewlett-Packard has produced such a unit to enable the Sony drive to be used with its range of new personal computers.

Acorn Computers is evaluating the system for use with its BBC machine. A spokesman commented "We are looking to cut the cost of disc storage for the BBC machine, but a system, if it is to be adopted, would have to be approved both by us, and by the BBC."

Dragon Data currently has no plans to adopt the Sony drive for its micro. Tony Clarke, Dragon's managing director, explained: "The 5¼-inch disc drive Dragon will launch next Spring will include a controller that will only

Continued on page 5

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Continued on page 32

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All submissions should be typed and a double space should be left between each line. Please leave wide margins.

Programs should, whenever possible, be computer printed.

We cannot guarantee to return every submitted article or program, so please keep a copy. If you want to have your program returned you must include a stamped, addressed envelope.

Accuracy
Popular Computing Weekly cannot accept any responsibility for any errors in programs we publish, although we will always try our best to make sure programs work.

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Editorial

Copyright is an issue which seems to recur with increasing regularity in the micro world.

Over the past few months, a growing number of programs have appeared based on popular books and tv series such as the *Hitchhiker's Guide to the Galaxy*. Unless permission has been obtained from the author and/or publishers, such programs are breaches of copyright.

Little action has been taken so far, mainly, I suspect, because most authors and publishers are unaware that these programs exist.

Software companies who want to base programs around books and films must obtain permission first.

While on the subject of copyright, there has also been an increase in the number of software libraries. Many of these libraries, which hire out tapes at about £1 a time, pay no royalties to the authors of these programs.

Irrespective of the legal position, software libraries should be morally obligated to pay royalties (preferably at least 20 percent) to program authors. Even the public book lending libraries have finally agreed to this principle.

Next Thursday

Can you defend your base against the marauding invaders? Find out in Missile Strike — a new game for 16K ZX81 by David Lawrence.

Other features next week include a look at the musical abilities of the Atari, Vic20 and Dragon 32. Jon Chambers compares these modern micros and sees how they measure up to Mozart and Beethoven.

Also next week, Colin McCormick presents a machine code monitor for the Vic20.

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Sharp products and profits increased

TWO new Sharp microcomputers have gone on sale in Japan at the same time as the company has announced increased profits for 1982.

Selling at £175, the MZ-700 has 64K Ram. A colour printer is also available for the computer, priced at £85. At about £690, the MZ-3500 has 128K Ram and single disc drive. High sales are anticipated and the Japanese company hopes to produce 20,000 MZ-700s and 5,000 MZ-3500s per month. As yet there are no plans to launch the machines in the UK.

The computers are an extension of Sharp's MZ range. Both of the other MZ computers are available in Britain: the MZ-80A at £549 and the MZ-80B at £1,034 — each with built-in cassette drive and display.

The Japanese company has reported interim pre-tax profits up 19.4 percent to over £47m. Full year net profits are expected to top £54m.

Sinclair joysticks for Spectrum

SINCLAIR is to produce its own joystick for the Spectrum microcomputer.

The device will plug into the edge connector on the Spectrum and is of the switching type. It will be able to recognise eight directions and have a 'fire' facility. Software being developed now by Sinclair will be compatible with the new device.

The Sinclair joystick is planned for launch early next year but no price has so far been decided.

Kempston Electronics already market a joystick compatible with the Spectrum which is priced at £19.95.

Sony micro-drive

from page 1

operate up to 80 tracks per inch. With the Sony discs' 135 tracks per inch you would either not be able to use them to full capacity, or you would need to design a new disc operating system to run them. Such a system — a direct memory access system — would cost us about £80. Our 5¼-inch drive will be complete with its own operating system and cost about £250."

Sinclair sceptical

Martin Brenan at Sinclair Research was sceptical that the Sony drives would find application with the Sinclair Spectrum. "Although a floppy-disc based system will be much faster than the Sinclair micro-drive — which has a three-second access time — it is also more than four times the price. Our micro-drive, when it comes out, will revolutionise mass storage thinking."

At £235 for the disc drive plus about £80 for the operating system the Sony microfloppy would offer 437K of storage.

Cromemco launches new system for £1100

CROMEMCO'S Personal Computer is scheduled to go on sale in the UK by the end of December.

The basic C10 unit is Z80A-based with 64K Ram and 24K Rom, RS232, parallel and serial printer ports. It is supplied with integral 12in green screen monitor, but without keyboard, for £795. A keyboard is available at £140, a 5¼-inch floppy disc drive costs £395, and a low-speed daisy-wheel printer is £565.

With a 25 × 80 character display, 20 function keys, four character sets (three text, one graphics), and capable of running CDOS (Cromemco's CP/MR software compatible system), the machine emulates a large-scale unit.

The Personal Computer will be marketed in the UK as the C10 SuperPak. This option includes the C10 unit, keyboard, single disc drive and three software packages. The software packs are the Cromemco Word Processing Pack, 32K Structured Basic and Financial Spreadsheet calculator. The C10 Superpak will cost £1095.

Like the rest of Cromemco's range of microcomputer systems, the Personal Computer will be available from usual UK importers including: Microcentre Ltd, 30 Dundas Street, Edinburgh and Comart Ltd, St Neots, Cambridge.

Plans for 50 more IT Centres

INFORMATION TECHNOLOGY Minister, Kenneth Baker, has announced plans to set up 50 more IT Centres.

This means that 150 centres are now proposed. Of the 100 first planned in 1981, 27 are in operation and 32 more have been finally approved.

The expansion is to go ahead despite criticism that the present IT Centres are lacking in training material. Kenneth Baker said that the IT Centres were "one of the most effective initiatives in post school training."

Youngsters going through the scheme are for the most part without formal educational qualifications and most of the new centres announced will be located in high unemployment city areas.

Kenneth Baker.

Dragon Users Group

EVERYONE who buys a Dragon 32 microcomputer is being offered free membership of the Dragon Users Group.

The group is being organised by Dragon themselves and will publish its first free users' newsletter before the end of the year. The issue will feature software and hardware news and programs for the Dragon.

Teletext on BBC micro in January

ACORN has begun manufacture of its teletext adaptor for the BBC microcomputer.

The receiver will only be for use with the BBC Model B machine and will take the form of a hardware/software combination. It will convert the computer to access the teletext system and down-load telesoftware at a rate of 128K per second.

The adaptor has two parts: a main unit which connects to the computer through the 1MHz bus and a plug-in Rom which must be fitted into the computer.

Available in early January, the complete unit will cost £225.

Competition winners

Nick Lambert.

ROY Butterfield of Keighley, Yorkshire, has won a Dragon 32 in the *Popular Computing Weekly* Whizzkid '82 competition.

His winning *Auto-Sonics* program provides more than 20 different sound effects for the ZX Spectrum. You can vary the tone and tempo of each sound to create your own individual effects.

The *Auto-Sonics* program was chosen from more than 70 entries by *Popular Computing Weekly* Editor Brendon Gore and Quicksilva's Nick Lambert.

Other programs to be commended in the competition included Kevin Kirkland's *Gobble Garden*, Peter Donn's *Snakes and Ladders* and Silas Patrick's *Woods of Winter* adventure.

A special mention goes to Michael Kern of Paris, our first overseas entrant.

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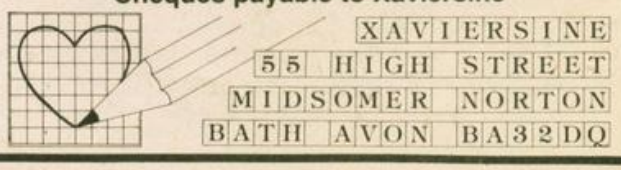

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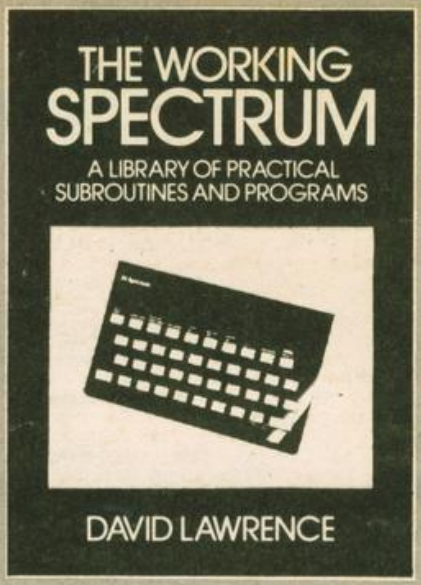
By David Lawrence



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Starfighter

A new game for Vic20
by Terence Wilson

In the aftermath of the Alderean wars, the Galactic Federation has broken up. Individual star systems have set themselves up as mini empires. Communications between the different reaches of the galaxy have broken down.

Born on the planet Deneb, you grew up in the shadow of a tyrannical warlord. But, you were not content to remain a dirt-scratcher — one of the planet bound. You wanted to become a spacer.

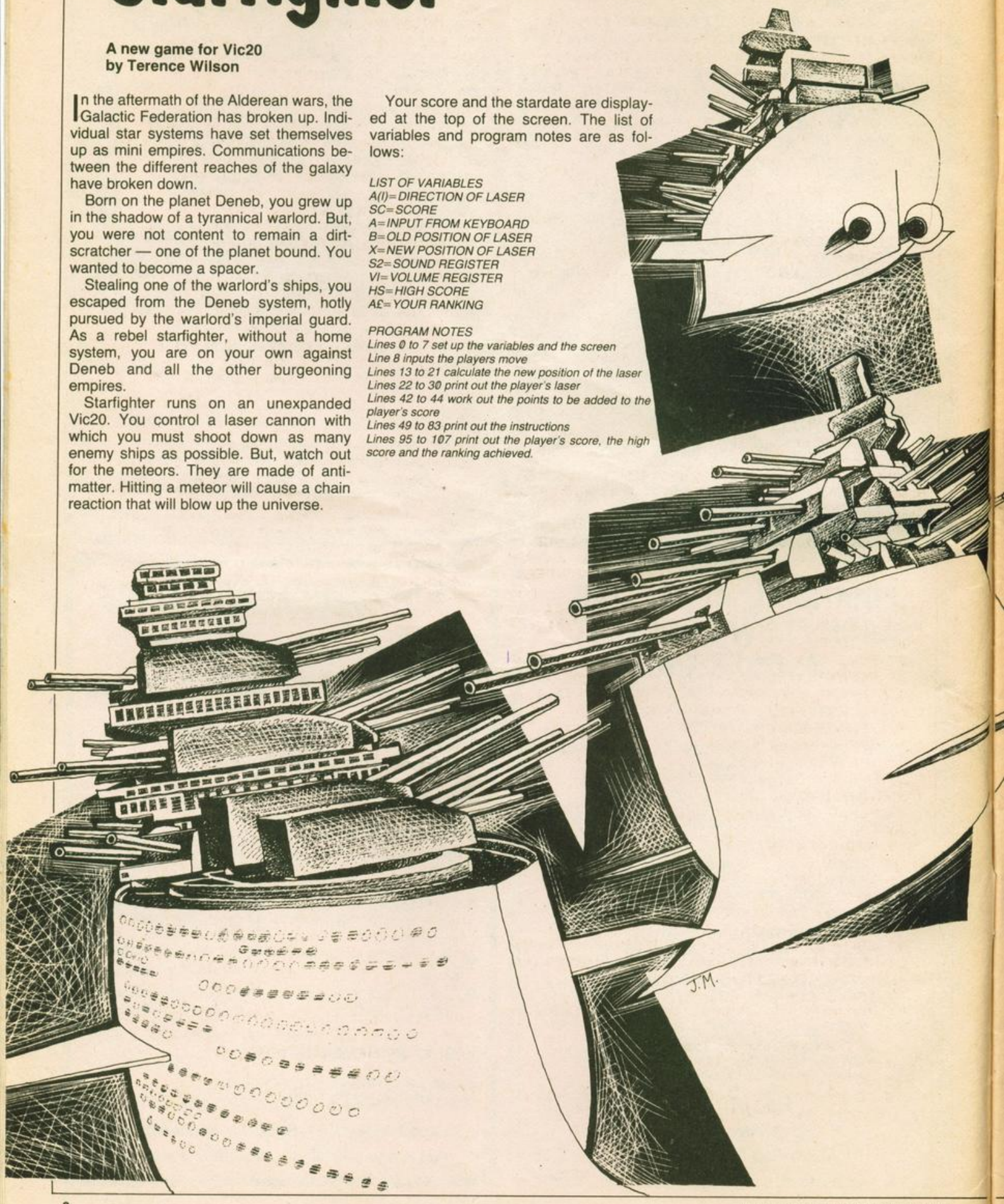
Stealing one of the warlord's ships, you escaped from the Deneb system, hotly pursued by the warlord's imperial guard. As a rebel starfighter, without a home system, you are on your own against Deneb and all the other burgeoning empires.

Starfighter runs on an unexpanded Vic20. You control a laser cannon with which you must shoot down as many enemy ships as possible. But, watch out for the meteors. They are made of anti-matter. Hitting a meteor will cause a chain reaction that will blow up the universe.

Your score and the stardate are displayed at the top of the screen. The list of variables and program notes are as follows:

LIST OF VARIABLES
A(I)=DIRECTION OF LASER
SC=SCORE
A=INPUT FROM KEYBOARD
B=OLD POSITION OF LASER
X=NEW POSITION OF LASER
S2=SOUND REGISTER
VI=VOLUME REGISTER
HS=HIGH SCORE
A£=YOUR RANKING

PROGRAM NOTES
Lines 0 to 7 set up the variables and the screen
Line 8 inputs the players move
Lines 13 to 21 calculate the new position of the laser
Lines 22 to 30 print out the player's laser
Lines 42 to 44 work out the points to be added to the player's score
Lines 49 to 83 print out the instructions
Lines 95 to 107 print out the player's score, the high score and the ranking achieved.



```
 0 A(1)=1:A(2)=22:A(3)=-21:GOSUB57:R=81
 1 U=U+1:S2=36876:Y=30720:C0=36879:
V1=36878:POKEC0,14
 2 POKEV1,15:DEFFNR(X)=INT(RND(1)*X+1)
 3 PRINT"■":FORI=1TO200:A=FNR(439)+7724:
POKEA,46:POKEA+Y,FNR(6):NEXT:X=7910
 4 FORI=7702TO7723:POKEI,160:POKEI+Y,1:
POKEI+462,160:POKEI+Y+462,1:NEXT
 5 FORI=7724TO8142STEP22:POKEI,160:POKEI
+Y,1:POKEI+21,160:POKEI+Y+21,1:NEXT:TI$=
"000000"
 6 N=1:C=FNR(439)+7724:IFPEEK(C)=
160THEN6
 7 PRINT"■■TIME:"RIGHT$(TI$,3);"
SCORE:"SC
 8 A=PEEK(197):IFA=64OR(A<>17ANDA<>33AND
A<>29ANDA<>30ANDA<>37)THEN30
 9 IFFNR(30)>1THEN12
 10 K=FNR(439)+7724:IFPEEK(K)=160THEN10
 11 POKEK,42:POKEK+Y,FNR(5)+1
 12 IFA=37THEN38
 13 IFA=17ANDPEEK(X-22)=160THEN30
 14 IFA=33ANDPEEK(X+66)=160THEN30
 15 IFA=29ANDPEEK(X-1)=160THEN30
 16 IFA=30ANDPEEK(X+3)=160THEN30
 17 B=X
 18 IFA=17THENX=X-22
 19 IFA=33THENX=X+22
 20 IFA=29THENX=X-1
 21 IFA=30THENX=X+1
 22 POKEB,32:POKEB+1,32:POKEB+2,32:POKEB
+22,32:POKEB+24,32:POKEB+44,32:POKEB+45,32
 23 POKEB+46,32:B=X
 24 IFPEEK(B)=42ORPEEK(B+1)=42ORPEEK
(B+2)=42ORPEEK(B+22)=42ORPEEK(B+24)=42
THEN48
 25 IFPEEK(B+44)=42ORPEEK(B+45)=42ORPEEK
(B+46)=42THEN48
 26 POKEX,112:POKEX+1,68:POKEX+2,110:
POKEX+22,93:POKEX+24,93:POKEX+44,109:
POKEX+45,70
 27 POKEB+46,125
 28 POKEX+Y,1:POKEX+Y+1,1:POKEX+Y+2,1:
POKEX+Y+22,1:POKEX+Y+24,1:POKEX+Y+44,1
 29 POKEX+Y+45,1:POKEX+Y+46,1
 30 IFN=0THEN35
 31 IFFNR(10)=1THENR=65
 32 IFFNR(20)=1THENR=90
 33 B=A(FNR(3)):IFPEEK(B+C)=160THEN
POKEC,32:N=0:GOTO7
 34 POKEC,32:C=C+B:POKEC,R:POKEC+Y,
1:GOTO7
 35 N=1:C=FNR(439)+7724:IFPEEK(C)
=160THEN35
 36 IFR=65ORR=90THENR=81
 37 GOTO7
 38 POKEC0,120:POKEX+1,66:POKEX+22,67:POK
EX+24,67:POKEX+45,66
 39 FORL=1TO20:FORM=250TO240STEP-1:POKES
2,M:NEXTM:FORM=240TO250:POKES2,M:NEXTM
 40 POKES2,0:NEXTL:POKEC0,14
 41 IFR=65ORR=90THENR=81
 42 T=PEEK(X+23):IFT=81THENSC=SC+10:GOTO
46
 43 IFT=65THENSC=SC+100:GOTO46
 44 IFT=90THENSC=SC+1000:GOTO46
 45 GOTO7
 46 POKE36877,220:FORL=15TO0STEP-1:POKEV
1,L:FORM=1TO150:NEXTM:NEXTL:POKE36877,0
 47 POKEX+23,32:POKEV1,15:GOTO35
 48 FORI=8TO255:POKEC0,I:NEXT:POKEC0,27
 49 PRINT"■■■       STARFIGHTER      ■■"
 50 PRINT"■ YOU HAVE JUST CAUSED"
 51 PRINT"■ A SUPER-NOVA TO BLOW"
 52 PRINT"■UP THE GALAXY..HOWEVER"
 53 PRINT" YOU DID SURVIVE FOR■"
 54 PRINTMID$(TI$,3,2)" MINUTES "RIGHT$
(TI$,2)" SECONDS"
 55 PRINT"■ AND SCORED";SC(U);"POINTS"
 56 GOSUB86:RESTORE:GOTO95
 57 PRINT"■■■      STAR FIGHTER      "
 58 PRINT"■■YOU ARE THE COMMANDER"
 59 PRINT"■OF A GALACTIC SPACE"
 60 PRINT"■ORBITER,AND YOU HAVE"
 61 PRINT"■BEEN ATTACKED BY A"
 62 PRINT"■FLEET OF ASTRO-MUTANTS"
 63 PRINT"YOUR TASK IS TO SHOOT"
 64 PRINT"■THEM WITH YOUR LASER"
 65 PRINT"■ [.]=FIRE  [/]=RIGHT"
 66 PRINT" [,]=LEFT  [A]=UP"
 67 PRINT"       [Z]=DOWN"
 68 PRINT"■■HIT A ■KEY■ TO COMMENCE"
 69 GETA$:IFA$=""THEN69
 70 PRINT"■■■      STAR FIGHTER      "
 71 PRINT"■  YOU HAVE UNLIMITED"
 72 PRINT" TIME TO DO THIS BUT"
 73 PRINT"  YOUR TASK BECOMES"
 74 PRINT"HARDER AS MORE METEORS"
 75 PRINT"APPEAR (*) IF YOU HIT"
 76 PRINT" ONE YOU WILL DESTROY"
 77 PRINT" THE ENTIRE UNIVERSE"
 78 PRINT"■AND GOD WILL GET MAD!"
 79 PRINT"POINTS,AS FOLLOWS"
 80 PRINT"■  ●=10 POINTS"
 81 PRINT"■  ♠=100 POINTS"
 82 PRINT"■  ◆=1000 POINTS"
 83 PRINT"■  HIT A ■KEY■ TO BEGIN"
 84 GETA$:IFA$=""THEN84
 85 RETURN
 86 S2=S2-1
 87 READP
 88 IFP=-1THENRETURN
 89 READD:POKES2,P
 90 FORN=1TOD:NEXT
 91 POKES2,0:FORN=1TO20:NEXT:GOTO87
 92 S2=S2+1:RETURN
 93 DATA195,800,0,80,195,600,0,80,195,200,
195,800,0,80,203,600,201,200,0,80,201,600
 94 DATA195,200,0,80,195,600,0,80,195,200,
0,80,195,1000,-1
 95 PRINT"■■■■■YOU HAVE ACHIEVED THE"
 96 PRINT"■    RANK OF.....■"
 97 IFSC>-1THENA$="       ■GRANNY"
 98 IFSC>20THENA$="   ■LOWER COMMANDER"
 99 IFSC>40THENA$="    ■SPACE CAPTAIN"
 100 IFSC>70THENA$="■ADMIRAL OF THE FLEET"
 101 PRINTA$
 102 IFSC>HSTHENHS=SC
 103 PRINT"■THE HIGHEST SCORE"
 104 PRINT"    YOUR SCORE:"
 105 PRINTTAB(5)SC
 106 PRINTTAB(5)HS
 107 PRINT"■■ANOTHER GO (Y/N)?"
 108 GETA$:IFA$<>"N"ANDA$<>"Y"THEN108
 109 IFA$="Y"THEN1
READY.
```

The number of the beast

***David Kelly** talks to Tony Clarke about the Dragon 32 and its prospects.*

Tony Clarke, Dragon managing director designate.

That the manufacturer of Corgi model cars should branch out and produce a highly successful microcomputer always seemed faintly bizarre.

And, indeed, three weeks ago Mettoy was forced to sell more than 80 percent of the Dragon venture to help overcome spiralling debts arising from the collapse of its toy market.

At the time, however, looking out from within Mettoy, the move seemed perfectly natural.

The Dragon 32 was the brain-child of Mettoy director, Tony Clarke. Having pursued a dual career as management consultant and electrical engineer — ending as financial director of Mettoy — he was in an ideal position to spot the potential.

Two years ago Tony bought an Apple for himself. "I started to look at what it did — and to compare it with the other machines on the market," he explains. "It struck me

Twenty-four-hour soak-testing.

that our company could do a better job — in terms of value for money.

"Mettoy is a strange animal. It has enormous resources — machine tool making, plastic moulding, high-volume manufacturing capacity and marketing skills. All the things in fact that infant computer manufacturers lack.

"If you look at most of the British microcomputer manufacturers, they do not have the organisational and non-computing skills necessary for producing a high-volume product. They end up sub-contracting much of that work out — leading to all sorts of problems.

"Mettoy has 200 plastic moulding machines of various sizes and over 1000 assembly workers used to working on small intricate assemblies."

So Mettoy appeared well placed to produce a computer — especially since it has dabbled in electronic products before — like radio-controlled cars. In addition, Mettoy was very keen to diversify.

The company has shown a financial deficit over the last two years totalling £5.6m, caused by the collapse of its traditional markets. Mettoy has always regarded the three to 14 age range as the purchasers of its toys. In the last couple of years all that has changed. It now sells to three- to eight-year-olds. The over-nines now buy electronic goods — computers, video games, tape recorders and televisions.

"So an ex-employee of Mettoy — Gerry Quick (who did a PhD in computer science) and I, got together," says Tony. And the result of those discussions formed the basis of what is now called the Dragon.

"I looked at the various available microprocessors. We had a major advantage over other manufacturers in that we were not committed to any particular processor — such as the Z80 or 6502. The 6809 which was chosen for the Dragon was particularly suitable for graphics — its 16-bit register makes them fast. We also chose the SAM (Synchronous Address Multiplexer) chip which carries out many of the functions that would usually go into Rom on a Z80- or 6502-based machine.

"The combination of these two chips makes the computer very cheap to manufacture and very powerful in use.

"We chose Microsoft Basic because it was there — and we didn't have to get the whole of the UK debugging the software in service — all that was already done. Microsoft is very powerful. The 16K Rom gave us all the features we wanted and easy-to-use graphics. We took the version of Basic from Microsoft that is used on the Tandy Colour Computer and wrote our own input/output drivers. That is why the Dragon is faster than the Tandy.

"In September 1981 we pursuaded the Mettoy Board to agree to the manufacture of a prototype — and the PATS Centre in Cambridge was engaged to build it. The Board took a lot of convincing that they should give the go-ahead. In the end I pursuaded them to hold a board meeting down at the 1981 *Personal Computer World* show. They saw hundreds of kids hammering away at keyboards programming micros in ways they couldn't begin to comprehend and they were convinced!

"The prototype was finished at the end of November. When they saw what it could do they gave full agreement to the project and the PATS Centre was contracted to engineer the production."

The Dragon 32 went into production in July this year. Its launch, manufacture and sales have all gone off untarnished by the kind of production difficulties which habitually plague its rivals.

"The reason for that is quite simple," explains Tony. "Mettoy is a manufacturing company. Its whole life is devoted to production in high volume, and we just tapped into that resource. A few thousand Dragons per week really makes very little difference to the plant at Swansea. I suppose Mettoy must make getting on for half a million Corgi toys every week. Besides, at the moment, assembly of the boards is being carried out by Race Electronics in Llantrisant.

"When we designed the Dragon we tried to make it well built and good value for money. We could have made the Dragon a 16K machine and done just as well with it — but that is not our philosophy. Ram is cheap if you design it in in the first place — and we are not into ripping people off. We tried to make it robust — and we gave it a good keyboard. That board costs ten times more than the one on the Spectrum — but it was worth it. I'm convinced that it is one of the reasons the Dragon sells.

"It was really designed with my own family in mind — I have three sons aged between 10 and 15. Their interests are in

graphics and in games. On the Apple we had at home, the graphics were difficult to get at. I decided the Dragon must have fast, easily-accessible graphics — so it has the *Draw, Circle, Line* and *Paint* commands. And it has been designed to be well suited for games playing.

"A lot depends on production — our only constraint at the moment. We are now turning down retail orders for Christmas and only taking 1983 orders. Even so we will produce 30,000–35,000 machines this year.

"It was a very positive decision to sell the Dragon in high street shops. At £200 the machine is a considered purchase. There is only so much information you can get from an advertisement — and actually being able to try out the machine in the shop is very important. You can't do that through mail-order.

"All the big chain stores are going through a transition period — they are learning that they cannot sell computers in the same way as a tv or hi-fi. The big multiples will, I am sure, end up with special micro display areas within the stores staffed with people who know what they are doing. A computer is a specialist sale.

"We see a great future for the Dragon. It will continue as a product at least until 1985 with enhanced features. It is big — and the inside can change an awful lot without needing to change the moulding.

"February or March next year should see a disc-operating system and discs. The disc controller will operate any 40 tpi or 80 tpi 5¼in double- or single-sided disc drives. We will be offering a 40 tpi drive. The operating system and discs will be available together for around £250.

"We have more or less finished design work on a multi-tasking operating system for the machine — an OS9 system. Using it the Dragon will be able to do more than one thing at a time. The OS9 system can also support a whole range of compilers — Forth, Pascal, Cobol, Unix and 09-structured Basic, all of which will enhance the value of the machine to the serious micro user.

"We will also do a special version for use in education — with built-in RGB monitor and cassette player — and a networking system is being developed.

"There will be an expansion box early next year, giving a 64K Dragon. The expansion kit will include the OS9 system, an editor/assembler, and O9 Basic — all for less than £150.

"The whole theme from Dragon is good quality and good value for money — and we try very hard not to offer what we don't have. We will be going for Roms on the disc-operating system in the next two or three weeks — and we will announce the launch to the public at the time we can manufacture it, and not before.

"As the machine grows, software is going to become more and more important. We have a range of small business software — using the disc system — planned for the Spring. This will be followed by more games, home utilities — again making use of the discs — and a range of educational software for schools."

All of which explains Mettoy's decision to sell Dragon to a consortium in which it holds only an 18.61 percent share. Such an ambitious development program requires considerable capital expenditure — expenditure which Mettoy at present can ill afford.

The sale — giving Prutec (the Prudential Group's high-technology investment company) a 40.74 percent stake in Dragon Data — will raise £2.4m to fund the development programme. Mettoy retains the option to buy back into the company, to the tune of 35 percent, in 1984–85, and will continue to manufacture and assemble the body of the Dragon micro.

"Dragon Data will manufacture between 150,000 and 200,000 machines next year of which at least half will be exported, first to Europe and then the US and Japan. The only problem is compatibility with the various tv systems. We will have a SECAM version for France in a few weeks. NTSC is easy, and of course we already have a PAL version.

"Dragon also has an entirely new machine, scheduled for the third quarter of 1983. It will complement the Dragon — not replace it — and is aimed at another very specific undeveloped area of the market. It will not be 6809 but will run both 6809 and 68000 software.

"We may call it the Super Dragon — but we will sort out the name when we get a little closer to it!"

Assembling and quality-checking.

The Lynx: pause for thought

***Tim Langdell** presents the first review of the 48K Lynx from Camputers – a low cost micro that is equally at home in the house or the office.*

The 48K Lynx.

At £225, the Lynx from Camputers of Cambridge promises to be one of the most exciting new micros to arrive on the scene this year. It offers 48K of Ram as standard, expandable almost without limit in 64K blocks, and 32K of video memory (leaving 16K of workspace) expandable to 64K for even higher resolution graphics. Its Basic is among the most advanced available, and its potential for future expansion is among the best there is.

The heart of the Lynx is a Z80A CPU as used in the Spectrum, ZX81, early Tandy machines and the Research Machines 380Z. The Z80A is probably the most advanced 8-bit CPU presently available (although lovers of the 6809 may argue differently). It has a well-structured machine language which makes the design of a sophisticated micro relatively easy compared with the less sophisticated 6502 chip (as used on the BBC machines for instance). However, using the Z80A with more advanced high-resolution colour micros can lead to problems with screen handling — but more of that later.

The Lynx comes with 48K of Ram and 16K of Rom. Of the 48K Ram, 32K is used as video Ram allowing a bit-addressable high-resolution graphic display of 248 by 256. The eight available colours are bit-addressable, too. Thus the Lynx can put all eight colours in a single character square, unlike its nearest rivals the Spectrum or the Dragon 32. The text is 40 columns by 24 rows and is thus teletext compatible — again unlike the Dragon or the Spectrum.

The Ram can be extended indefinitely in banks of 64K, much as the NewBrain can be. Being Z80A based and capable of such Ram upgrade, the Lynx is able to run CPM TM, unlike all other micros in this price range. Although the video memory is standard at 32K, it can be upgraded to 64K by a very simple modification, giving 80-column text display instead of the regular 40-column version. The potential for the business market is clear. Moreover, a disc drive card which plugs inside the casing will become available soon. It has an RS232 interface as standard, and a parallel interface is an integral part of the disc card.

What Camputer's programming expert, Davis Jansons, has managed to cram into the 16K of Rom in the Lynx is quite incredible. He has created a new Basic with similarities to Microsoft, BBC Basic and Sinclair Basic, too. The Lynx's Basic is structured as the BBC machine's is — with *Procedures, If-Then-Else,* and so on — but goes further than the BBC by having *While* and *Wend*, too.

John Shirreff and Davis Jansons.

Davis has made the entry of machine code from Basic a superbly easy task for the more serious programmer. The keyword *Code* has been included to indicate that what follows are *Hex* bytes of machine code. The keyword *Call* then enables the user to call the machine code routine from Basic and *Lctn* xxx allows the user to indicate that the machine code routine is in line number xxx. All of which adds up to an extremely useful tool.

The more usual Basic keywords are, of course, also there, with many enhancements. For instance, as well as offering *Goto* and *Gosub,* the Lynx offers *Goto Label* and *Gosub Label* which allows the user to give a subroutine or part of a program a label rather than refer to it by its starting line number. The Spectrum also effectively supports such a facility because it will allow numeric variables to have full names. However, the Lynx, while only allowing single character variables, does offer a more obviously structured Basic.

The attention given to making programs clear, easy to read and write, is laudable. Camputers has even made the Lynx's listings indented, with *For-Next* loops being more indented than other statements, and so on. While this feature is possible on the BBC machines, too, it is a relief not to have to type in additional commands to achieve this useful feature.

In brief, then, the Lynx's Basic is superbly complete, offering many luxuries such as auto line numbering, deletion of line num-

The Lynx.

bers, direct entry to the monitor *(Mon)*, renumber, and even a keyword *Ext* which allows the user to add extra Basic keywords called from Ram or stored on Eproms or Roms.

Davis Jansens has aimed to make Lynx Basic among the fastest around. While no 'bench test' type figures are available yet, running many standard tests of speed on the Lynx puts it in a class alongside the BBC machines.

However, while the Lynx Basic's speed of execution is fast, its screen handling is rather slow. This seems to be due to the inherent problem of screen handling with a Z80A when high resolution colour and graphics are being supported. When displaying to the screen, the Lynx seems to be several orders of magnitude slower than machines using the 6502 (such as the BBC) or the 6809 (such as the Dragon). This is a great pity, given that the availability of colour definition at the pixel level makes the writing of colourful games very tempting — without recourse to good machine code writing though, fast-moving games on the Lynx may not be possible.

This said, there is no other micro for its price (except perhaps the recent MPF2 from Multitech) that allows true high resolution colour. The Lynx also has many built-in graphics commands such as *Draw, Move, Plot, Paint, Ink* and *Paper* (at least some of Sinclair Basic has caught on). The Lynx also offers a *Window* facility, enabling the user to define a text window within the normal screen area — much as the BBC machines do.

Autorun

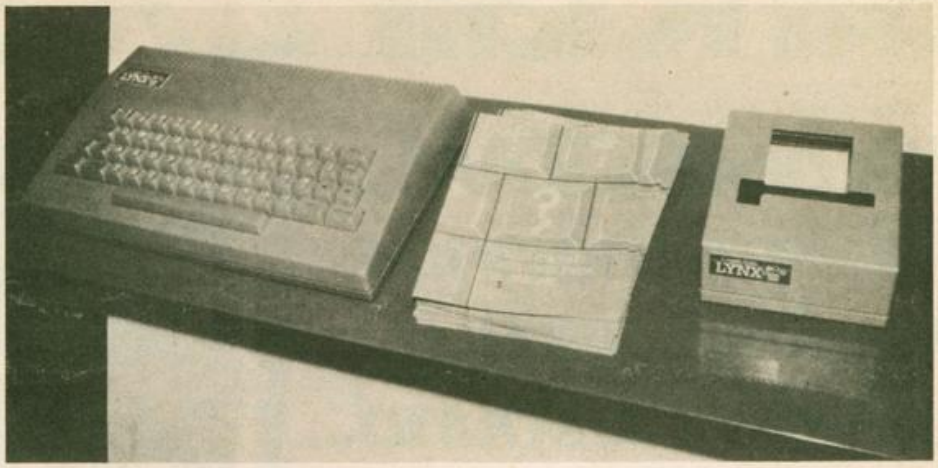
As with the ZX Spectrum, programs can be *Saved* to tape followed by both a name and *Line* which causes the program to autorun upon *Loading*. Unlike the Spectrum, though, the Lynx makes it easy to have *Appended* (ie *Merged*) programs autorun, too.

Other non-standard features also, are rather nice. For instance, the Lynx has an immediate calculator mode where you simply type in the numbers, eg 4*65, no keywords such as *Print* being necessary.

Whereas you would normally type in a program in full on the Lynx, as with most machines, it is also possible to have Spectrum-like single-key entry of just about every command. Simply press the *Escape* key along with any of the main keyboard keys. This feature is excellent, and once again shows the great deal of thought that has gone into the Lynx.

The keyboard also deserves a mention, as does its general appearance. The keyboard is among the best I have used on a micro — standing alongside the BBC machine as my favourite for touch-typing. The quality seems up to the standard of many word processors at least. The casing of the Lynx is both functional and elegant — the sort of design which would be equally suited to the home as to the office.

The room for expansion of this machine is very good indeed. A 5¼in disc drive should be available soon, and a 40-way bus at the rear of the machine brings out most of the connections necessary for hardware additions. The Lynx comes standard with rgb+sync, composite video and pal outputs all available from sockets at the back.

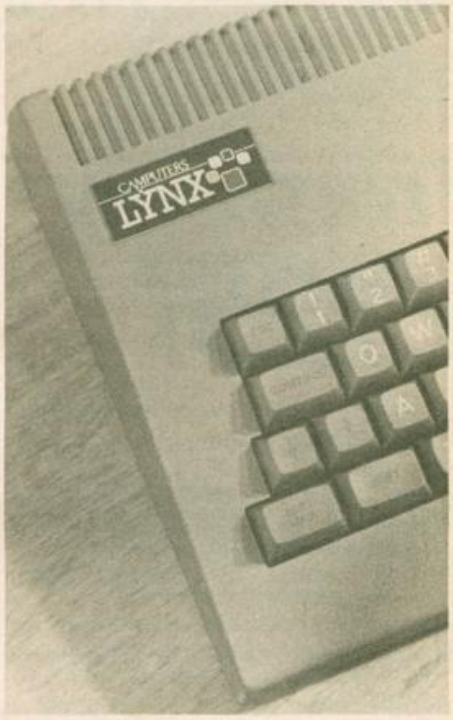


Lynx computer and printer.

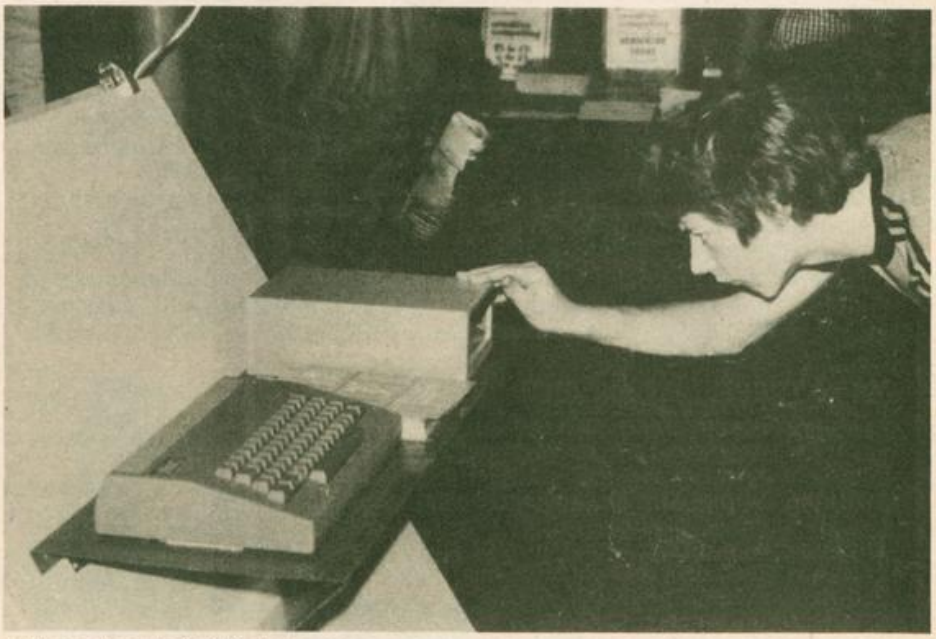
In conclusion, Lynx seems to have struck a very good middle ground in trying to please the serious user, the first time buyer of a home computer, and the small business user. In many ways the Lynx must rival micros costing at least twice as much (such as the BBC model B and new SuperBrain) in the business sector, as well as offering extremely strong competition to micros in the £175 to £225 region such as the Dragon 32, the Vic and the 48K Spectrum.

The Lynx is perhaps less well equipped than some others in the market for games playing (the screen handling is slow, and there is no ready provision for joysticks or plug-in Roms), but it does offer a full eight colours in true high resolution which no other similar-priced micro can offer.

All in all, the Lynx is excellent value at £225 for the standard 48K version.



Camputers' Lynx.



Taking a closer look at the Lynx.

Sinclair ZX Spectr

16K or 48K RAM... full-size moving-key keyboard... colour and sound... high-resolution graphics...

From only £125!

First, there was the world-beating Sinclair ZX80. The first personal computer for under £100.

Then, the ZX81. With up to 16K RAM available, and the ZX Printer. Giving more power and more flexibility. Together, they've sold over 500,000 so far, to make Sinclair world leaders in personal computing. And the ZX81 remains the ideal low-cost introduction to computing.

Now there's the ZX Spectrum! With up to 48K of RAM. A full-size moving-key keyboard. Vivid colour and sound. High-resolution graphics. And a low price that's unrivalled.

Professional power– personal computer price!

The ZX Spectrum incorporates all the proven features of the ZX81. But its new 16K BASIC ROM dramatically increases your computing power.

You have access to a range of 8 colours for foreground, background and border, together with a sound generator and high-resolution graphics.

You have the facility to support separate data files.

You have a choice of storage capacities (governed by the amount of RAM). 16K of RAM (which you can uprate later to 48K of RAM) or a massive 48K of RAM.

Yet the price of the Spectrum 16K is an amazing £125! Even the popular 48K version costs only £175!

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

Ready to use today, easy to expand tomorrow

Your ZX Spectrum comes with a mains adaptor and all the necessary leads to connect to most cassette recorders and TVs (colour or black and white).

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.

um

The ZX Printer – available now

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

A special feature is COPY which prints out exactly what is on the whole TV screen without the need for further instructions. Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your ZX Spectrum. A roll of paper (65ft long and 4in wide) is supplied, along with full instructions. Further supplies of paper are available in packs of five rolls.

The ZX Microdrive – coming soon

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

Each Microdrive is capable of holding up to 100K bytes using a single interchangeable microfloppy.

The transfer rate is 16K bytes per second, with average access time of 3.5 seconds. And you'll be able to connect up to 8 ZX Microdrives to your ZX Spectrum.

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

A remarkable breakthrough at a remarkable price. The Microdrives are available later this year, for around £50.

How to order your ZX Spectrum

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day. BY FREEPOST – use the no-stamp needed coupon below. You can pay by cheque, postal order, Access, Barclaycard or Trustcard.

EITHER WAY – please allow up to 28 days for delivery. And there's a 14-day money-back option, of course. We want you to be satisfied beyond doubt – and we have no doubt that you will be.

To: Sinclair Research, FREEPOST, Camberley, Surrey, GU15 3BR. **Order**

Qty	Item	Code	Item Price £	Total £
	Sinclair ZX Spectrum – 16K RAM version	100	125.00	
	Sinclair ZX Spectrum – 48K RAM version	101	175.00	
	Sinclair ZX Printer	27	59.95	
	Printer paper (pack of 5 rolls)	16	11.95	
	Postage and packing: orders under £100	28	2.95	
	orders over £100	29	4.95	
			Total £	

Please tick if you require a VAT receipt ☐

*I enclose a cheque/postal order payable to Sinclair Research Ltd for £ _____

*Please charge to my Access/Barclaycard/Trustcard account no.

*Please delete/complete as applicable

Signature

PLEASE PRINT

Name: Mr/Mrs/Miss

Address

POC811

FREEPOST – no stamp needed. Prices apply to UK only. Export prices on application.

ZX Spectrum software on cassettes – available now

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

RS232 / network interface board

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

The potential is enormous. And the astonishingly low price of only £20 is possible only because the operating systems are already designed into the ROM.

sinclair

Sinclair Research Ltd, Stanhope Road, Camberley, Surrey GU15 3PS.
Tel: Camberley (0276) 685311.

Open Forum

Open Forum is for you to publish your programs and ideas.
It is important that your programs are bug free before you send them in. We cannot test all of them.
Contributions should be sent to: Popular Computing Weekly, *Hobhouse Court, 19 Whitcomb Street, London WC2H 7HF.*

How to contribute

Each week the editor goes through all the programs that you send to Open Forum in order to find the Program of the Week.

The author of that program will qualify for DOUBLE the usual fee we pay for published programs.
(The usual fee is £6.)

Presentation hints

Programs which are most likely to be considered for the Program of the Week will be computer printed and accompanied by a cassette.

The program will be well documented, the documentation being typed with double spacing between each line.

The documentation should start with a general description of the program and then give some detail of how the program has been constructed and of its special features.

Listings taken from a ZX Printer should be cut into convenient lengths and carefully stuck down on to white paper, avoiding any creasing.

Please enclose a stamped, self-addressed envelope.

Panic

on ZX81

On a distant planet in a far galaxy lives a gardener. He was once very happy until one day as he was gardening he saw two green eyes peeping over his hedge. As he walked around a small alien pest followed him, so he grabbed his spade in order to kill it. He swung his spade at it and it vanished. But who was to know that his garden was ridden with another four of these pests.

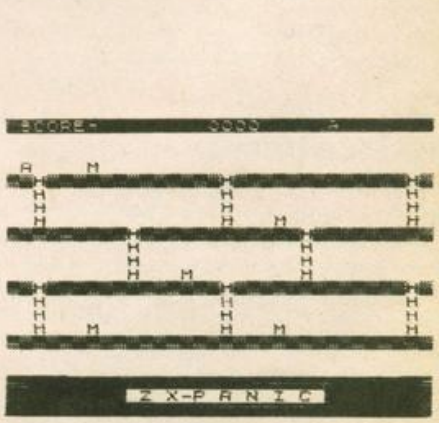
In this game for the ZX81 you are the gardener armed with a spade. You must beat the alien garden pests without them, or you, bumping into each other. Unfortunately life is not as simple as that because every time you kill an alien it leaves an uncrossable hole that must be avoided.

Once you clear one sheet of them another sheet appears, but after each sheet there are more holes which make you have to take diversions and are more difficult to avoid. For each alien killed you are awarded ten points. You are represented as **A** and the alien pests are represented as letter **M**s which wander along the garden hedges. The controls are: 5 Left, 8 Right, 6 Down, 7 Up, 0 Spade.

The variables are:
A/B Position of gardener.
D/E Alien, positions.
S Score.
C$, D$, E$, F$, G$ Aliens.

```
  1 REM        ZX-PANIC
  2 REM    BY SIMON COX (C) 82"
 10 LET S=0
100 CLS
101 PRINT "SCORE:-      0000
110 PRINT
120 PRINT
130 PRINT
160 PRINT "
170 PRINT "   H                H
180 PRINT "   H                H
190 PRINT "   H                H
210 PRINT "
220 PRINT "                    H
230 PRINT "                    H
240 PRINT "                    H
260 PRINT "
270 PRINT "   H                H
280 PRINT "   H                H
290 PRINT "   H                H
300 PRINT "
310 PRINT
320 PRINT
330 PRINT "
340 PRINT "          Z X-P A N
I C
350 PRINT "
370 LET A=3
380 LET B=1
390 LET D=1
400 LET C=0
401 LET E=3
410 LET C$=" M "
420 LET D$=" M "
430 LET E$=" M "
440 LET F$=" M "
450 LET G$=" M "
500 PRINT AT 3,E;D$;AT 7,E+14;E
$;AT 11,E+7;F$;AT 15,E;C$;AT 15,
E+14;G$
510 LET E=E+D
540 PRINT AT A,B
550 LET A$=CHR$ PEEK (PEEK 1639
8+256*PEEK 16399)
552 PRINT AT A+1,B;
553 LET Z$=CHR$ PEEK (PEEK 1639
8+256*PEEK 16399)
560 PRINT AT A,B;"A"
561 IF Z$=" " THEN GOTO 1000
562 IF A$="M" THEN GOTO 1000
563 IF E=12 THEN LET D=-1
564 IF E=3 THEN LET D=1
569 PRINT AT A,B;A$
570 LET B=B+(INKEY$="8" AND B<3
1)-(INKEY$="5" AND B>0)
580 LET A=A+(INKEY$="6" AND Z$=
"M")-(INKEY$="7" AND A$="M")
590 IF INKEY$<>"0" THEN GOTO 50
0
591 PRINT AT A,B+1;
592 LET Y$=CHR$ PEEK (PEEK 1639
8+256*PEEK 16399)
593 PRINT AT A,B-1;
594 LET V$=CHR$ PEEK (PEEK 1639
8+256*PEEK 16399)
600 FOR N=1 TO 5
610 PRINT AT A,B;"A";AT A,B+1;"
";AT A,B+1;"";AT A,B+1;" ";AT
A,B;" "
620 NEXT N
621 FOR N=1 TO 5
622 PRINT AT A,B;"A";AT A,B-1;"
";AT A,B-1;"";AT A,B-1;" ";AT
A,B;" "
623 NEXT N
900 IF A=3 AND B+1=E OR A=3 AND
B-1=E THEN LET D$="
```

```
 901 IF A=7 AND B+1=E+14 OR A=7
AND B-1=E+14 THEN LET E$="
 902 IF A=11 AND B+1=E+7 OR A=11
 AND B-1=E+7 THEN LET F$="
 904 IF A=15 AND B+1=E OR A=15 A
ND B-1=E THEN LET C$="
 905 IF A=15 AND B+1=E+14 OR A=1
5 AND B-1=E+14 THEN LET G$="
 906 IF A=3 AND B+1=E THEN PRINT
 AT A+1,B+1;"M";AT A+1,B+1;" "
 907 IF A=3 AND B-1=E THEN PRINT
 AT A+1,B-1;"M";AT A+1,B-1;" "
 908 IF A=7 AND B+1=E+14 THEN PR
INT AT A+1,B+1;"M";AT A+1,B+1;"
"
 909 IF A=7 AND B-1=E+14 THEN PR
INT AT A+1,B-1;"M";AT A+1,B-1;"
"
 910 IF A=11 AND B+1=E+7 THEN PR
INT AT A+1,B+1;"M";AT A+1,B+1;"
"
 920 IF A=11 AND B-1=E+7 THEN PR
INT AT A+1,B-1;"M";AT A+1,B-1;"
"
 930 IF A=15 AND B+1=E THEN PRIN
T AT A+1,B+1;"M";AT A+1,B+1;" "
 940 IF A=15 AND B-1=E THEN PRIN
T AT A+1,B-1;"M";AT A+1,B-1;" "
 941 PRINT AT 3,E;D$;AT 7,E+14;E
$;AT 11,E+7;F$;AT 15,E;C$;AT 15,
E+14;G$
 942 IF V$="M" OR Y$="M" THEN LE
T S=S+10
 995 PRINT AT 0,15;S;"
 996 IF C$="     " AND D$="
" AN
D E$="     " AND F$="     " AND G$="
     " THEN GOTO 1065
 998 GOTO 500
1010 PRINT AT A,B;"
";AT A,B;"A"
1030 PRINT AT 19,12;"GAME-OVER";
AT 21,9;" PRESS ANY KEY "
1040 IF INKEY$="" THEN GOTO 1010
1050 CLS
1060 RUN
1065 PRINT AT A,B;" "
1070 LET A=3
1080 LET B=1
2000 GOTO 410
```



Panic
by Simon Cox

Turn to page 21

How to make the best home computer in the world even better.

Peripherals to turn a powerful computer into a super-computer for the professional.

With VIC, you have the finest home computer money can buy. And the more you use it, the more you will ask it to do.

Pretty soon, you'll want to extend VIC's vast potential to the full; and there is a wide range of VIC peripherals to help you do it.

Disk drives, disk-based software, a printer, cassette unit, joysticks, paddles – with these, VIC computing becomes total computing: giving you true professional power and capability.

We describe the major units here.

VIC PRINTER

The VIC Printer, like all VIC peripherals, offers a very high specification at a very competitive price.

It will print programs, letters, business data, graphic displays and so on.

Its main features include: 80 characters per line • Tractor feed dot matrix • 30 characters per second print speed • Full alphanumerics and graphic printing • Double-size character capability • All cables and leads.

VIC FLOPPY DISK UNIT

The VIC single-drive Disk Unit provides a fast, accurate and efficient means of storing and retrieving data and programs.

Together with the Printer, it transforms the VIC 20 into the ideal system for the small businessman or serious computer programmer.

Features include: 174,848 bytes capacity • Uses soft-sectored standard 5¼" single density floppy disks • Direct interface to VIC • Direct compatibility with Printer Intelligent system independent of VIC. (VIC RAM not required to run it).

EXPANSION MEMORY CARTRIDGES

Special plug-in cartridges are available to expand VIC's memory. 3K, 8K and 16K RAM packs plug directly into the computer.

A Memory Expansion Board is also available to develop VIC's capabilities to the maximum.

For full details of VIC 20, its peripherals and software, and a list of your local dealers, contact: The Commodore Information Centre, 675 Ajax Avenue, Slough, Berkshire, SL1 4BG. Tel: Slough (0753) 79292.

commodore

VIC 20

The best home computer in the world.

Let Commodore expand your horizons.

VIC 20 is the finest home computer that money can buy.

And the better you get to know it, the more confident, adventurous and ambitious you'll become.

You'll want to take advantage of the vast range of VIC software: a superb and constantly-growing selection of programs, embracing business systems, entertainment, education and many applications in the home.

Every program in the series has been designed by experts, and chosen for its quality and value for money.

VIC business software covers a wide range of applications, including spread-sheet analysis, stock control, information handling and word-processing.

A mind-blowing range of games including Scott Adams' world-famous 'Adventure' series.

Advanced space games, including the sophisticated 'Omega Race'.

Learn subjects as diverse as English Language, programming, and biology.

And 'home' software ranges from IQ tests to Robert Carrier menus.

In addition, there is a range of VIC software, like programmers' aids and graphics packages–

to add to your understanding and enjoyment of computers and computing.

There's even a special 'VicSoft' Club for VIC 20 enthusiasts, with many advantages including special offers to club members.

VIC software will expand your horizons. And your mind.

PRICES RANGE FROM £4.99 to £24.95 INC. VAT.

commodore

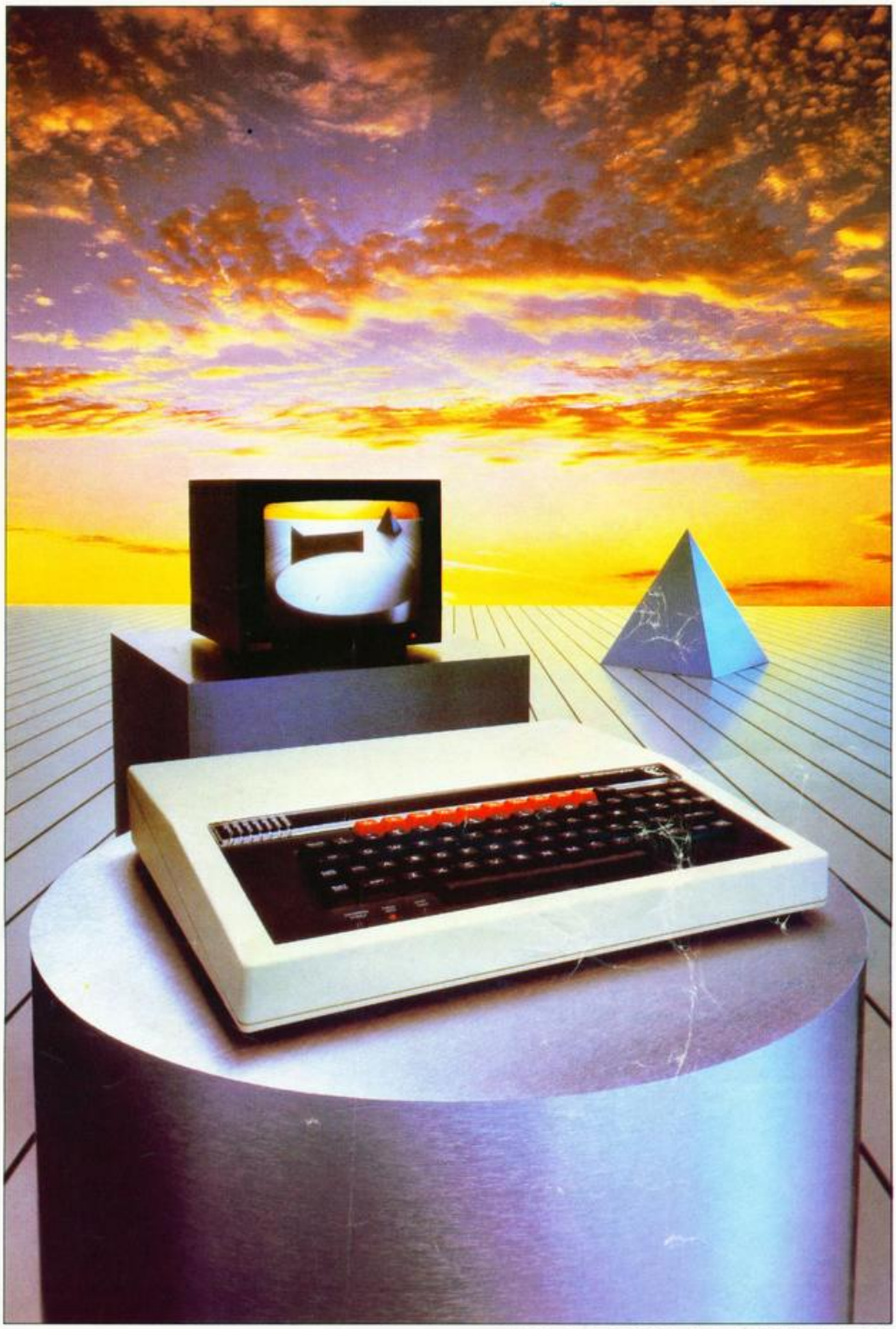
VIC 20

For more information, a catalogue of VIC software and details of your local retailers or dealers please phone or complete the coupon and send to:
The Commodore Information Centre,
675 Ajax Avenue, Slough, Berkshire SL1 4BG.
Telephone: Slough (0753) 79292.

Name
(MR./MRS./MISS)
Address

Postcode

VCPCY 11/82



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

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

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

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

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

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

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

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

Broader horizons

BBC Model B Microcomputers are available for immediate despatch by courier to your door.

If you would like to take advantage of our special delivery offer just fill in this coupon, but remember this only applies to the Model B, and only in the UK. Any other items have to be ordered on the standard order form or from a BBC Computer Stockist.

BBC Microcomputer System Offer
c/o Vector Marketing
Dennington Estate
Wellingborough
Northamptonshire NN8 2RL

Please send me by courier 1 BBC Model B Microcomputer(s) at £399 including VAT and delivery.

Cheque enclosed for £ 399 payable to BBC Microcomputer System readers a/c or charge
ACCESS BARCLAYCARD

Signed Simon Bray
Name SIMON BRAY
Address 40 ROCK ROAD
CAMBRIDGE
Postal Code CB1 4UF

Co Reg No 1403810 VAT No. 215400220

The BBC Microcomputer System

BBC Microcomputer System Offer, c/o Vector Marketing, Dennington Estate, Wellingborough, Northamptonshire NN8 2RL.

*Model A has a limited range of interfaces but can be upgraded to meet Model B specification.
**CP/M is a registered trade mark of Digital Research.

The BBC Microcomputer is designed, produced and distributed in the UK by Acorn Computers Limited.

from page 16

City Bomber

on Vic20

The object of City Bomber is to land on the city — but before you can land, you must destroy the buildings. This version has only one control — Fire (controllable by any key). Only one bomb may be falling at any time.

There are nine skill levels (1-9). One is the hardest, nine the easiest. These are selected at the beginning of the game. When a city is destroyed, you are given a bonus and start on a new city, but on a slightly higher level.

Program notes:

Lines 0 to 50 — set up buildings and jump to instructions etc. at 500.
Lines 60 to 150 — main game.
Lines 200 to 300 — ending routine.
Lines 350 to 400 — landing routine.
Lines 500 to 600 — instructions.
Lines 1000 to 1035 — *Hi-res* routine.
Lines 1040 to 1202 — data for *Hi-res*.

```
0 DIML,I,B,H,C
1 GOSUB500
2 POKE36878,15
3 DEFFNA(X)=PEEK(828)+256*PEEK(829)
4 DEFFNB(X)=INT(X/256)
6 FORF=22T00STEP-1:POKE36866,(F)OR128:POKE36867,F*2OR128:
POKE36876,F*2+128
7 POKE36864,(22-F)+12:POKE36865,(22-F)+38:FORL=0T010:NEXT
L,F
10 PRINT"■":POKE36879,11:POKE36869,255
15 FORF=0T022:POKE36866,(F)OR128:POKE36867,F*2OR128:
POKE36876,F*2+128
16 POKE36864,(22-F)+12:POKE36865,(22-F)+38:FORL=0T010:
NEXT L,F
17 POKE36867,46+128:POKE36876,0
18 FORF=22*22T022*22+21:POKEF+7680,47:NEXT
19 LE=INT(LE/1.5)+1
20 FORA=0T021
25 RH=INT(RND(1)*10)+5+LE:RC=INT(RND(1)*7)+1
26 IFRH=21THENRH=20
30 FORB=21TORHSTEP-1
35 IFB=RHTHENPOKEA+B*22+7680,40:POKEA+B*22+38400,RC:GOT050
40 POKEA+B*22+7680,39:POKEA+B*22+38400,RC
45 POKE36876,A*4+128
50 NEXTB,A:POKE36876,0
60 B=0:L=0:H=2:G=36876
70 POKE781,H:POKE782,L:SYS65520:PRINT"  "
75 L=L+1:IFPEEK(L+H*22+7681)=40THENPOKEL,32:POKE30720+L,1:
GOT0200
76 IFINT(L/22)*22=LTHENH=H+1:L=0
80 POKE782,L:POKE781,H:SYS65520:PRINT")*"
90 X=PEEK(197)
95 PRINT"■■SCORE"S;TAB(11)"HIGH";FNA(1)
110 IFX=32ANDB=0THENB=L+22*H+22+7680
115 IFB=0THENFORF=0T030:NEXT:GOT0141
120 POKEB,32:POKE30720+B,1:B=B+22
121 IFPEEK(B)=39ORPEEK(B)=40THENS=S+10
122 POKEB,43
123 IFC=0THENC=230
124 POKE36876,C
125 C=C-1:IFC<128THENC=0:POKE36876,0
130 V=7
140 IFB>8141THENPOKEB,32:B=0:C=0:POKEG,0
141 V=7
145 IFL+22*H=469THEN350
150 GOT070
200 POKEG,0:POKEG+3,8:FORF=15T00STEP-1:POKEG+1,220:
POKEG+2,F:FORT=0T0100:NEXTT,F
210 POKE36877,0:POKE36879,8:POKE36869,240:PRINT"■■"TAB(5)
"CRASHED!"
220 PRINTTAB(5)"■■■■■■■■"
230 PRINT"SCORE=";S
240 IFS>FNA(1)THENPRINT"■■A NEW HIGH SCORE!■":B=FNB(S):
POKE829,B:POKE828,S-B*256:GOT0260
250 PRINT"HIGH SCORE=";FNA(1)
260 PRINT"■ANOTHER GO?":
270 GETX$:IFX$=""THEN270
280 IFX$<>"Y"ANDX$<>"N"THEN270
285 POKE36879,27:PRINT"■■"
286 POKE36867,128+46:POKE650,0
290 IFX$="Y"THENRUN
300 END
350 FORL=1T03
355 PRINT"■■■■■■■■■■■■■BONUS 100 POINTS"
360 FORM=200T0220+L*2:POKE36876,M:FORT=1T025:NEXTT,M
370 PRINT"■■■■■■■■■■■■■                "
380 FORF=1T025:NEXT
390 NEXTL
400 S=S+100:GOT06
500 PRINT"■"TAB(5)"■■CITY BOMBER"
510 PRINT"■■■■I.HEGERTY"
550 PRINT"■LAND THE SHIP ON THE  CITY!YOU MUST DESTROY THE
SKYSCRAPERS USING ■SPACE■ ";
555 PRINT"TO DROP A BOMB."
560 PRINT"EACH LEVEL OF A       BUILDING IS WORTH
10  POINTS."
570 PRINT"IF YOU CRASH,YOUR GO  IS OVER."
571 PRINT"■LEVEL 9 IS THE EASIEST! IS THE HARDEST"
580 GOSUB1000
581 PRINT"■■SELECT LEVEL(1-9)■";
582 SYS65508:LE=VAL(CHR$(PEEK(780))):IFLE<1ORLE>9THEN582
583 PRINTLE
590 PRINT"■■■■■■PRESS ANY KEY"
600 WAIT198,1:RETURN
999 END
1000 POKE56,28:POKE55,0
1005 IFPEEK(7300)=64THEN1020
1010 FORF=7168T07680:POKEF,PEEK(25600+F):NEXT
1012 FORF=7424T07431:POKEF,0:NEXT
1015 POKE828,0:POKE829,0
1020 FORF=7480T07487+8*8
1030 READXX:POKEF,XX:NEXT
1031 IFPEEK(0)=76THENPOKE0,0
1034 PRINTCHR$(142),CHR$(8)
1035 RETURN
1040 DATA127,127,73,73,73,73,127,127
1050 DATA8,8,8,28,62,62,127,127
1055 DATA128,128,255,255,159,255,17,55
1060 DATA0,0,240,240,232,252,0,128
1070 DATA0,56,16,16,56,56,56,16
1090 DATA17,19,19,255,255,19,19,17
1100 DATA60,66,157,145,145,157,66,60
1110 DATA0,0,0,0,0,8,8,16
1111 DATA170,85,170,85,170,85,170,85
1202 DATA140,40,0,5,140,40,0,5,150,40,0,1
```

City Bomber
by Ian Hegarty

Draw

on BBC Micro

This program will run on the BBC model A or B. It can be used to experiment with drawing rectangles, polygons, circles, or cones. Shapes drawn can easily be erased, redrawn, translated or scaled.

Program notes:

Lines	
20	Selects a red background and yellow foreground.
50	Sets up a two line text window at the top of the screen.
60	Selects centre of shape, eg 640,512 is the middle of the screen.
70	*Radii*, if A = B shape is symmetrical, eg 100,100.
80	Number of sides to shape. With sides > 20 the closer shape becomes a circle.
90 to 100	Option to connect up corners of shape to a given point thereby producing a cone effect.
130 to 160	*Input* statement. Translate (T) moves object centre point to new position and redraws. Scale (S), multiplying factor; increases or decreases overall size of object. *Clg* (C), can be used to clear entire graphics area and start again.
180	*Input* values used to translate shape. *Input* string used to enable erase to work (if required) before using *Val* function to convert string to number.
240	*Input* multiplying factors to produce scaling. String used again as in line 180.
300 to 430	*Procedure* used to draw required shape.
440 to 480	*Procedure* used to erase last shape in response to input 'E'.

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from page 21

```
 10 CLS :MODE4
 20 VDU 19,0,1,0,0,0,19,1,3,0,0,0
 30 LET H=0:LETV=0:LET S1=1:LET S2=1
 50 VDU 28,0,1,39,0
 60 INPUT"CENTRE X Y "HS,VS
 70 INPUT "RADII A,B "A,B
 80 INPUT"NUMBER OF SIDES "N
 90 INPUT"CONE GEN(Y/N) "ZC$:IF ZC$="N"THEN 110
100 INPUT"POINT OF CONE X,Y " PX,PY
110 ANGLE=2*PI/N
120 CLS :PROCdraw
130 INPUT"(T)ranslate (S)cale or (C)LG...?"A$
140 IF A$="T" GOTO 180
150 IF A$="S" GOTO 240
160 IF A$="C" CLG
170 GOTO 30
180 INPUT"HORIZ SHIFT, VERT SHIFT " H$,V$
190 INPUT"(E)rase or <CR>...? " A$
200 IF A$="E" PROCdelete
210 LET H=VAL(H$):LET V=VAL(V$)
220 PROCdraw
230 GOTO 130
240 INPUT"HORIZ STRETCH, VERT STRETCH "S1$,S2$
250 INPUT"(E)rase or <CR>...? " A$
260 IF A$="E" PROCdelete
270 LET S1=VAL(S1$):LET S2=VAL(S2$)
280 PROCdraw
290 GOTO 130
300 DEF PROCdraw
310 C=COS(ANGLE):S=SIN(ANGLE)
320 XA=1:YA=1
330 FOR I=1 TO N+1
340 X=XA*C-YA*S:Y=XA*S+YA*C
360 XA=X:YA=Y
370 IF I>1 THEN 380 ELSE 390
380 DRAW ((A*S1)*XA+HS)+H,((B*S2)*YA+VS)+V
390 MOVE ((A*S1)*XA+HS)+H,((B*S2)*YA+VS+V)
400 IF ZC$="N" THEN 420
410 MOVE PX,PY:DRAW((A*S1)*XA+HS)+H,((B*S2)*YA+VS)+V
420 NEXT I
430 ENDPROC
440 DEF PROCdelete
450 GCOL 0,0
460 PROCdraw
470 GCOL 0,1
480 ENDPROC
```

Draw
by Barry Wells

Data Statement Builder

on Spectrum

The construction of Basic *Data* statements can be a very tedious task especially when there is a lot of mixed (numeric and alphabetic) data in the line. This might often be the case when very complex displays are being *Drawn* or *Plotted*. This program was designed to make the construction of a complex *Data* statement a little less tedious. It relieves the user of the need to remember the intervalue commas, and the quotes round alphanumeric data.

The data to be stored is housed in a *Rem* statement which the program converts to a *Data* line at the finish of the program. The user only needs to edit the line to remove surplus bytes at the statement's end — and your *Data* statement is ready for the rest of your program. The length of line 1 must be equal at least to the amount of data you want to store.

Lines 550 and 560 check for the presence of the *Rem* and the amount in it, if present. Lines 2 to 8 determine the start of the *Basic* program, the address of the first byte after *Rem* and the amount of space in it.

Data is entered in two forms — A Test for alphabetical data (strings); and N 12.45 for numeric data. The presence of illegal characters in numeric data is checked in lines 60 to 75. Line 85 determines the length of the whole string to be poked into the *Rem*, viz the enclosing quotes for string variables plus the comma following the value.

Subroutine 500 is the routine that checks the type of data present. Only N or A prefixed data is allowed. Lines 105 to 130 *Poke* the data into the *Rem* with enclosing quotes if needed, and follow with a comma. The data just entered is printed on-screen at line 140 and the available bytes up-dated and checked in subroutine 560. Accepted data is signalled by a high *Beep*, rejected data or an error condition by a low *Beep*.

It would be possible to shorten line 1 after all data is entered, though it was felt that the need to edit out the trailing bytes was a useful point at which to visually inspect the line. Note that the *Rem* must be in line 1, though it could be anywhere if its address is known.

Note that in line 42 *Stop* is the token Stop. In line 560 "@" AND amount 'less than sign' 10) will print a leading '@' when the byte count gets below 10. @ = space. Several possible uses could be made of this technique; viz building *Plot* and *Draw* data lines and large amounts of string data for screen printing.

```
  1 REM .....................
  5 LET l=PEEK 23635+256*PEEK 2
3636: LET end=PEEK (l+2)+256*PEE
K (l+3)
  6 LET start=l+5: LET instr=st
art-1
  8 LET amnt=end-2
 15 BRIGHT 1: CLS : LET z$="  "
 20 PRINT '"####################
##############"''''   DATA build
er program"''''   © Sept 1982 by P
 L Newman"''''"####################
##############"
 25 PRINT '"This program allows
 entry of"'"numeric,alphabetic o
r mixed data"'"which is built in
to a DATA line."
 30 PRINT '"Data is entered lik
e this -- "''"N[or n]12.3 -- for
 numeric"'"A[or a]abcd -- for al
phabetic"
 35 BEEP .2,30: PRINT '"Use sym
-shift A to finish": GO SUB 550
 40 INPUT FLASH 1;"Data value ?
";: LINE a$: IF a$="" THEN GO TO
 40
 42 IF a$=" STOP " THEN GO TO 6
10
 45 GO SUB 500: IF t<>-1 AND LE
N a$>1 THEN GO TO 55
 50 BEEP .2,10: GO TO 40
 55 IF t=1 THEN GO TO 65
 60 FOR j=2 TO LEN a$
 65 IF a$(j)="," THEN GO TO 75
 70 IF a$(j)<"0" OR a$(j)>"9" T
HEN GO TO 80
 75 NEXT j: GO TO 85
 80 PRINT AT 21,0;z$;AT 21,0; F
LASH 1;"Error in numeric data":
PAUSE 100: PRINT AT 21,0; FLASH
0;z$: GO TO 40
 85 LET l=LEN a$-1+1+2*(t=1)
 90 IF LEN a$-2+1+2*(t=1)>=amnt
 THEN GO TO 570
 95 BEEP .2,30
100 IF t=0 THEN GO TO 110
105 POKE start,34: LET start=st
art+1
110 FOR j=1 TO l-1-2*(t=1)
115 POKE start,CODE a$(j+1)
120 LET start=start+1: NEXT j
125 IF t=1 THEN POKE start,34:
LET start=start+1
130 POKE start,44: LET start=st
art+1
135 LET amnt=amnt-l: GO SUB 560
140 PRINT AT 20,0;z$;z$;AT 20,0
;"last data= ";a$(2 TO )
145 GO TO 40
500 LET t=-1
510 IF a$(1)="A" OR a$(1)="a" T
HEN LET t=1: RETURN
```

To next page

```
 520 IF a$(1)="N" OR a$(1)="n" T
HEN LET t=0: RETURN
 530 RETURN
 550 IF PEEK (l+4)<>234 THEN PRI
NT AT 6,5; FLASH 1;"No REM please
nt": GO TO 600
 560 PRINT AT 6,4;" " AND (amnt<
10);amnt;" bytes,incl.punctuatio
n"
 565 IF amnt>1 THEN GO TO 580
 570 PRINT AT 6,4; FLASH 1;"No r
oom - extend line 1 ": GO TO
600
 580 RETURN
 600 BEEP 1,-10: STOP
 610 POKE instr,228
 620 CLS : PRINT AT 10,0;";;;;;;
;;;;;
```

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```
420 X=X(C):X(C)=X(C)+RND(15)*2
430 FOR M=X+2 TO X(C) STEP 4
440 IF C=PC THEN PUT(M,Y(C))-(M+35,Y(C)+25),B,PSET ELSE PUT(M,Y(C))-(M+3
5,Y(C)+25),A,PSET
450 IF M>210 THEN 490
460 NEXT M
470 C=C+1:IF C=5 THEN C=1
480 NEXT A:GOTO 400
490 AUDIOOFF:MOTOR OFF:RA=RA+1:IF PC=C THEN 510
500 FORD=1TO500:NEXTD:SOUND100,4:SCREEN0,0:CLS:PRINT@266,"BAD LUCK!!!":I
F RA=4 THEN 520 ELSE FORD=1TO2000:NEXTD:GOTO90
510 PLAY"T25V31O3ABCDEFGABCDEFGABCDEFG":CLS:PRINT@266,"WELL DONE!!!":PRI
NT@330,"YOU WIN $"PB*3:SCREEN0,1:PT=PT+PB*3:FORD=1TO2000:NEXTD:IFRA<4THE
N90
520 CLS:PRINT@264,"***GAME OVER***":PLAY"T25V31O2GFEDCGFEDCGFEDCGFEDC":P
RINT:PRINT:PRINT:PRINT"YOUR TOTAL NOW $"PT:PRINT:PRINT:SCREEN0,1
530 FOR D=1TO2000:NEXTD:END
540 'OUT OF MONEY
550 A$=CHR$(143+96):CLS7:PRINT@262,"YOU"A$"ARE"A$"OUT"A$"OF"A$"MONEY";:S
OUND100,1:FORD=1TO2000:NEXTD:PRINT@480,"";:END
```

Grandprix
by Brian Cadge

Leopard

on ZX81

This is a game for the ZX81 with the 16K Ram. The program traps you in the jungle at midnight with a hungry leopard. You can only see the whites of his eyes and you have five bullets which are really more like guided missiles. Each bullet has a life of approximately 15 seconds before it explodes; the leopard moves about quickly from place to place.

Success in catching the leopard depends to some extent upon luck but also on the skill with which the operator moves about on the cursor keys. The moving display celebrates your success with the words "Well done, you are safe" but failure results in a moving display which gives the disgusting sound of a leopard munching its prey (or at least, that's the intention!).

Program notes:

Lines:

1 — Complaints that the game is too difficult have forced the compiler to include this Rem line, giving details of how to make it easier.

25 to 90 — Gives instructions and explains the game.

200 to 220 — Fills the screen with inverse spaces.

230 to 270 — Sets up the variables: X and Y (position of moving bullet): G (length of time leopard stays in one place): Z (life of bullet): M (no. of bullets).

280 to 290 — Prints information showing position of bullet and its number. Sends program to subroutine 3000, for position of leopard's eyes.

300 to 470 — Loop for moving bullet; each trip through the loop adds 1 to the variables G and Z, checks their values, limits the values of X and Y to prevent going "off-screen" and checks the position of XY in relation to AB (the position of the leopard).

1000 to 1110 — This subroutine shows the explosion of the bullet, adds one to M (no. of bullets used), reduces Z (life of bullet) to 0 and returns.

3000 to 3050 — Changes the position of the leopard, signified by graphics character shifted E printed twice. Returns G to 0, G being the measure of the length of time the position of the leopard remains static.

4000 to 4080 — When M = 6, all bullets are gone. A moving display is set up to tell you what has happened.

5000 to 5250 — Gives a display showing the bullet hitting the leopard, gives the number of bullets used and celebrates with a moving display of congratulations!

```
  1 REM : TO MAKE THE GAME EASI
ER, CHANGE LINE 490 TO: IF Z=100
 THEN GOSUB 1000
  10 REM : LEOPARD
  20 REM : EVE GORTON
  25 PRINT TAB 6;"SPOT THE LEOPA
RD"
  30 PRINT AT 3,0;"MIDNIGHT IN T
HE JUNGLE....THERE IS A HUNGRY L
EOPARD AFTER YOU.....ALL YOU CAN
 SEE ARE THE WHITES OF HIS EYES"
  40 PRINT AT 10,3;"YOU HAVE 5 B
ULLETS - CONTROL KEYS 5,6,7 AND
8"
  50 PRINT AT 15,0;"A BULLET LAS
TS 15 SECONDS, THEN IT GOES BANG
"
  70 PRINT AT 18,0;"WATCH OUT-LE
OPARDS MOVE QUICKLY"
  80 PRINT AT 20,0;"PRESS 0 TO G
O ON"
  90 IF INKEY$<>"0" THEN GOTO 90
 200 FOR N=0 TO 20
 210 PRINT AT N,0;"                
                "
 220 NEXT N
 230 LET G=0
 240 LET Z=0
 250 LET M=1
 260 LET X=20
 270 LET Y=10
 280 PRINT AT 20,10;"■";AT 21,10
;"BULLET NO:";M
 290 GOSUB 3000
 300 REM MOVING BULLET
 310 PRINT AT X,Y;"■"
 320 LET G=G+1
 330 LET Z=Z+1
 340 PRINT AT X,Y;" "
 350 IF INKEY$="7" THEN LET X=X-
1
 360 IF INKEY$="6" THEN LET X=X+
1
 370 IF INKEY$="5" THEN LET Y=Y-
1
 380 IF INKEY$="8" THEN LET Y=Y+
1
 390 IF Z=45 THEN GOSUB 1000
 400 IF G=10 THEN PRINT AT A,B;"
  "
 410 IF G=10 THEN GOSUB 3000
 420 IF X<0 THEN LET X=0
 430 IF Y<0 THEN LET Y=0
 440 IF X>20 THEN LET X=20
 450 IF Y>30 THEN LET Y=30
 460 IF X=A AND Y=B OR X=A AND Y
=B+1 THEN GOTO 5000
 470 GOTO 300
1000 REM BANG
1010 PRINT AT X,Y;"BANG"
1020 FOR J=0 TO 9
1030 NEXT J
1040 PRINT AT X,Y;"    "
1050 LET Z=0
1060 LET X=20
1070 LET Y=20
1080 LET M=M+1
1090 IF M=6 THEN GOTO 4000
1100 PRINT AT 21,10,"BULLET NO:"
;M
1110 RETURN
3000 REM LEOPARD MOVE
3010 LET A=INT (RND*18)+1
3020 LET B=INT (RND*28)+2
3030 PRINT AT A,B;"FF"
3040 LET G=0
3050 RETURN
4000 REM BULLETS GONE
4010 CLS
4020 PRINT AT 5,0;"ALL BULLETS G
ONE - YOU ARE"
4030 LET A$=" LEOPARDFOOD - MUNC
H SLURP CHOMP"
4040 FOR X=0 TO 46
4050 PRINT AT 10,0;A$
4060 LET A$=A$(2 TO )+A$(1)
4070 NEXT X
4080 STOP
5000 REM DEAD LEOPARD
5010 PRINT AT A,B;"**"
5020 FOR J=0 TO 5
5030 NEXT J
5040 PRINT AT A,B;"EE"
5050 FOR J=0 TO 5
5060 NEXT J
5070 PRINT AT A-2,B-2;"GOTTIM"
5080 FOR J=0 TO 20
5090 NEXT J
5100 PRINT AT 21,1;"NO.OF BULLET
S USED:";M
5110 LET A$=" WELL DONE -*- YOU
ARE SAFE -*- "
5120 FOR X=0 TO 46
5130 PRINT AT 10,0;A$
5140 LET A$=A$(2 TO )+A$(1)
5150 NEXT X
```

GRAPHICS

Line 210	32 inverse spaces
Line 310	inverse *
Line 340	inverse space
Line 400	2 inverse spaces
Line 1040	4 inverse spaces
Line 3030	2 shifted Es
Line 5010	2 inverse *s
Line 5040	2 inverse dollar signs

Leopard
by Eve Gorton

Open Forum

Four Up

on Spectrum

This game is based on the children's game Connect Four where you must try to get four in a row (vertical, horizontal or diagonal) before the computer. The program can give you a tough time but not so tough that you can't win.

After the opening moves the Spectrum appears to be thinking — it keeps pointing to different slots which sometimes will have you byting your nails. It is fully automatic, will keep score and inform you of the winner.

```
  5 REM FOUR UP By Jim Walsh.
 10 GO SUB 2000: GO SUB 3000
 15 DATA 7,15,31,63,127,255,255
,255,224,240,248,252,254,255,255
,255,255,255,255
 17 DATA 127,63,31,15,7,255,255
,255,254,252,248,240,224,128,64,
32
 19 DATA 16,8,4,2,1,1,2,4,8,16,
32,64,128
 25 RESTORE : FOR n=0 TO 47: RE
AD a: POKE 32600+n,a: NEXT n
 30 [illegible]
 50 DIM m(8,9): FOR n=1 TO 9: L
ET m(1,n)=3: LET m(8,n)=3: NEXT
n
 60 LET me=0: LET you=0
 100 CLS : BORDER 0: PRINT AT 2,
0;" ": FOR n=1 TO 6: PRINT INK 2
;"
 105 PRINT INK 2;"
 110 PAUSE 20: FOR n=0 TO 2: PRI
NT PAPER 5;AT n,0;"
                    ": NEXT n
 115 PAUSE 20: FOR n=3 TO 21: PR
INT AT n,0; PAPER 5;"      ": NEX
T n
 120 PAUSE 20: FOR n=3 TO 21: PR
INT AT n,27; PAPER 5;"      ": NE
XT n
 125 PAUSE 50: BEEP .5,-20: PRIN
T AT 0,5; INK 0;"Press Any Key T
o start": PAUSE 0
 130 PRINT AT 0,5; PAPER 5;"
                    ": BEEP .25,25
 134 [illegible]
 135 LET go=-1: LET r=RND*10+1:
IF r>5 THEN LET go=1
 137 LET z=0: LET d=6: LET found
=0: LET move=0
 140 FOR n=1 TO 900: NEXT n
 245 [illegible]
 250 LET move=move+1: LET go=go*
-1: IF move>42 THEN GO TO 1100
 252 IF go=1 THEN GO TO 300
 255 PRINT AT 0,14; BRIGHT 1; PA
PER 6; INK 1;"My Move": BEEP .25
,21
 257 PAUSE 100
 260 PRINT AT 0,14; BRIGHT 0; PA
PER 5;"      "
 265 LET sf=1: LET z=2: LET x3=0
 266 IF move<5 THEN GO TO 275
 268 GO SUB 650
 270 LET z=1: GO SUB 650
 273 LET z=2: IF found=1 THEN LE
T m(y1,x1)=0
 274 IF found=1 THEN GO TO 850
 275 IF x3<>0 THEN GO TO 870
 276 LET w=INT (RND*7)+2: IF m(2
,w)<>0 THEN GO TO 275
 277 LET y=2: LET x=w
 280 PRINT AT 1,d; PAPER 5;"  ";
AT 2,d;" ";AT 1,3+((x-1)*3); IN
K 1; FLASH 1;"\/";AT 2,3+((x-1)*
3);"\/": PAUSE 100: [illegible]
 283 GO SUB 400
 285 PAUSE 100: PRINT AT 1,3+((x
-1)*3); PAPER 5;"  ";AT 2,3+((x-
1)*3);"  "
 290 GO TO 250
 300 PRINT AT 0,12; INK 1; PAPER
6; BRIGHT 1;"Your Move": BEEP .
25,35
 302 PAUSE 100: LET sf=0
 305 PRINT AT 0,12; BRIGHT 0; PA
PER 5;"      "
 309 LET c=1: LET d=15: LET x=5:
 LET y=2: LET z=1
 310 PRINT PAPER 5; INK 0; FLASH
1;AT c,d;"\/";AT c+1,d;"\/"
 315 PAUSE 1: LET z$=INKEY$: IF
z$="" THEN GO TO 315
 317 IF z$="0" OR z$="8" OR z$="
5" THEN GO TO 320
 318 GO TO 315
 320 BEEP .2,12: PRINT AT c,d; P
APER 5;"  ";AT c+1,d;"  "
 325 IF z$="8" THEN LET d=d+3
 326 IF z$="6" THEN LET x=x+1
 330 IF d>24 THEN LET d=24
 331 IF x>8 THEN LET x=8
 335 IF z$="5" THEN LET d=d-3
 336 IF z$="4" THEN LET x=x-1
 340 IF d<6 THEN LET d=6
 341 IF x<2 THEN LET x=2
 345 IF z$="0" THEN GO TO 355
 350 GO TO 310
 355 IF m(2,x)<>0 THEN GO TO 309
 356 GO SUB 400: REM drop
 365 GO SUB 700: IF found=1 THEN
GO TO 1000
 395 GO TO 250
 400 REM drop
 401 IF m(y+1,x)=0 THEN LET y=y+
1
 405 IF m(y+1,x)<>0 THEN GO TO 4
20
 410 GO TO 401
 420 LET m(y,x)=z
 450 LET a=1: LET b=3
 455 IF z=1 THEN LET in=6
 460 IF z=1 THEN LET pa=1
 465 IF z=2 THEN LET in=1
 470 IF z=2 THEN LET pa=6
 475 LET a=a+(y-1)*3: LET b=b+(x
-1)*3
 480 PRINT INK in; PAPER pa;AT a
,b;" ";AT a+1,b;"\/": [illegible]
 485 RETURN
 500 IF sf=0 THEN RETURN
 505 PRINT AT 1,d; PAPER 5;"  ";
AT 2,d;"  "
 510 LET d=6+INT (RND*6)*3
 515 PRINT INK 1; FLASH 1;AT 1,d
;"\/";AT 2,d;"\/": REM Graphics
EF
 520 PAUSE 5: RETURN
 530 LET n=0: LET temp=0
 535 LET t=m(y+n,x): IF t=z THEN
 LET temp=temp+1
 540 LET n=n+1: IF z=t THEN GO T
O 535
 545 IF temp>=4 THEN LET found=1
 546 IF temp>2 AND z=1 THEN LET
x3=x
 547 RETURN
 550 LET n=0: LET temp=0
 555 LET t=m(y,x-n): IF t=z THEN
 LET temp=temp+1
 560 LET n=n+1: IF t=z THEN GO T
O 555
 565 LET n=1
 567 LET t=m(y,x+n): IF t=z THEN
 LET temp=temp+1
 569 LET n=n+1: IF t=z THEN GO T
O 567
 570 IF temp>=4 THEN LET found=1
 571 IF temp>2 AND z=1 THEN LET
x3=x
 572 RETURN
 575 LET n=1: LET temp=0
 577 LET t=m(y+n,x+n): IF t=z TH
EN LET temp=temp+1
 579 LET n=n+1: IF t=z THEN GO T
O 577
 581 LET n=0
 583 LET t=m(y-n,x-n): IF t=z TH
EN LET temp=temp+1
 585 LET n=n+1: IF t=z THEN GO T
O 583
 587 IF temp>=4 THEN LET found=1
 588 IF temp>2 AND z=2 THEN LET
x3=x
 589 RETURN
 600 LET n=0: LET temp=0
 605 LET t=m(y+n,x-n): IF t=z TH
EN LET temp=temp+1
 610 LET n=n+1: IF t=z THEN GO T
O 605
 615 LET n=1
 620 LET t=m(y-n,x+n): IF t=z TH
EN LET temp=temp+1
 625 LET n=n+1: IF t=z THEN GO T
O 620
 630 IF temp>=4 THEN LET found=1
 632 IF temp>2 AND z=2 THEN LET
x3=x
 635 RETURN
 650 LET found=0
 655 FOR y=2 TO 7: FOR x=2 TO 8
 660 LET t=m(y,x): IF t=0 THEN G
O SUB 690
 665 IF found=1 THEN GO TO 800
 670 NEXT x: NEXT y
 675 LET y=2: RETURN
 690 IF m(y+1,x)=0 THEN RETURN
 691 LET m(y,x)=z: GO SUB 700
 692 IF found=0 THEN LET m(y,x)=
0
 693 IF found=1 THEN LET y1=y
 694 IF found=1 THEN LET x1=x
 695 RETURN
 700 GO SUB 500: GO SUB 530
 705 GO SUB 550
 710 GO SUB 500: GO SUB 575
 715 GO SUB 600
 720 RETURN
 800 IF z=1 THEN GO TO 675
 802 PRINT AT 1,d; PAPER 5; INK
1;"  ";AT 2,d;"  ";AT 1,3+((x-1)
*3); INK 1; FLASH 1;"\/";AT 2,3+
((x-1)*3);"\/"
 805 PAUSE 50
 810 GO SUB 450
 815 GO TO 1000
 850 LET found=0: PRINT AT 1,d;
PAPER 5;"  ";AT 2,d;"  ";AT 1,3+
((x-1)*3); FLASH 1;"\/";AT 2,3+(
(x-1)*3);"\/": PAUSE 100: PRINT
PAPER 5;AT 1,3+((x-1)*3);"  ";AT
 2,3+((x-1)*3);"  "
 860 GO SUB 400
 865 PAUSE 100: GO TO 250
 870 LET x=x3: GO TO 850
1000 IF z=1 THEN LET you=you+1
1002 BEEP .5,3: BEEP .2,6: BEEP
.5,9
1005 IF z=2 THEN LET me=me+1
1010 IF z=1 THEN PRINT AT 0,11;
BRIGHT 1; PAPER 6; INK 1; FLASH
1;"YOU WIN"
1015 IF z=2 THEN PRINT AT 0,11;
BRIGHT 1; PAPER 6; INK 1; FLASH
1;"  I WIN  "
1020 FOR n=1 TO 1000: NEXT n
1025 PRINT AT 0,11; PAPER 5;"
          "
1027 PRINT AT 11,1; PAPER 5; INK
 0;"Me";AT 13,2;me;AT 11,28;"You
";AT 13,29;you
1030 LET a=1: LET b=3
1035 FOR x=2 TO 8: FOR y=7 TO 2
STEP -1
1037 LET m(y,x)=0
1040 PRINT PAPER 7;AT a+((y-1)*3
),b+((x-1)*3);"  ";AT a+1+((y-1)
*3),b+((x-1)*3);"  "
1045 LET r=INT (RND*12)+1: BEEP
.02,r
1050 NEXT y: NEXT x: PRINT AT 1,
6; PAPER 5;"
          ";AT 2,6;"
          "
1055 GO TO 135
1100 PRINT PAPER 5; INK 0;AT 0,9
;"Its a draw"
1105 FOR k=1 TO 775: NEXT k
1110 PRINT AT 0,9; PAPER 5;"
          "
1115 GO TO 1030
2000 PAPER 6: INK 1: BORDER 6: C
LS : PRINT AT 9,8;"FOUR'S UP!!"'
''"By Jim Walsh"''' (C) 5
ept 1982": PAUSE 300: RETURN
3000 BORDER 7: PAPER 7: INK 0: C
LS
3005 PRINT "   Beat the 'Spectru
m to get "''"four on the same ve
rtical,"''"horizontal or diagona
l."''"Press 8 to go right"''"Pre
ss 5 to go left"''"and '0' to dr
op."
3010 PRINT AT 18,5; FLASH 1;"PRE
SS ANY KEY": PAUSE 0: CLS : RETU
RN
```

Four Up
by Jim Walsh

Accounts

on Spectrum

This program should be useful to those who have a building society account. It enables you to work out how much interest you would gain in a certain time, or the percentage of interest you gain for a certain time.

After entering the program you must *Poke* 16518,100 in order to give the variable Z in line 1 the value 100. This, along with a lot of other memory saving techniques, enables the program to fit into the 1K machine.

```
  1 LET Z=CODE "?"
  2 PRINT '''''"CHOOSE:"''''"I
NTEREST....1"';"PERCENTAGE..2"
  4 INPUT E
  8 IF E<>SGN PI AND E<>VAL "2"
 THEN GOTO PI
  9 CLS
 10 IF E<>SGN E THEN GOTO Z
 20 PRINT "**INTEREST**";AT PI+
PI,NOT PI;"ENTER BALANCE:";
 30 INPUT A
 40 PRINT "£";A,,,"ENTER INTERE
ST RATE:";
 50 INPUT B
 60 PRINT B;" PC.",,,"OVER HOW
MANY YEARS? ";
 70 INPUT C
 75 PRINT C
 90 LET X=INT (Z*(B/Z*A*C)+VAL
".5")/Z
 93 PRINT ''''''"£";X;" INTERES
T"''''"£";A+X;" OVERALL"
 96 STOP
100 PRINT "**PERCENTAGE**";AT E
XP E,NOT PI;"ENTER BALANCE:";
110 INPUT A
115 PRINT "£";A,,,"ENTER INTERE
ST:";
120 INPUT B
125 PRINT "£";B,,,"OVER HOW MAN
Y YEARS? ";
130 INPUT C
135 PRINT C,,,,,,,B/A*Z/C;" PER
CENT INTEREST"
```

Accounts
by Mike Dipol

Running on Acorn 6502

***Gareth Jones** throws some light on the intricacies of the BBC's assembler.*

Acorn has supplied an excellent assembler in the BBC machine's Rom. However, the User Guide assumes the reader has a prior knowledge of 6502 machine code. For those Beeb owners who do not have this knowledge, but are interested in machine code, this article will hopefully throw a little light on the subject. Learning how to write simple machine code programs is easy once you have grasped the difference between machine code and Basic. The effort is well worthwhile.

The 6502 is an 8-bit processor, ie it can only deal with numbers in the range 0-255. It can, however, address 64K directly so 16 bits (2 bytes) must normally be used for addressing.

Numbers cannot be stored in variables, as in Basic, they must be stored directly into memory locations one byte at a time. To do this, the number must be in one of three registers, the Accumulator, X register or Y register (all 8 bits long). The instructions to store the contents of these registers are *Sta, Stx* and *Sty*. These instructions must be followed by an address to tell the computer where to store the number (different forms of addressing are obtained by using brackets and/or the X and Y registers to give 'indexed addressing').

Status register

Another of the 6502's registers is the Status register. This cannot be used by the programmer directly, but the different bits are set or cleared by the processor according to the outcome of different operations. For example, if an addition was performed and the answer was over 255, the carry flag/bit would automatically be set to 1. You could then subsequently branch (BCS) to another part of your program.

Program 1 inverts the whole of the screen using Basic (see UG page 250 for *Eor*). Next, it clears the screen and assembles the machine code version of 'invert'. Note that it does not execute the code.

In line 70 the Basic variable *Start* was given the address of the first instruction by the assembler. If you now type in *'Call Start'*, control will be transferred from Basic to the code (note the *Return* subroutine *(Rts)* command at the end which passes control back to the Basic interpreter). You may notice that the machine code version is slightly faster.

Program notes — as in Basic you must use a counter to run through all the screen addresses. There is spare memory from &70 to &8F so &70 and &71 can be used to hold the 16-bit address. First, you must *Load* the accumulator with &58 — the high byte of the start of screen memory, then store it in location &71 (the #&58 means the actual number (immediate addressing), *Lda* &58 loads in the number contained in location &58 (absolute addressing)). The low byte is then stored in &70.

If you are going to have a loop, you must jump back to somewhere, hence line 110. Since you want to *Eor* each memory location with 255, first load the number into the accumulator, then *Eor* it with the number stored in the address given by your counter (&70,&71). The actual syntax for the address is (&70),y which takes the lowest byte from &70, the highest byte from &71 and adds the number in the Y register on to this, ie address=(?&70+(?&71*255)+Y).

The result of this operation is held in the accumulator, so you must store it back into screen memory. In this example the Y register takes no part in the addressing (line 100 loaded it with 0) but it is necessary in the syntax of the instruction.

The next step is to increment the counter. First, load the lower byte into the accumulator (line 150) then *Add* 1 with *Carry (ADC)* to this. Line 140 clears the carry initially.

The highest byte, however, must only be incremented when the lower byte overflows. Adding (0+carry) achieves this. The result is still in the accumulator even after storing the result in memory, therefore you can compare it with the number &80 (high byte of the end address). If they are not the same, branch back to *Label*.

In the user guide there are references to certain routines being 'vectored'. What this means is that when the computer wants to write a character to the screen, it puts the ASCII code of the character into the accumulator (A) then jumps to subroutine (JSR) &FFEE. At &FFEE there is a *Jmp* (&20E) instruction (Jump). The brackets serve the same purpose as in program 1, but this time no Y is needed, so control is transferred to the address contained by &20E and &20F, namely &E1BB (the address of the routine to print the character). This seems a rather long way of going about it, a *Jsr* &E1BB would have done the same job. However, if you change the addresses in &20E,&20F you can change the way the computer writes to the screen. This is what program 2 does.

Line 40 calls the subroutine to print the character. Since all of the various routines have a *Rts* at their end, control will be passed back to line 50. Everything sent to the screen now will be printed twice (the *Rts* at the end will this time pass control back to the program which called the modified print routine).

Lastly, you must make &20E and &20F point to the routine. *Double* holds the address, so line 70 places the lower byte in &20E and line 80 places the highest byte into &20F (because of the way the 6502 is designed, you must put the lower byte before the higher byte — the assembler automatically changes round the two bytes when you specify a 16-bit address). This method will work wherever the code is assembled. Once you run the program, there is no need to *Call* it since the machine will do it for you.

Program 2 demonstrates some of the possibilities of relatively simple machine code programs. Program 1 could be useful but it is slow for a machine code program.

```
 5 REM ** PROG1 ** GLJ SEP 82 **
10 MODE4:FOR L=1TO100:DRAWRND(1280),RND(1024):NEXT
20 FOR X%=&5800TO&8000:?X%=?X% EOR 255:NEXT
30 MODE4
40 FOR O=0TO1
50 DIM P%100
60[OPT O*3
70.START
80 LDA #&58:STA &71
90 LDA #0:STA &70
100 LDY #0
110.LABEL
120 LDA #255
130 EOR (&70),Y
135 STA (&70),Y
140 CLC
150 LDA &70:ADC #1:STA &70
160 LDA &71:ADC #0:STA &71
170 CMP #&80:BNE LABEL
180 RTS
190]
200 NEXT
```

```
 5 REM** PROG 2 **
10 P%=&80
20[
30.DOUBLE
40 JSR &E1BB
50 JMP &E1BB
60]
70 ?&20E=DOUBLE AND &FF
80 ?&20F=(DOUBLE AND
   &FF00)/&FF
```

Into the subset

Experiment, by altering the values being added (just *Poke* new values into 17154 and 17156 and *goto* 220). Alternatively put the result somewhere else — say 17153. See how it changes the program? Try adding 240 to 100 (decimal). The result is not 340! Why? Think about it in binary:

```
240        1 1 1 1 0 0 0 0
100    +   0 1 1 0 0 1 0 0
          ---------------
          0 1 0 1 0 1 0 0   =  84
          ---------------
          1 1
          |
          1
```

The sum generates a 1 in the ninth bit, which cannot be held in an 8-bit byte, so it falls off the end. The quoted result is too small by the value of that ninth bit — 256. No check has been made, no helpful error message printed. When you write machine code you are on your own. What you do not test for, you do not find out about.

Here's how to modify the *loader* program to accept hex, by combining it with the decimal/hex converter in *Machine Code*, September 23.

Change lines 120, 130, 140, 150 to:

```
120 INPUT C$
130 IF C$="S" THEN GOTO 180
140 PRINT C$
150 POKE A, 16* (CODE C$(1)-28)+CODE
    C$(2) -28
```

The procedure is exactly as before, but now at each input you key in the hex code: 3E, then 04, then 06, etc. Do not omit the zeros. Use "S" to end the inputs, in place of the previous "negative number" delimiter.

In the previous description, we assumed you might only have 1K of memory. Machine code is of course a useful space-saver with 1K, but anyone interested in it is likely to have 16K. Further, some of our later routines using the display file need at least 4K. To reserve a 256-byte attic in 16K, proceed as follows:

```
POKE 16389, 127
NEW
```

Now *load* in the machine code. Replace 4300 hex by 7F00 hex and 17152 decimal by 32512 decimal. From now on, we are only going to give the hex codes, for which you can use the modified *loader* program.

It is a terrible nuisance that the ZX81 needs a *new* before it recognises changes to *ramtop*. You are half way through typing in a basic program, with some machine code to accompany it later . . . and you have forgotten to allocate memory.

Using what we have told you so far, all you can do is *save* on tape, reset *ramtop*, then *load* back in, and continue. But there *is* a way to avoid this, by using a Rom routine.

Suppose you want to allocate a 256-byte attic, leaving your precious Basic intact. From the keyboard, type:

```
POKE 16389, 127     [reserve space]
PRINT USR 1040      [call from ROM]
```

You will get a listing and the program will halt. Restart with Run (this technique loses your variables anyway). That's it. For different sizes of attic, change the 127 (and *Poke* 16388 with the junior byte if this is not zero).

You can use this in a program, but the program will halt after the *USR* 1040, and need a manual restart. And directly entered variables will be lost.

We are not going to describe one of the 694 opcodes the Z80 has — that would be tedious and unnecessary. Instead we will look at a subset of 30-odd types of instruction (covering about 230 actual commands). Unfortunately, not all of them can use all the addressing modes. Here is a quick reference table showing with which instructions can use what:

Address Mode	LD	ADD ADC SUB SBC AND OR XOR CP	INC DEC SLA SRA SRL	JR JRC JRNC JRZ JRNZ DJNZ	JP	JPZ JPNZ JPC JPNC JPP JPM	LD	ADD ADC SBC	INC DEC PUSH POP
Register	LD r, s	ADD A, r	INC r					ADD HL, r	INC r
Immediate	LD r, n	ADD A, n			JP nn	JPZ nn	LD r, nn		
Direct	LD A, (nn) LD (nn), A						LD HL, (nn) LD (nn), HL		
Indirect	LD A, (HL) LD (HL), A	ADD A, (HL)	INC (HL)		JP (HL)				
Indexed	LD A, (IY + d) LD (IY + d), A	ADD A, (IY + d)	INC (IY + d)	JR d					

8-bit operations — 16-bit operations

The notation is the table needs some explanation. Some of the opcodes will be unfamiliar, but we will deal with those later. Otherwise, the conventions are:

1) Each entry in the table shows an example of the format of the instruction type. Any of the other opcodes in that column could be substituted.
2) "r" or "s" denotes any register. Whether this is an 8-bit or a 16-bit register depends on which part of the table the instruction is in. For instance, in the *Ld* r, s instruction, r and s are any 8-bit registers (A, B, C, D, E, H or L), but in *ADD Hl*, r "r" is one of *Bc, De, Hl, Sp.*
3) "n" is any 8-bit number. "nn" is an 16-bit number.
4) If a register is explicitly stated, as in *Ld A,* (nn), then this is the only register which may be used for this purpose.

This is a wild oversimplification. Sometimes, other registers are usable. But the set of instructions we have shown are *always* OK and you can worry about extending your vocabulary of instructions when you are handling this lot confidently.

5) "d" is any 8-bit number, but it is always added to some 16-bit value. In other words, it is an indexing displacement.

Now let's look at the new opcodes:

And

This operation takes the contents of the *A*-register, and another 8-bit field, and examines these, bit by bit. Only if corresponding bits are both "1" does it put a "1" back in this position in the *A*-register. Otherwise it inserts a "0".

For instance, *And A,* 07 has the following effect:

```
A-register before the operation:  0 0 1 1 0 1 0 1
07:                               0 0 0 0 0 1 1 1
A-register after the AND:         0 0 0 0 0 1 0 1
```

See how the junior three bits have been transmitted? So you can use *And* to select a portion of a byte.

OR

This works in a similar way to *And,* but this time, the resulting bit is a "1" if either of the initial bits is a "1". So *Or A,* 05 gives:

```
A-register before:  0 1 0 0 1 0 1 1
05:                 0 0 0 0 0 1 0 1
A-register before:  0 1 0 0 1 1 1 1
```

Now, certain bits are being forced to "1" regardless of their original value.

Xor

Here the initial bit values must be different for the result to be a "1". *Xor A,* B3 gives:

```
A-register before:  0 1 0 1 1 0 1 0
B3:                 1 0 1 1 0 0 1 1
A-register after:   1 1 1 0 1 0 0 1
```

It is particularly useful for flipping a register from 0 to 1 and back again. If a *A*-register contains 0 to start with, every time the instruction *Xor A,* 01 is executed, the value in the *A*-register will flip. (0 to 1, back to 0, back to 1 and so on.)

Cp

This is the "Compare" instruction. The contents of the *A*-register are compared with those of another 8-bit field. That raises a problem, though — how is the result of the comparison signalled?

This is what the *F* (or *flags*) register is used for. Each bit of the *F*-register holds some information about the effect of the last instruction to alter them (Not all instructions do alter them).

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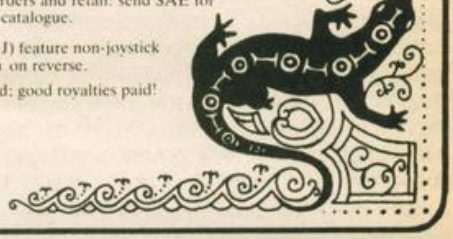

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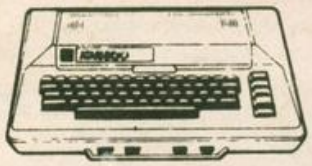

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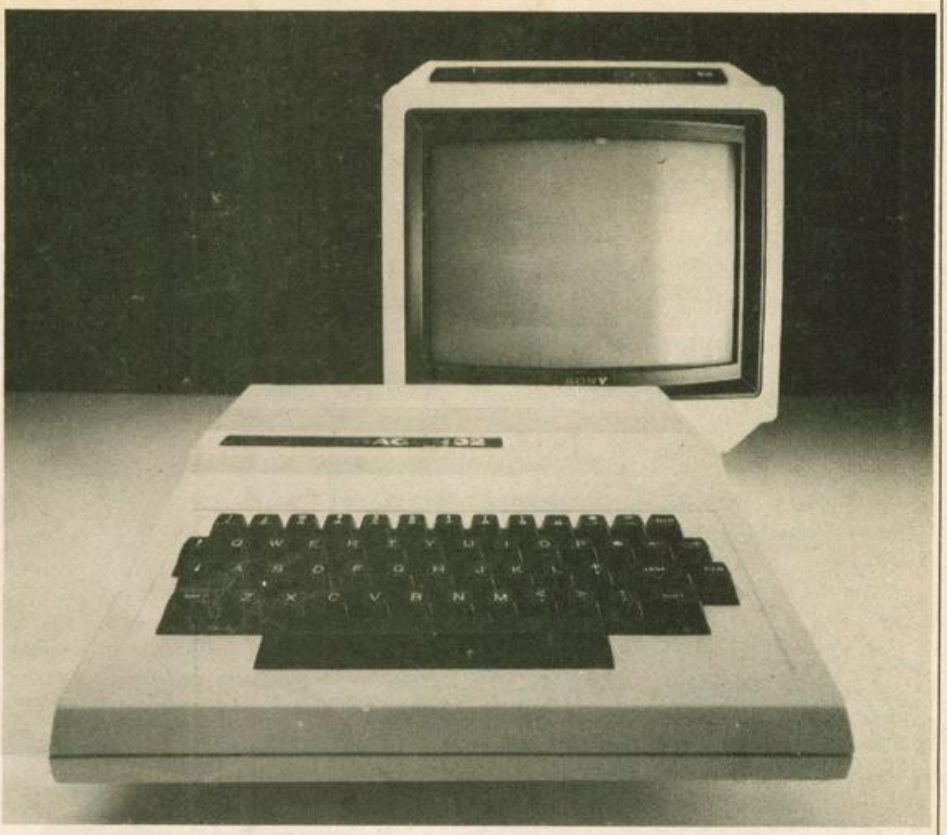
Plotting on micros

***Tim Langdell** explains how to create user-defined graphics characters.*



The Dragon 32 does not have any easy way to allow you to create your own graphics characters, unlike machines such as the Spectrum. However, using *Get* and *Put* you can store your characters created by plotting to the screen, and place them anywhere on the screen.

One advantage this system can offer on the Dragon is that you are not restricted to 8 by 8 character squares, as on other machines. Since the character is stored in an array it can be virtually as small or as large as you wish. For simplicity though I will restrict myself to an 8 by 8 character for space invaders as an example.

The first stage is to plot the points which make up the character onto the screen using *Pset* in, say, *Pmode* 4. I have chosen *Pmode* 4 because it gives you the maximum resolution available to define detailed characters. The program requires you to type in the character as 8 rows of 8 zeros and ones (pressing *Enter* between each digit), and then translates this pattern of zeros and ones into the character you have designed. The choice of zeros and ones was made to enable you to get an idea of how the graphic character will appear.

Lines 120 to 150 do the actual plotting on the screen in a box 8 pixels by 8 pixels in size. Line 160 uses a *Get* statement to store the box containing the character in an array *(C)*. In the first bracket of the *Get* statement is the co-ordinate of the upper left-hand corner of the box. The second bracket contains the co-ordinate of the bottom right-hand corner of the box.

Once the graphic is stored as the array *'C'* you can clear the screen *(PCLS)* and place the graphic anywhere using a *Put* statement. This statement in line 180 is, as you can see, very similar to the *Get* statement — with the contents of the brackets referring to the two corners of the new box's position.

The problem with using *Pmode* 4 is that you can only have either white (buff) and black or green and black (with *Screen*1, and *Screen*1,0 respectively). To get some colour into the game you would need to use *Pmode* 3. But in *Pmode* 3 the resolution is exactly half as good and you will need to design your characters with care. The zeros and ones to *Input* for this program to get a space invader are:

```
00111100
01011010
01111110
00111100
00011000
00100100
01011010
00000000
```

If you do not wish to design your own character but wish to use one already planned, then you might be better advised to employ *Read* and *Data*. In this case you might consider storing the co-ordinates for the *Pset* statements in the form of *Data*, and use a *For/Next* loop to *Read* the *Data* onto the screen in the form of *Pset* dots. Thus the form would be:

```
10 FOR X = 1 TO 3
20 READ A :READ B
30 PSET (A,B,2)
40 NEXT
50 DATA 10,10,10,11,10,12
```

The final part of the formula, to put the character on the screen and move it about, involves *Putting* the character at a position and then a moment later *Putting* the same character at that position as *Reset* (which *Resets* the points which were *Set* before — ie blanks them out). This *Put* statement will thus look like this:

```
PUT (110,110) - (118,118),C,RESET
```

The character is then *Put* in the next position on the screen, cleared again and so on.

```
1 REM USING GET AND PUT
2 REM FOR CHARACTER DEFINITION
10 DIM A$(9,9)
20 FOR N=1 TO 8:FOR M=1 TO 8
30 INPUT A$(N,M)
40 NEXT M
50 FOR T=1 TO 8: FOR S= 1 TO 8
60 PRINT A$(T,S);:NEXT:PRINT:NEXT
70 NEXT N
80 PMODE 4,1
90 PCLS
100 SCREEN 1,1
110 DIM C(9,9)
120 FOR X=1 TO 8: FOR Y=1 TO 8
130 LET K=0: IF A$(X,Y)="1" THEN K=1
140 PSET(9+Y,9+X,K+1)
150 NEXT: NEXT
160 GET(10,10)-(18,18),C
170 PCLS
180 PUT(110,110)-(118,118),C
190 GOTO 190
```

Common characters

1.1 Unifile/Spectrum page

Sooner or later most micro owners realise that their new digital friend comes into its own when it is storing information, processing it and presenting it in ways that would be laborious if done manually. They soon begin the task of writing simple programs which will store their friends' names and addresses or catalogue their stamp album. They may end up with half a dozen programs, all of them using roughly the same method but working on different types of information. In this series of extracts from *The Working Spectrum** we examine how a single program can be written to cover a variety of filing tasks without the need for constant re-writing every time a new usage comes along.

Before we write the program we must decide on an economical way of storing the date we wish to file. Small programs can afford to fudge this issue since they are unlikely to make use of all the available memory anyway. Such a small program might, for instance, declare an array with dimensions of 50,4,20. This would allow the storage of up to 50 entries, each with four constituent items, each item being up to 20 characters long. The advantage of this is that each entry to the file would be clearly identifiable since entry X would be made up, if the array were called A$, of:
A$(X,1),A$(X,2), A$(X,3) and A$(X,4).

The disadvantage of this method is that for most filing uses it is likely to result in an enormous waste of space within the limited amount of memory available. The reason for this is simply that the length of the fixed space you allocate to each item must be adequate to the longest item you are likely to input. If, for instance, you want to store the names of your friends and one of them is graced with the surname Farquarson-Smythe, then you will have to set aside at least 17 characters for every surname, despite the fact that the rest of your friends are nowhere near so impressively named. The space allocated to most of the names would be more than half empty.

This is a problem encountered by any storage method which allocates a fixed amount of memory to each item regardless of its size. But if each entry is not to be allocated a fixed amount of space then the file in which the data is stored will not be divided up in any regular way. This makes its difficult for the program to keep track of the position of individual entries or even to identify where one entry ends and another begins.

Take the following example of two entries in a file which have been allocated precisely the right amount of space:
SMITHJOHN331255645677HIGH STTHOMASBILL45109567851EDEN AV.

You probably had no difficulty in identifying the names of the two men, but your Spectrum is not as familiar as you with common surnames. Even you probably did not guess that each name is followed by the age, file number, telephone number and street number of the man in question. How is the program to identify each of these given that any of them can vary in length?

The answer to such problems is normally provided by a combination of indicators and pointers. Indicators are markers set into the main body of data which allow the program to identify the length of the items which make up an entry. Pointers are normally set outside the main body of data. They consist of a list of the positions, in memory, of all the entries, enabling the program to jump into the middle of a long and complex file and unerringly find the first character of the desired entry.

The program below uses indicators and pointers to manage a file made up of 25,000 characters, made up of perhaps hundreds of separate entries all packed together in a seemingly random way. The program is called **Unifile.** I hope it will come to play a valuable part of your program library. More importantly, the techniques employed are essential tools for everyone who wants to pack his Spectrum, 16K or 48K, with the maximum amount of information.

Module 1.1

As a rule of thumb, a utility program that does not commence with a fairly clear-cut menu of the functions available is a bad program. If you do not agree with this now, you certainly will some time when you have to return to a complex but useful program which you have not used for some time and have to spend hours going through the listing trying to work out just what you have to do to make the program work for you.

```
1000 PAPER 7: CLS : BORDER 7: IN
K 0: PAPER 0: PRINT PAPER 2;"
     UNIFILE
1010 PRINT '"FUNCTIONS AVAILABLE
:"
1020 PRINT '"      1)SET UP NEW F
ILE"
1030 PRINT '"      2)ENTER INFORM
ATION"
1040 PRINT '"      3)SEARCH/DISPL
AY/CHANGE"
1050 PRINT '"      4)STOP"
1060 PRINT '''"PLEASE ENTER WHICH
 YOU REQUIRE."
1070 INPUT Z$
1080 CLS
1090 IF Z$="1" THEN GO SUB 1210
1100 IF Z$="2" THEN GO SUB 1440
1110 IF Z$="3" THEN GO SUB 2180
1120 IF Z$="4" THEN GO SUB 1150
1130 CLS
1140 GO TO 1000
1150 PRINT AT 10,5; INK 7; PAPER
 2;"FILING SYSTEM CLOSED"
1160 BEEP 2,2
1180 INPUT "Have you input new i
nformation you wish to save? (Y
/N)";Q$: IF Q$="N" THEN STOP
1190 SAVE "UNIFILE": PRINT '"Rew
ind tape, then press any key to
VERIFY": PAUSE 0: VERIFY "UNIFIL
E": STOP
```

In this module the user is requested to choose between four numbered functions. No particular attempt is made to guard against mistaken inputs. Mistakes at this stage are not serious. If a number or character other than 1-4 is input, the program ignores it. The module also contains, as one of the four menu choices, the *Stop* function. This serves the purpose of marking an end of the use of the program and reminds the user to re-record any new data which has been entered.

Commentary

Line 1000: Every program on the Spectrum which is not going to be in black on white needs to declare somewhere near the start the colours to be used for:
a) the border around the screen
b) the screen
c) the ink with which the characters appear on the screen.

There are three separate *Paper* instructions in this line. The first instruction stands alone and, with the CLS command, sets the screen to white. In the second instruction the *Paper* colour is set to black so that the menu stands out boldly from the white background. The third *Paper* instruction is tied to a *Print* instruction. It makes no permanent difference to the paper colour, but ensures that the word Unifile is printed on a red background.

It is important that you can distinguish between those colour commands which stand alone and set a colour, and those colour commands which refer only to the single *Print* statement to which they are tied. A single *Print* statement can have every characteristic set by such tied commands. For example:
PRINT FLASH 1;OVER 1;INVERSE 1;PAPER 7;INK 0; "HELLO"

None of these colour commands will have any effect on Print statements in other parts of the program.

Line 1070: When you have an input to a program menu do remember to check that the variables you use are not duplicated in other parts of the program.

Line 1080: The menu is printed on white paper in bold black strips. But the last *Paper* command sets the background to black so this *CLS* command sets the whole screen black. It remains black until the program returns to the menu.

Line 1190: For any data storage program it is far more convenient to have a *Save* instruction built into the program rather than having to enter it in direct mode every time new data has been added.

Testing Module 1.1.1

A rough and ready test of the module is simply to *Run* it and enter numbers in the range 1 to 3. The program should then stop with the report 0 OK followed by the appropriate line number from 1090-1110. Input of 4 should result in a prompt to *Save* and then *Verify* the program. Any other input should be ignored.

More of the Unifile program will be presented next week.

This is an extract from *The Working Spectrum,* by David Lawrence (price £5.95) published by Sunshine Books, Hobhouse Court, 19 Whitcomb Street, London WC2 7HF.

Is there anything about your computer you don't understand, and which everyone else seems to take for granted? Whatever your problem *Peek* it to Ian Beardsmore and every week he will *Poke* back as many answers as he can. The address is *Peek & Poke, PCW,* Hobhouse Court, 19 Whitcomb Street, London WC2 7HF.

OLIVER ASKS FOR MORE

Jason Derry of Rosehill Way, Guildford, writes:

Q I have a Vic20 and want to expand it. But, as I am limited to my pocket money, I would like to know if there is any other way of adding memory, apart from buying the super expander. I can borrow a soldering iron if necessary. Is there anyone who makes a kit for extra memory, preferably more than 3K? If not, is there any way I can add the extra memory myself?

A This is the sort of question that needs a whole article in answer. I do know that 2114 chips, such as the Vic uses, have been 'Piggy backed', so as to effectively double the memory available to the user. However, this was done on a ZX80, I do not know if it has been tried on the Vic.

As there seem to be three unused control lines on the unexpanded Vic, it may well be possible to add 3K yourself, though this would void your guarantee. Unfortunately, I do not know how you should go about adding 3K on your own. Does anyone have any ideas?

KACK-HANDED

Paul Thompson of Rowan Drive, Newbury, Berkshire, writes:

Q In February I bought a Vic20 after selling my ZX81. I would like to know if there is a numeric keypad available for it, with a built-in *Return* key. But, as I am left handed, it would have to have enough cable to reach around the left-hand side of the machine.

A The Vic keyboard is an 8 × 8 matrix. The only number pad I know about is made by Dk'tronics for the ZX81. It costs £10 and should be possible to convert to the Vic20.

Alternatively, it should be possible to make one, as described by Stephen Adams in his book *20 Simple Electronic Projects for the ZX81 and other computers.* The lines that you will have to deal with are line 7, which will give you the even numbers, and line 0, which will give you the odd digits. *Return* is line 1, H. The keyboard connectors for the Vic are on the left as you look at the computer, so the length of wire you will need should not be a problem.

But such a conversion, unless it can be done through your Commodore dealer, will void your guarantee.

LANGUAGE SPECIFICATIONS

Joe Laine of Yew Road, Stockport, writes:

Q I am very interested in the new Jupiter Ace, but I am unsure whether or not to buy it. I was going to get a ZX81 or Spectrum to learn on, because I am going to start learning computing at school soon. What I want to know is, will I have to learn two languages, one at school and one on a Jupiter Ace? Also will there be software coming out for the Ace? I do not want to buy a computer that has no software.

A The Jupiter Ace has caused quite a lot of interest, and not a small amount of decision taking. It is not an easy choice to make if you want to buy a computer, even if you do believe that Forth is a better language than Basic.

What you say about school is very important. I know that last year the London Board specified any high level language for the O-level, but only Basic for the A-level. This year the AEB has not specified Basic only. The thing to do in this case is to talk with your teachers, find out what the syllabus asks and what they are going to teach. While an increasing number of staff are becoming computer literate, I doubt if many of them are conversant with Forth.

My worry with the Ace is that it is in a Catch 22 situation, where everyone is waiting for 'Everyone Else' to buy the machine, so that it generates enough interest for software companies to write programs for it. I feel that it is a very good choice for a second machine, and I can see it picking up some extra trade if the Spectrum problems continue. As to whether you should make it your first choice — I would again suggest you talk to your teachers before deciding.

BAR CODE DEVICE

Dermott Bicker of Skipton Street, Morecambe, Lancashire, writes:

Q Is it possible to use a bar code to program computers. I have seen this idea used with an electric organ to play tunes. Would it be a quick and easy method of programming simple 1K games on the ZX81?

A This can be done. Apparently a device to use a bar code has been marketed in the United States by Mindware. Unfortunately, I have no other details. As far as I know, there is no comparable device available over here.

The address of Mindware is 15 Tec Circle, Natick, Mass 01760, USA.

MODULATING IMAGING

Rodney Bennett of Oxford Gardens, London, W10, writes:

Q I have a ZX81 and have recently acquired a video recorder, an excellent Sony C5. However, when I tried to use the ZX81 through my video recorder, replacing the aerial input in the normal way, the result was a much inferior screen image. I have had to return to feeding my ZX81 directly into the television set.

This is a pity, as I had hoped that one use of the ZX81 would be to generate captions that could be used on video tapes. This is possible but only with a very poor quality screen image. Is there any way to improve this?

Also I am hoping to use my Spectrum (when it arrives) for the same purpose. Will I find the same problems?

On a related subject, I find it almost impossible to keep my television set tuned so that I get the best possible image from my computer without having to adjust it each time I use it. I have reserved a special channel but this does not seem to help. Is there any way around this?

A I think this problem is due to the fact that both machines are using the same RF signal. Like the computer a video has an in-built modulator, and it is almost an industry standard to pre-tune these to channel 36. I do not know the Sony C5 model specifically, but is there a small screw visible whereby you can slightly re-tune its modulator?

If you can, do this, and then fine-tune your ZX81 or Spectrum to the one on the video.

As regards the re-tuning of your ZX81 in normal use, the problem you have is so common that it is usually considered to be just part of the setting-up routine. If you use more than one computer on a single set you will find that a signal does tend to wander off station slightly.

BROADCASTING CONFUSION

I Baker of Kingsman Street, Woolwich, London, writes:

Q I have ordered a Spectrum, and have been following the correspondence and articles about television and video. However, I am now more baffled than ever.

What is the difference between video and television? Are videos available on retail? Is there any particular video or television that works well with the Spectrum?

A These two words are easy to confuse. Essentially a television is a screen display that has been *tele*'d. That is it has been broadcast and the material has come across the airwaves. This signal then has to be picked up and translated into the picture you see.

A video display does not have to go through this process. The display you see is fed directly into the television. Thus a computer gives a video picture when plugged in to a domestic television. A monitor cannot receive broadcast signals. It boils down to the different ways in which a signal gets to the cathode ray tube which gives the screen display.

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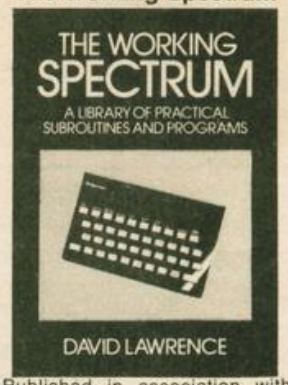

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SHARP MZ 80K 48K, some software, 10 months old, £340. Tel: Eastbourne 21814, normal office hours.

INTELLIVISION VIDEO GAME plus 11 cartridges, Space Battle, Boxing, Skiing, Star Strike, etc, Soccer Free, £200 ono. Birmingham. Tel: 021-770 4730.

ZX PRINTER plus six rolls of paper for sale, £50. G. D. Potter, Batley 440389.

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ZX81 64K AD ON KEYBOARD, magazines, manuals, price £140, 6 months old. Tel: 0628 30966.

MICROTAN 65 plus graphics, leather case, MM/board, Tanex 8K+1/0 Xbug, basic keyboard, tangerine, bargain, £160. 061-865 5809 any time.

DAI, used demonstration only, plus joystick, Adventure cassette and handbook. Bargain, £590. Everyman Computers, Edward Street, Westbury, Wilts. Tel: 0373-864644.

SHARP PC1500, colour printer, plotter, 8K RAM. £275. Tel: Bognor Regis 864021.

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VIDEO GENIE, 16K, sound, books, games on cassette, £200 ono. Robin Freeman, Great Missenden (02406) 5888.

EXIDY SOURCERER 32K, including tool kit, Tandy conversion tape, lots of software, including Asteroids, Chess, Invaders, Galaxions, Backgammon and Defender. Cassette motor control, £350 ono. Tel: Ivybridge 4088.

G700 by Phillips, £65 ono + computer tape + music + space invader game. Tel: 01-656 4142.

DATA GENERAL CS10 model C3, 2 Data General visual display units, still in original cartons. Best offer secures. Bolton 24431, Mr Cardwell.

2 ITT 20 20 COMPUTERS 48K, with disc controllers + 3 drives + visicalc for £1,000 the lot. Tel: 0371 820790. Mr Dawkins.

ROTRON TCS, cartridges including Space Invaders, £55 ono. Tel: 0691 830072.

COMPUKIT UK 101 8K Compukit built (wooden case) software including Space Invaders, £100. Tel: Peter 01-981 5818, after 6 pm.

DRAGON 32, joystick and manuals, 2 months old, £230, want £170. Tel: 061-483 9121, after 2 pm.

ZX SPECTRUM PRINTER for sale, less than 12 inches paper used since new. Quick sale wanted, £45 ono. Ring 571 1309 (after 7 pm).

Wanted

VIC20, Adventure Land cartridge. Swap for another adventure. Tel: Stevenage (0438) 811634. after 6 pm, Mr Goodman.

SHARP MZ 80B COMPUTER, top price paid. Tel: Watford 46955.

WANTED. Dragon 32. Tel: Biggleswade (0767) 312870. J. Tasker after 5 pm.

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Brain teasers

by Gordon Lee

You are probably familiar with the sliding puzzle shown below which can be found in most toyshops.

1	2	3	4
5	6	7	8
9	10	11	12
13	14	15	■

It consists of a grid of 15 plastic squares which can slide freely around in a frame. The object of the puzzle is to rearrange the squares to form different patterns or to restore their order after they have been jumbled at random.

One of the earliest brain teasers using this puzzle involved lifting out the two tiles 14 and 15 and swapping them over. The task was then to rearrange them — by sliding only — to their original order. This problem is in fact insoluble, since the exchange of two tiles is said to alter the 'polarity' of the puzzle. There is no way that this can be reversed simply by sliding tiles.

If we remove all the tiles and replace them at random there are 20,992,789,888,000 different starting positions possible. The first tile can be placed in any one of 16 positions, the second in any of 15, and so on. The total number of starting positions given above is in fact 16! or 16 factorial. (16! = 16x15x14x13x12x11x10x9x8x7 x6x5x4x3x2x1x = 20,922,789,888,000.)

Only half of these starting positions can successfully be rearranged into the correct numerical order.

The Rubik cube has similar properties, but it contains 12 separate cycles — not two. If the elements of a Rubik cube are reassembled at random there is only a 1 in 12 chance that the cube can be completed. Of the 43,252,003,-274,489,856,000 possible configurations of the cube, only 3,604,333,606,207,488,000 of them can be solved — still rather a formidable number.

An interesting variation uses letters instead of numbers.

R	A	T	E
Y	O	U	R
M	I	N	D
P	A	L	■

This forms the basis of a cunning trick. Show the puzzle to your friends, pointing out the wording and the two paired rows of differently coloured tiles. In full view, slide the tiles about and ask them to restore the original order. Try as they might, the closest they can get is "Rate your mind pla".

The catch is in the polarity of the puzzle. When you rearranged the tiles, apparently at random, you move the 'R' from the word 'Your' up to replace the 'R' from 'Rate'. Your friends naturally leave the 'R' from 'Your' in the top left as the start of the word 'Rate'. Unknown to them this reverses the polarity of the puzzle making it insoluble.

Puzzle No. 31

1	9	2
3	8	4
5	7	6

In this grid the middle number (384) is twice the top one (192), and the bottom number is three times the top one. Each number has three digits and no digit is used more than once. How may other sets of numbers can be formed with these conditions?

Solution to Puzzle No. 5

Using the standard technique for identifying primes, we check the odd numbers in sequence, counting them off into successive groups. The count, C is started at 1 to account for the first (and only) even prime, 2.

Line

```
 10 LET C=1
 20 LET M=1
 30 LET T=3
 40 FOR N=3 TO (SQR T)+.5
 50 IF T/N-INT(T/N)=0 THEN GOTO 80
 60 NEXT N
 70 LET C=C+1
 80 LET T=T+2
 90 IF T>M*1000 THEN GOSUB 200
100 GOTO 40
200 PRINT M*1000-1000; "TO"; M* 1000; "CON-
    TAIN";C; "PRIMES"
210 LET M=M+1
220 IF M=11 THEN STOP
230 LET C=0
240 RETURN
```

This gives us the answer:

```
    1 TO  1000 contain  168 primes
 1000 TO  2000 contain  135 primes
 2000 TO  3000 contain  127 primes
 3000 TO  4000 contain  120 primes
 4000 TO  5000 contain  119 primes
 5000 TO  6000 contain  114 primes
 6000 TO  7000 contain  117 primes
 7000 TO  8000 contain  107 primes
 8000 TO  9000 contain  110 primes
 9000 TO 10000 contain  112 primes
    0 TO 10000 contain 1229 primes
```

Winner of Puzzle No 25

The winner is: Ms H Eshun, Wolfe House, London W12, who receives £10.

ZIGGURAT

The Monkey Puzzle

It is worth wondering how people's minds work, and how, in particular, your mind works. Seymour Papert (in *Mindstorms*, 1980) poses the following puzzle: "A monkey and a rock are attached to opposite ends of a rope that is hung over a pulley. The monkey and the rock are of equal weight and balance one another. The monkey begins to climb the rope. What happens to the rock?"

There are three possible answers to the question: the rock goes up, goes down, or stays where it is — which is correct?

Papert notes that three quarters of several hundred physics students at MIT gave wrong answers, or were unable to make up their mind. I have asked people from many different occupations, of many different ages, and the ability to arrive at the correct response seems to be unpredictable. Obviously the correct answer is that the rock goes up: those who were right, work out why you were right; and those who were wrong, try to work out why you were wrong.

This is, in essence, a very simple task, and it is only the solver who makes the task complex; the rock must rise, because the monkey is pulling on the rope. Asking people to justify incorrect answers is very illuminating. Those who have a knowledge of physics — sometimes dimly remembered — often talk about conservation of energy so that if the monkey goes up, the rock must go down, or sometimes they talk about inertia, so that the rock must stay where it is.

Sometimes people think that the rock must go up, but then think that this is too obvious so it must be one of the other solutions — these are people who are not sure of the solution, and naturally distrust easy answers.

What else can we learn from this example? One conclusion that Papert himself draws is that most (ie more than half) people cannot see the wood for the trees, that is, the structure of the problem is lost in the detail. When the problem is seen as a whole — after all, the rock is attached to monkey by the rope — the answer is obvious; but if attention is focused on to the rock (as it often is) then the integrity of the system is violated.

This is the way many people program: they are so concerned with the intricacies of tiny portions of programs, that the total way the program is designed is highly wasteful, and confusing to follow.

A program is designed, but for many programmers the design is unknown to the designer: the program just grows from a few lines typed in at the keyboard, to a vast unwieldly monolith. A programmer is a designer, a programmer is an architect whose building bricks are ideas, and a program is only as good as the ideas it contains. If a program is very long and complex, then that program is either having to deal with a long and complex task, or it is badly written (or it might lie somewhere between these extremes).

When we try to evaluate programs, therefore, we should use design criteria and that usually means that the programmer needs to have had an appreciation of the program as an entity, an entity which has certain distinct parts or modules. Some languages are supposed to promote better programming practices than are other languages, but usually 'better' seems to mean neat and tidy (not a bad thing in itself) and the 'wholeness' is still lost.

The best designed programs do not come from a particular language, they come from programmers who understand the underlying structure of the problem for which they are writing a program. It is also a question of understanding what is the problem.

To write a program to use graphics to show addition in practice is not difficult. What are we to make, however, of a program for infant school children which puts three yachts on the screen, two cars, and five houses, and then tells the children that 3 + 2 = 5?

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Instructions. You have to score nearer (but not over) 21, than the computer does. The computer deals your first card, you then place your bet and hit the return key, the computer then deals your second card. If you want another card hit the "C" key, if not hit the "S" key.

Points. Ace 1 or 11. Jack, Queen, King 10.

Scoring 21 points with 2 cards — you automatically win.

Scoring 21 points or less with 5 cards — you automatically win.

Draw — the computer wins.

Your kitty is automatically adjusted win or lose. If you lose all your kitty — game over.

DECIPHER

You have to guess what combination of colours the computer has selected — to enter a colour just hit the colour button on the computer, when you have entered your five choices of colour, the computer will display (a) Nothing at all — none right; (b) Black or white squares or both — for every black square you will have a correct colour in the correction position, for every white square you will have a correct colour in the wrong position. If you cannot find the complete combination, it will be displayed when you have had twelve attempts.

FOUR THOUGHT

You have to make a line of four squares — horizontally, vertically or diagonally BEFORE the computer does, taking turns to take a square (squares can only be placed at the bottom of the grid or on top of another square). **Keys.** Hit the number key of the column you want your square dropped in then hit the return key.

TEASER

The aim of the game is to score "15" BEFORE the computer does, using any combination of three boxes. If you cannot score "15" then you must try and stop the computer from doing so and force a draw. **Keys.** Hit the number key of the box that you want (you can only select an empty box).

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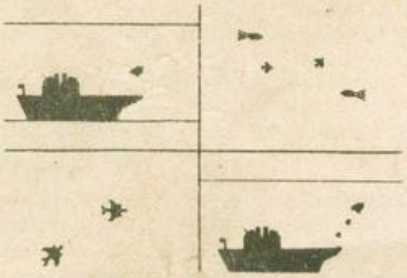

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NEW NEW NEW

SPACE ATTACK
For the unexpanded Vic20

NEW NEW NEW

MOONS OF JUPITER
For expanded Vic20, 3K, 8K or 16K

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For unexpanded Vic20

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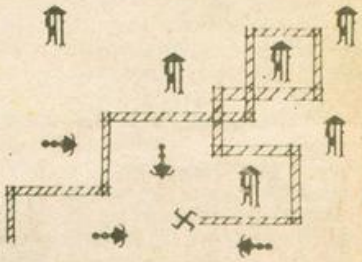

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