

POPULAR **Computing** WEEKLY

5 August 1982 Vol 1 No 16

35_p

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on Spectrum**

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Robot Nim

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**Space-saving
on PC1211**

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How to submit articles

Articles which are submitted for publication should not be more than 1000 words long.

All submissions should be typed and a double space should be left between each line.

Programs should, whenever possible, be computer printed.

At present we cannot guarantee to return every submitted article, so please keep a copy.

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.

This Week



Cover illustration by Ian Craig

News	5
Enter Sony, with a video link.	
Letters	7
Pope blocks Fair deal.	
Hunter-killer	8
Spectrum game by David Lawrence.	
Street Life	11
David Kelly reports on the PATS Centre.	
Reviews	12
Volcanic Dungeon, Robot Nim.	
Copyright	13
How the law on software affects you, by Roger Pearson.	
Open Forum	15
Six pages of your programs.	
Programming	21
Space saving on PC1211.	
Spectrum	22
Machine code tips.	
Sound & vision	23
Graph plot on BBC micro.	
Peek & poke	24
Your questions answered.	
Puzzle	25
Cartoon.	

Editorial

The future of home computers lies in telesoftware, according to Nigel Searle, head of Sinclair's computer division. That is a bold, not to say prophetic, statement, considering the conspicuous lack of interest so far engendered by Prestel, Ceefax, Oracle et al.

Certainly, the development of a low-cost Prestel adaptor (*PCW* July 29) would make a telesoftware scheme financially feasible. But, what benefits would it offer to the user?

The most obvious benefit is access to an extremely large data base. This would be useful for both educational and business applications.

Another benefit is immediacy. Programs and other information transmitted via Prestel can be constantly updated.

A further benefit is the possibility of interaction with other users. It would be possible for clubs and individuals to contact each other over the air. The first CB micro may yet appear.

But, if telesoftware is to be a success, systems such as Prestel will have to be a great deal more user-friendly than they are at present.

Next Week



Survival in post-holocaust London means gang warfare. Can you lead your men to victory? You'll find out in *Street Alley* — a new game for Vic20.

Classified

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Enter Sony with a video-linked micro

SONY has made its long-awaited entry into the micro market with the new SMC-70.

The machine, with an optional video disc interface, is intended both for conventional computing and video applications.

The SMC-70, an 8-bit micro based around the Z80A processor, features 64K Ram, 16 colours and hi-resolution graphics. The machine uses a version of Basic designed by Sony and the CP/M® operating system.

It is the first micro to be designed specifically for use with a video disc player.

Selected information can be lifted off the Sony video disc system and displayed — its format and content being determined by the user. The main application of this will be an educational one, being well suited for presenting all types of learning material.

To ensure that this video facility is useful the SMC-70 has advanced graphics capabilities. The 16-colour mode will display either four pages of 160 × 100 pixels or one page of 320 × 200 pixels. The hi-resolution black-and-white mode will display a page of 640 × 400 pixels.



Sony's SMC-70 microcomputer with dual disc-drive unit.

Other facilities include cassette, IEEE and RS232 interfaces, floppy disc control unit (for Sony's 3in micro-floppies), light-pen input and battery back-up unit.

Among the expansion options are a 256K cache disc unit and a 256K-1M 16-bit

CPU adaptor unit.

The SMC-70 will go on sale in the US in September. The basic model will cost around £750 but a complete system will cost nearer £2500.

At present Sony has not announced any plans to sell the machine in the UK.

Primary schools get a £9m micro boost

KENNETH Baker, Minister for Information Technology, has announced details of the government's £9m "Micros in Primaries" scheme.

Under the plan, the government will contribute half the cost of putting a micro-computer in Britain's 27,000 primary schools. The other half of the cost will be met by local education authorities, parent/teacher associations and local interest groups.

Only three micros are eligible for the scheme — Sinclair's 48K Spectrum, Acorn's BBC model B with disc interface and Research Machines Link 480Z.

Each micro is available with a teacher training package. Two teachers from each participating school will be required to attend a short course on the use of micros in primary education.

The scheme, which will run from October 1 this year to the end of 1984, is an extension of the existing secondary schools grants system.

Some 5200 secondary schools have benefited so far, to the tune of £3m.

"Our objective is to enable teachers to get started in giving all young pupils — the five-to-ten-year-olds — experience with technology," concluded Kenneth Baker.



And they're off . . . looking for their Spectrums?

Clive shows his pace in Cambridge race

THE first Sinclair Cambridge half-marathon, held on July 18, has been won by Ian Thompson.

The former British, European and Commonwealth champion completed the course in 1hr 5mins 17secs.

Of more than 1300 hopeful competitors exactly 1000 finished the 13.1-mile route. The race, sponsored by Sinclair Research, was the first of its kind to be included in the Cambridge Festival Calendar.

Clive Sinclair and Nigel Searle were among the large contingent of Sinclair staff taking part.

Clive finished 699th in a time of 1hr 51min 41sec.

The three-lap race through the streets of Cambridge was organised by the city council in conjunction with the Festival. Cambridge City council's Brian Allinson said: "We were particularly delighted with the very festive crowd which gathered around the course."

Unemployed to learn computing skills

AN Information Technology Centre has opened in Camden, London.

At the centre, the first of 10

soon to be opened, 50 unemployed school-leavers each year will be taught a range of computing skills.

Hitachi at IBM secrets hearing

HITACHI has announced its intention to "voluntarily appear" before a US court to hear charges relating to the IBM secrets case.

It is alleged that nine Hitachi and four Mitsubishi employees were involved in illegal purchases of stolen IBM computer secrets.

Both companies deny that they acted illegally.

Hitachi itself and its nine employees in Japan have received summonses to attend the hearings. These orders issued by the US Embassy in Tokyo were delivered by Japan's Foreign Ministry.

No Hitachi executive is expected to attend the hearing at the North California district court in San Jose. The company will be represented by one of its US lawyers.


A spokesman for Hitachi has said that it will "in no way interfere" with the decisions of its nine employees whether or not to attend the San Jose hearings.

Spectrum game

QUICKSILVA has now produced its first Spectrum software game.

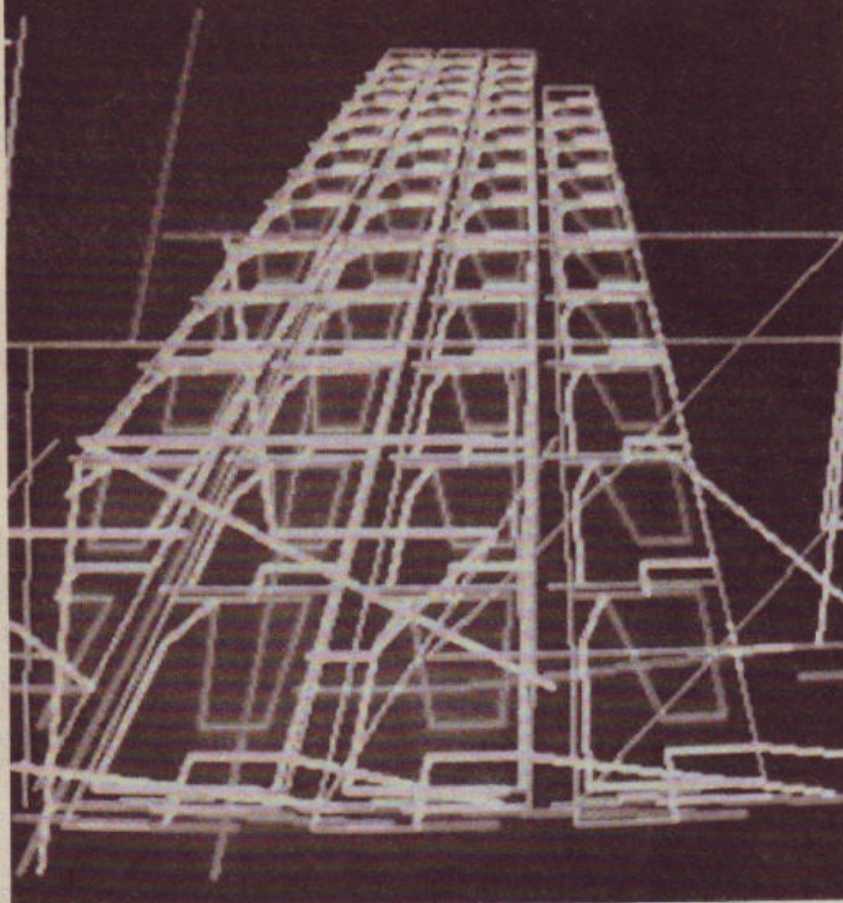
Space Intruders costs £5.95 and is available from Quicksilva at their new address — 92 Northam Road, Southampton.

Further QS Spectrum cassettes are to follow shortly.

 commodore

COMPUTING

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Letters

write to Letters, Popular Computing Weekly, Hobhouse Court, 19 Whitcomb Street, London WC2

Hey! Where's ma Spectrum?

It is nine weeks today since I sent off my order for a Sinclair ZX Spectrum. It is seven weeks since my cheque was cashed.

If, as appears in a recent edition of your magazine, 17,000 Spectrums have been ordered at an average price of say £145, then Clive Sinclair is holding on to £2.465m of other people's money. The interest accruing at Building Society Rates, say 13 per cent, for a seven-week period is over £43,000.

With £10m profit and an additional £43,000 of our money, the least I would have expected would be a letter of explanation.

Michael Diamond
20 Thorncliffe Gardens
Glasgow G41 2DE

Another Beeb fan bytes the dust

I am glad that PCW has got nearer the truth about BBC computer deliveries after the totally fallacious story of June 10 that "Acorn had cleared its backlog of orders". My order of November 28, 1981, is still outstanding, even though it is a re-order of a requisition made the previous June. Frankly, I don't call a year's delay "clearing the backlog of orders".

I won't bore you with the tale of frustrating phone calls trying to get information, nor of the sadly lacking "customer relations" on the part of a number of Acorn representatives. John Coll did offer to help back in February, when there was a need to use the BBC computer to consider its use in a £16,000 computer package for the local comprehensive school. Sadly, the sales department were unaware of the offer when I phoned them in a fit of frustration in May.

In response to their request to send a copy of John Coll's letter, so that they could know what was going on, they sent me a cyclostyled form to con-

firm delivery in "June/July".

The local computer committee met last month to consider its deliberations. By this time the school had had a visit from the Acorn caravan to demonstrate the Econet system. It didn't work, even though it stayed in the school for over a week. We were told that there was a fault in the network using BBC computers which had yet to be solved.

In response to a reminder that a rather important order was involved (from the school's point of view, at least), Acorn's representative replied that £16,000 was "peanuts" to them.

I was appalled with this attitude. How insignificant an order for a mere one-off computer must be. Other customers beware! Frankly, even if the problem is only a duff cassette recorder, any reputable firm should surely show concern.

Our committee showed its concern by confirming an order for the latest Nascom System. It actually works and will be installed in July. Despite my firm advocacy for the Acorn BBC computer throughout the committee's deliberations, I could not maintain my support when the company's confused state pulled the rug out from under their own feet.

David Tall
21 Laburnum Avenue
Kenilworth CV8 2DR

While another gets a bit miffed

One, if not the only frustrating element in purchasing your magazine is that you are too biased to ZX81 and Vic (see PCW July 15).

Owning a BBC micro, I feel really "had" by the now 35p price tag. So how about fair shares for all, or are you paid by the ZX81 reference?

D Nevard
1 Sands Lane
Carleton-le-Moorland
Lincoln LN59 8HJ

If you look at PCW July 22, you will see that we are not biased against the BBC micro. That issue contained a cover

story (Voyager on BBC) and three Open Forum programs written specifically for the BBC micro.

However, there are approximately 300,000 ZX81s in the UK as against some 20,000 BBC micros. While we try to provide a balanced coverage of different micros, we also try to reflect the interests of our readers.

Pope is unfair competition

Having read the article in PCW June 24, regarding the first ZX Fair to take place outside London, I feel (like many ZX users in the north) that I must comment on the reasons for the attendance being "down to few more than 2000 for the two days".

First of all, having spoken to users who did not even know the show had taken place, I feel that the publicity was very poor. The only advertisement I have seen for the show was a small advertisement for one week in your own magazine. There was no mention of it in *Sinclair User* which I am sure many ZX users read.

Secondly, it was unfortunately held on the worst weekend of the year, when, owing to the once-in-a-lifetime visit of Pope John Paul II there was no parking in a 50-mile radius of Manchester (a slight exaggeration, but I am sure it did not help).

As one of the 2000 or so who attended the fair, may I please say do not let it put you off holding another one in the future. We thought it was super, only next time let more people know about it.

S Metcalfe
21 Sherwood Avenue
Radcliffe
Manchester M26 0LE

Upon the merits of competition

Re Mr Robert Lober's slight criticism of the ZX Spectrum in PCW July 1, may I reply on behalf of many of us waiting for our Spectrums to arrive.

Even the novices to the computing field, myself in-

cluded, probably accept that the BBC micro is indeed a fine computer with many good features, and that many people would like to own one. But, he has answered his own comparison query by stating that his satisfaction has been met by the expense of £600.

Bearing in mind the basic 16K Spectrum is only £125, one does not seem to get much extra value for the additional £475. Also, how many newcomers can afford this kind of money, however advanced the equipment may be?

Having said that, is not the BBC micro model B approximately £400, if you can get one that is.

While writing, could I perhaps make a suggestion to the editorial team. Could you make your competitions available sometimes to those of us not yet able to invent programs? There are many of us who buy your magazine who would like to enter these competitions.

Robin Window
18 Easthams Road
Crewkerne
Somerset

Good news from the Beeb, at last

Just a line to send my apologies to your news editor concerning your editorial on Acorn's backlog. I accused him of not getting his facts right when, in point of fact, it was me who had the facts wrong.

Even though the girls at Kettering's telephone department told me that my expected delivery date was September, and that they had not cleared their backlog, yesterday my BBC micro was delivered. Once again, I therefore apologise for the comments I made.

May I also compliment you on a very interesting and topical magazine which I now subscribe to every week.

F Wright
7 Eastbourn Street
Lincoln
Lincolnshire

Please keep your letters as brief as possible.

COVER STORY

Hunter-Killer

A new game for Spectrum
by David Lawrence

As the moon slipped behind a cloud, a lone figure fell silently from the plane. Suddenly a parachute blossomed and the plane banked away sharply.

The soft velvety landscape of dense Amazon jungle drew nearer with upper

branches and creepers apparent more than 80 feet above the ground.

This lush cushion rushed up as the intruder crashed into the trees. Painfully suspended on the lines from the 'chute, the suffocating heat engulfed him as branches closed overhead.

A quarter of a mile away, the small supplies package broke through the green surface and fell to the ground. Immediately it began sending its radio signal so that the killer could be reunited with his weapons.

In Catrillia, the arrival had not gone unnoticed.

Zironas turned to Epa "He is with us" he said. "We have no choice now. You must go, and go quickly." Epa nodded, stern faced, and Zironas continued: "He comes

with evil intent. Though it offends our code to send you, we can do nothing else.

"If he comes to kill, he will be killed. In these times any measures become acceptable. One orders actions, without second thought, that before would have seemed too appalling to contemplate.

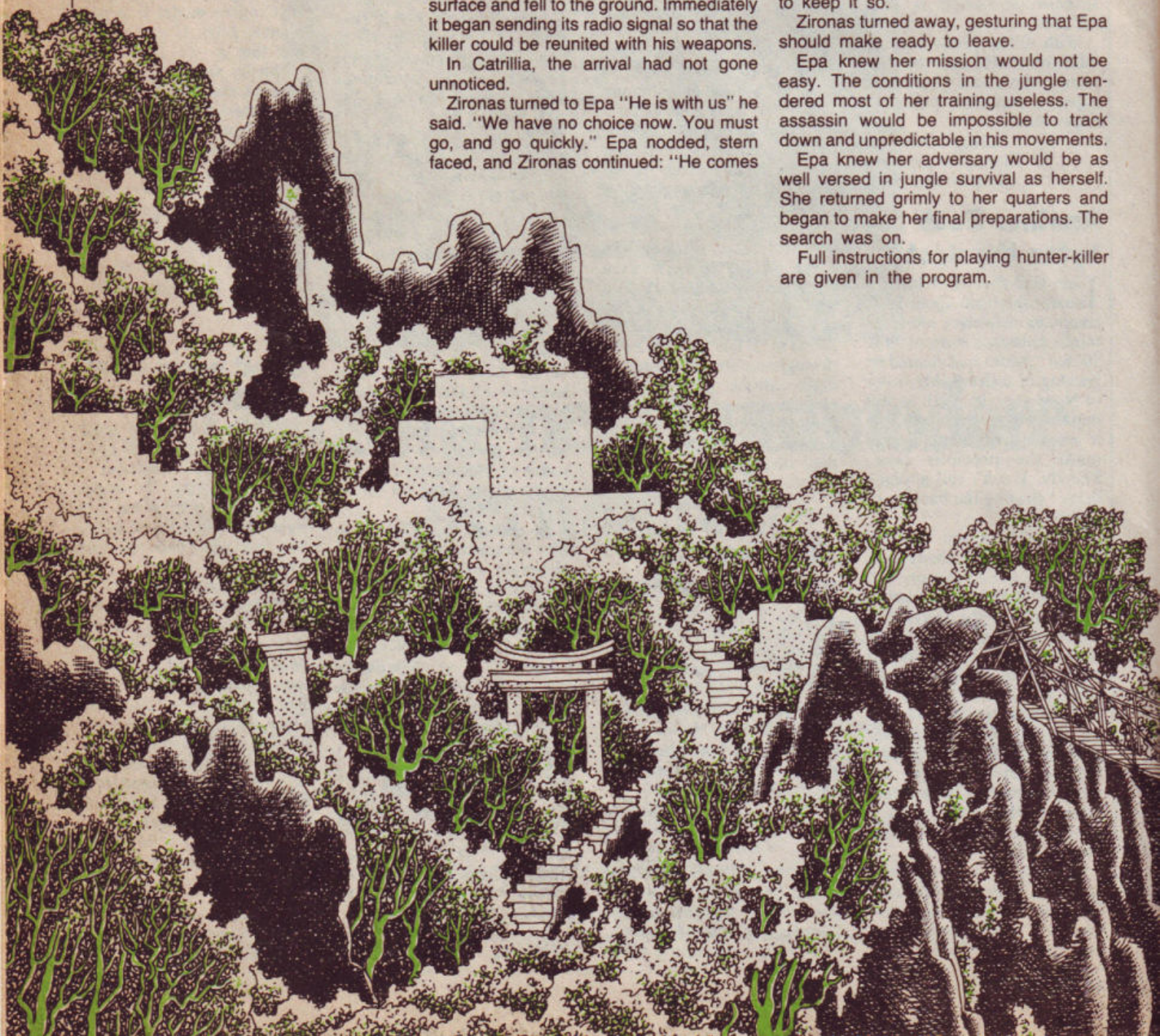
"But it must be. Our country has lived in peace for 40 years now — and we will kill to keep it so."

Zironas turned away, gesturing that Epa should make ready to leave.

Epa knew her mission would not be easy. The conditions in the jungle rendered most of her training useless. The assassin would be impossible to track down and unpredictable in his movements.

Epa knew her adversary would be as well versed in jungle survival as herself. She returned grimly to her quarters and began to make her final preparations. The search was on.

Full instructions for playing hunter-killer are given in the program.




```

1000 BORDER 0: INK 1: PAPER 7: P
PRINT AT 10,12; "*****"
1010 INPUT "Do you want instruct
ions? (Y/N)"; Q$
1030 CLS
1035 GO SUB 3010
1040 IF Q$="Y" OR Q$="y" THEN GO
SUB 2070
1050 GO SUB 2670
1060 REM *****
1070 REM VARIABLES
1080 REM *****
1090 LET A=0
1100 DIM M(100,4)
1110 LET C=20
1120 LET C1=0
1130 LET T=0
1140 DIM O$(32)
1150 LET R1=6-INT (RND*13)
1160 LET R2=6-INT (RND*13)
1170 LET P1=INT (RND*18+1)
1180 LET P2=INT (RND*30+1)
1190 REM *****
1200 REM INITIAL BOARD
1210 REM *****
1220 CLS
1230 LET A$="1234567890123456789
01234567890": PRINT "A$
1240 FOR I=1 TO 18: PRINT A$(I):
NEXT I
1250 GO SUB 1680
1260 REM *****
1270 REM INPUT AND DIRECTIONS
1280 REM *****
1290 INK 0
1300 LET T=T+1
1310 IF T>100 THEN GO SUB 2620
1320 LET Q$=""
1330 PRINT AT 19,23; "MOVE "; T
1340 PRINT AT 19,17; "(0 FOR REVI
EW)"
1350 PRINT AT 19,1; "DOWN:"; INP
UT M1: PRINT M1
1360 IF M1<19 AND M1>-1 THEN GO
TO 1450
1370 PRINT "OUT OF RANGE": PRIN
T AT 19,0; Q$: GO TO 1360
1380 IF M1<0 THEN GO TO 1490
1390 GO SUB 2000
1400 GO TO 1330
1410 PRINT AT 21,0; Q$
1420 PRINT AT 20,1; "ACROSS:"; I
NPUT M2: PRINT M2
1430 IF M2<31 AND M2>0 THEN GO T
O 1570
1440 PRINT "OUT OF RANGE": PRIN
T AT 20,0; Q$: GO TO 1500
1450 PRINT AT 21,0; Q$
1460 LET M(T,1)=M1: LET M(T,2)=M
2
1470 IF M1<>P1 OR M2<>P2 THEN GO
TO 1610
1480 GO TO 1940
1490 LET M3=(M1<P1)-(M1>P1)+1
1500 LET M4=(M2<P2)-(M2>P2)+2
1510 LET D=M3*3+M4
1520 IF D>4 THEN LET D=D-1
1530 LET M(T,3)=D
1540 GO SUB 1680: GO SUB 1650: G
O TO 1330
1550 REM *****
1560 REM PRINT BOARD AND MOVE
1570 REM *****
1580 PAPER 5: INK 1
1590 FOR I=1 TO 9
1600 PRINT AT I+2-1,1; "
1610 PRINT AT I+2,1; "
1620 NEXT I
1630 INK 1: PAPER 7
1640 PRINT AT 19,0; Q$: Q$: Q$
1650 IF T=0 THEN RETURN
1660 PRINT AT M1,M2,CHR$(143+D)
1670 IF A<>1 THEN RETURN
1680 IF T/E=INT (T/E) THEN PRINT
AT 21,0; "RANDOM MOVE FOLLOWS"
1690 RETURN
1700 REM *****
1710 REM MOVE INCREMENT
1720 REM *****
1730 LET P1=P1+1: LET P2=P2+2
1740 IF T/E<INT (T/E) THEN GO T
O 1910
1750 LET P1=INT (P1+RND*6+1): LE
T P2=INT (P2+RND*6+1)
1760 PRINT AT 21,0; "RANDOM MOVE"
1770 LET P1=P1+18*(P1<1)-18*(P1>
18)
1780 LET P2=P2+30*(P2<1)-30*(P2>
18)
1790 RETURN

```

```

1940 REM *****
1950 REM SUCCESS AT LAST
1960 REM *****
1970 PRINT AT 10,13; "GOT IT"
1980 INPUT "Another game? (Y/N)";
Q$
1990 IF Q$="Y" THEN GO TO 1060
2000 STOP
2010 REM *****
2020 REM REVIEW OF GAME
2030 REM *****
2040 LET A=1
2050 PRINT AT 19,0; Q$: Q$: Q$
2060 IF C1<C THEN GO TO 2150
2070 PRINT AT 6,13; "
2080 PRINT AT 6,4; "REVIEW ALLOWA
NCE "C" MOVES"
2090 PRINT AT 10,8; "YOU HAVE USE
D "; C1
2100 PRINT AT 19,1; "LAST MOVE WA
S No. "; T-1
2110 PRINT AT 21,1; "INPUT FIRST
No. FOR REVIEW:"; INPUT T1: PRI
NT T1
2120 FOR J=T1 TO T-1
2130 LET C1=C1+1
2140 IF C1<C THEN GO TO 2170
2150 PRINT AT 10,4; "
2160 PAUSE 0
2170 LET M1=M(J,1): LET M2=M(J,2)
2180 LET D=M(J,3)
2190 GO SUB 1680
2200 PRINT AT 19,6; "REVIEW OF MO
VE "; J
2210 PRINT AT 21,20; "(0 TO QUIT)"
2220 INPUT Q$: PRINT AT 19,0; Q$:
Q$: Q$
2230 IF Q$="0" THEN GO TO 2260
2240 NEXT J
2250 LET T=T-1
2260 LET M1=M(T,1): LET M2=M(T,2)
2270 LET D=M(T,3)
2280 GO SUB 1680
2290 LET A=0
2300 RETURN
2310 REM *****
2320 REM INSTRUCTIONS
2330 REM *****
2340 INK 3: PRINT AT 0,11; "
2350 INK 0: PRINT "This is a hun
ting game. The hunting ground
is an 18 by 30 board. The
quarry is invisible.
2360 PRINT "Each turn the quarr
y makes a secret move. This mo
ve does not change during a pa
rticular hunt.
2370 PRINT "The move can be up
to six spaces, up or down and s
ix spaces left, right, or
2380 PRINT "Press any key for m
ore instructions.
2390 PAUSE 0
2400 CLS
2410 PRINT "Each turn consist
s of:
2420 PRINT "1) An invitation to
input your estimate of the po
sition of the quarry.
2430 PRINT "2) An arrow will ap
pear in your specified square,
indicating the direction of th
e quarry.
2440 PRINT "3) The quarry will
move.
2450 PRINT "Press any key to co
ntinue.
2460 PAUSE 0
2470 CLS
2480 PRINT "At the start of ea
ch turn you have the opportuni
ty to review the hunt so far.
2490 PRINT "This is done by en
tering 0 when the DOWN co-ordin
ate is called for.
2500 PRINT "You can start the r
eview at any previous move but
you are limited to reviewing
20 moves in any one hunt.

```

```

2570 PRINT "These 20 reviews ma
y be taken all at once or in b
atches.
2580 PRINT "Any key to start."
2590 PAUSE 0
2600 RETURN
2610 REM *****
2620 REM HARD LUCK
2630 REM *****
2640 CLS
2650 PRINT AT 10,0; "SORRY-CAN'T
TAKE ANY MORE MOVES."
2660 STOP
2670 REM *****
2680 REM SET DIFFICULTY
2690 REM *****
2700 CLS
2710 PRINT "There is a diffic
ulty factor built into the gam
e.
2720 PRINT "This consists of an
entirely random move every so
often.
2730 PRINT "The difficulty fact
or ranges from 0 to 10.
2740 PRINT "0 means no random m
oves at all.
2750 INK 0: INPUT "Please input
desired difficulty factor"
2760 LET E=(11-E)*2+2+100*(E=0)
2770 INK 0: CLS: RETURN
2780 REM *****
2790 REM USA CHARACTERS
2800 REM *****
2810 RESTORE
2820 FOR I=1 TO 8
2830 FOR J=0 TO 7
2840 READ B
2850 POKE USA CHR$(143+I)+J,B
2860 NEXT J
2870 NEXT I
2880 RETURN
2890 DATA BIN 00000000,BIN 01111
000,BIN 01100000,BIN 01010000,BI
N 01001000,BIN 00000100,BIN 0000
0010,BIN 00000001
2900 DATA BIN 00001000,BIN 00011
100,BIN 00101010,BIN 01001001,BI
N 00001000,BIN 00001000,BIN 0000
1000,BIN 00001000
2910 DATA BIN 00000000,BIN 00011
110,BIN 00000110,BIN 00001010,BI
N 00010010,BIN 00100010,BIN 0100
0000,BIN 10000000
2920 DATA BIN 00010000,BIN 00100
000,BIN 01000000,BIN 11111111,BI
N 01000000,BIN 00100000,BIN 0001
0000,BIN 00000000
2930 DATA BIN 00001000,BIN 00000
100,BIN 00000010,BIN 11111111,BI
N 00000010,BIN 00000100,BIN 0000
1000,BIN 00000000
2940 DATA BIN 00000001,BIN 00000
010,BIN 00000100,BIN 01001000,BI
N 01010000,BIN 01100000,BIN 0111
1000,BIN 00000000
2950 DATA BIN 00001000,BIN 00001
000,BIN 00001000,BIN 00001000,BI
N 01001001,BIN 00101010,BIN 0001
1100,BIN 00001000
2960 DATA BIN 10000000,BIN 01000
000,BIN 01000000,BIN 00010010,BI
N 00001010,BIN 00000110,BIN 0000
1111,BIN 00000000

```



PCW has negotiated a special discount offer on four of the top games cartridges for the Commodore Vic20. The cartridges are manufactured by Audiogenic.

SAVE £7 on Renaissance

PCW price £17.99 (List price £24.99).

Renaissance is the ultimate Othello package for the Vic20. Use joystick or keyboard control to play against the Vic. There are eight levels of play. During the game you can change sides and playing level, take back moves, set up and play special games. You can even save and recall whole games to and from cassette.

SAVE £7 on Meteor Run

PCW price £17.99 (List price £24.99).

In **Meteor Run** you must pilot your spaceship through the Meteor belt, blasting your way through the rocks and Alien saucers. Similar to an Asteroids game it includes an early warning radar display.

SAVE £7 on Spiders of Mars

PCW price £17.99 (List price £24.99).

In **Spiders of Mars** you are a trapped fly. You must shoot your way across Mars avoiding the dreaded Spiders and the other flying creatures. Accompanied by classical music.

SAVE £3 on Cloudburst

PCW price £16.99 (List price £19.99).

In **Cloudburst** you must save the Earth from the downpour of Acid raindrops and the invasion of the mutant Cloud Hoppers. Speed and skill are essential. With original music and ten levels of play.

To have these top cartridges sent to your home all you have to do is fill in the form below and send it off to *Popular Computing Weekly*.

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	Meteor Run	£17.99
	Spiders of Mars	£17.99
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Address

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Send this order form to *Popular Computing Weekly, Discount Club*, Hobhouse Court, 19 Whitcomb Street, London WC2 7HF.



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Street Life

Breathing fire into the Mettoy Dragon

David Kelly visits the Patscentre and talks to the designer of the Dragon 32.

The Patscentre is a unique development facility. For each client they draw on expertise in many disciplines in order to produce an innovative and competitive product.

From the car park the building is invisible. Nearing the top of the steps the long workshop suddenly emerges. It is low-lying and futuristic.

Inside, primary-coloured tubular steel railings and plants vie for attention. Everyone carries an identity card and a bleeper.

It is in this environment that Ian Thomson Bell conceived and developed Mettoy's micro, the Dragon 32.

Mettoy's brief was precise. Ian began work on the project in October 1981. The first prototype was demonstrated to the Mettoy board by Christmas. The Dragon should be on sale in the shops from August 2.

Ian is not unused to working to such tight schedules. That is what the Patscentre is about. At any given time he can be working on up to three such projects, each at different stages of development.

He explains how the design of the Dragon progressed: "We chose Microsoft Basic because the timescale dictated an off-the-shelf interpreter. The 6809 chip was selected because it is the best 8-bit processor.

"As far as the CPU is concerned, the design was relatively straightforward. With the 8-bit, the SAM chip and the 6847 you have virtually a home computer in three chips.

"The difficult parts of the design were the Microsoft driver and the video conversion."

The Microsoft driver was developed by Duncan Smeed at the University of Strathclyde.

"When Duncan brought it down," said Ian, "we tried to find out why it was so slow. After all, the 6809 is very fast.

"We looked at the Tandy TRS-80 which also uses the chip and found that it too was comparatively slow. On the first version we designed a For/Next loop from 1 to 1000 which took two seconds to run.

"At first we thought it was because the Microsoft Basic was in some way cross-assembled from the Z80 Basic. Then we thought it could be a problem with the



Dragon designer Ian Thomson Bell... used off-the-shelf parts.

internal clock. Neither proved to be the case.

"We looked at the amount of time spent scanning the keyboard. Of the 2ms spent in each run of the loop, 0.7ms was spent in the keyboard checking that keys such as Break had not been pressed.

"We tackled it as a logic problem. Instead of scanning each key in turn, we designed it to check if any key had been depressed. This speeded up the software considerably — that is why the Dragon is so quick."

The problem with the video side of the circuit was that the SAM chip gives an output compatible with the American tv standard — NTSC — rather than the British PAL colour system.

"We were quite tempted to go to ULAs for the conversion chip, but the tight time-scale really precluded that. Instead, we took an existing Motorola circuit and redesigned it."

There is a fundamental resolution limit with a conventional tv. At the start of the signal of every tv line scan there is a reference burst. This corrects the incoming line information so that it has the same quality of colour and intensity as the preceding lines.

If the pixel width is less than one cycle of this reference-seeking circuit, then the tv will not recognise colour. Thus, the resolution limit for colour graphics is set by the tv rather than the micro.

Ian explains: "The Dragon has been designed to operate on this screen limit of 128 x 192 for colour and 256 x 192 for black-and-white."

When at college Ian played in a band and designed a mixing desk. When he left,

he worked first for BAC and then Neve — a studio equipment manufacturer.

After building mixing consoles for the Who and the Kinks, he returned, briefly, to BAC before joining Patscentre International.

"It is good to see a thing through from the initial design to the finished product," he says. "The advantage of the Patscentre is that it has such a tremendous range of skills, all under one roof."

"One day we will tie up biotechnology with electronics on a molecular level to make a sort of living computer."

The centre is also working on what are called Thick Film Hybrid techniques — a way of producing a complete computer in one chip. "The whole shooting match would then fit in a match-box," says Ian.

Meanwhile, the Patscentre is continuing to extend the Dragon project.

Development is in hand for a mini-floppy disc system for under £250. Next year will also see the launch of an advanced Dragon — with 64K, enhanced graphics and a built-in disc operating system.

What's happening

East London micro users who are interested in getting together to exchange software and perhaps form a club should contact Noorel Haque, 35 Tunis House, Hartford Street, London E1.

Aylesbury ZX Computer Club now hold specific interest meetings (machine-code, hardware etc) each week at Quarrendon Youth Club, Aylesbury. General monthly meetings will recommence in October at Aylesbury College. Contact Ken Knight, 22 Mount Street, Aylesbury, Bucks.

Reviews

software

Robot Nim

A and F Software, 10 Wiltshire Avenue, Longsight, Manchester 12.
Atom, 5K test 0.5K graphics, cassette.
Price: £2.95.

This program is based on the old game of Nim where the aim is for two players, in turn, to remove matchsticks from a pile.

The winner is the one who picks up the last matchstick.

Nim has always been a standard exercise for student micro programmers. All states of the game can be represented as nodes in a binary tree, such that the winning strategy is always clear. This means a computerised form is just about unbeatable — unless you, too, know the technique.

"I won ... I usually do" crows the insufferable Atom at the end of each game in this version. Indeed, you little brat, I'll get you next time. This is one of the few programs that have caused me to laugh out loud. I love it.

The matchsticks in this implementation are cuddly little robots rather reminiscent of the Homepride flour men. You have the option of setting them up in rows totalling between nine and 35 targets. You have the option, too, of starting. In your move you specify the number of robots to be 'removed' and which row they are in. The robot executioner gallops off to do the dirty work for you and then for the computer.

Meanwhile, the non-exterminated robots visibly quail in fright. (A clever technique to stop you working out your strategy.) The robot next to be pulverised gains a look of terror and emits a terrified squeak. The sound in this program is as brilliant as the vision.

"I won ... I usually do" indeed. I'll wipe that grin off your smug little screen. Next time I'll set up the robot rows and really work out a strategy. Just don't let me see those frightened faces, that's all ...

Summary

A totally brilliant version of Nim. Get it, and experience a computer laughing at your incompetence.

KJ

Volcanic Dungeon

Carnell Software, 4 Staunton Road, Slough, Berkshire.
ZX81, 16K.

Price £4.50 plus 50p p&p.

Volcanic Dungeon is one of the better adventure games currently on the market. Set in a Tolkeinesque world of elves and dragons, you have the task of rescuing Princess Edora from a crystal coffin hidden deep within the Volcanic Dungeon.



Volcanic Dungeon & HANGMAN C2

When the game begins, you will find yourself in the top left-hand cavern. You are armed with a sword and a magic ring given to you by the elfin lord Fendhal. The ring has two important properties. It enables you to absorb strength from opponents that you succeed in killing, and it warns you when the evil witch Magra is powerful or weak.

Various treasures, in the form of enchanted weapons and defences, are scattered about the dungeon. But only experience will tell you which weapons/defences will be effective against which enemies.

The Volcanic Dungeon is ringed with fiery caverns. Death is instantaneous if you enter any of them.

Other hazards include unmarked pits. Falling into a pit is not necessarily fatal, but you will need at least 100 units of strength to climb out of it.

You can replenish your water supply from a number of water holes, provided they are unguarded. If a water hole is guarded, you will have to kill the guard before you can drink the water.

Parts of the Dungeon are only accessible by crossing bridges. If a bridge collapses, you will have to use a flying carpet or flying potion to reach the other side.

Summary

An excellent game at a reasonable price. The instructions are among the best I have ever seen. There is also a Hangman game on the other side of the tape.

BG

Astro Invaders

John Price, 29 Brook Avenue, Levenshulme, Manchester.

ZX81, 16K, cassette.

Price: £3.65.

It could have been any one of a thousand streets in a hundred cities.

I walked through the clammy fog, keep-

ing to the shadows. A light glinted weakly from the corner as I approached. I could make out a few words: "Astro-Invaders ... superior m/c programming ... explosive on-screen kill effect".

My attention was held. "A new dimension in ZX81 value — only £3.75" screamed at me in neon. That clinched it. This I gotta see, I muttered, as I entered the low doorway.

The place was almost deserted. Just a pianist doodling on a baby grand, two or three cool-looking guys and a couple of sparkling starlets. But at the bar ... WOW! I sidled up to the cassette, letting my cigarette dangle from the corner of my mouth. "This could be really something" I figured.

I loaded the program. Would it give me what it promised? I could see it had "high-scoring saucers" and "destructible defence shields".

For a while I got an "accelerating attack rate" but, in the end, it didn't deliver.

I tried to cover a yawn, but the cassette caught my eye. It hit me with a few other little games — but they were just window-dressing.

The spool ran some more. It's final play was Swat, which drew a momentary flicker of interest from the punters at the bar. It almost made it worth my while to stick around. After all, the price was cut back so far a bald man might think he needed a trim.

But I had places to go — things to do. I couldn't hang around all night.

It was getting light. As I passed the piano I threw a couple of dimes on to the polished keys. "Play it again" I drawled.

Summary

This spool promised a lot, but didn't deliver. Maybe, kiddo, you'd find the price right. I'll meet it again some day, when it's learnt some more tricks. Until then, I'll stick with the classier reels.

TB

Copyright

Hard lesson in store for 'soft' pirates

Roger Pearson explains how the law on software copyright could affect you.

A nasty shock could be in store for some home computer software producers. They could, in the near future, find themselves in the High Court accused of copyright piracy.

The past year has seen a flurry of activity at the High Court, in London, as various manufacturers of coin-operated video amusement machines have battled to stop their games being copied.

Various big names in the amusement industry such as Sega, Atari and Williams Electronics have taken legal action against alleged pirates, claiming that their games are protected by copyright. This action has provided an effective remedy against the unauthorised copying that has been going on.

Now it seems the big guns of the amusement industry could well be turned towards the home computer market, where they believe unauthorised copies of their games are being marketed to home computer enthusiasts.

A lawyer who has represented several of the major amusement industry companies, Mr Gordon Day, said: "Companies in the amusement industry are now beginning to turn their attention to the home computer versions of some successful amusement arcade games.

"I think the outcome could well be that some of the people who produce software for home computers could face legal action in the not too distant future."

A number of software writers and companies have been producing their own versions of popular arcade games such as Puckman, unaware that they may be in breach of copyright. But the copyright war in the amusement industry has gone a long way in clarifying certain aspects of the argument over copyright protection for computer programs.

However, this has gone largely unnoticed in the computer world. Micro enthusiasts have failed to recognise the similarity of the basic issues involved when it comes to protecting arcade games from unauthorised copying.

For this reason a look at the amusement industry copyright battle is worthwhile. So far, all the hearings in the High Court have been interim claims for injunctions to stop alleged piracy, pending the full trial of



Sega's Frogger . . . at the centre of an important legal battle to establish copyright.

copyright actions at a later stage.

Until July 2, judges had been careful not to give any firm judicial indications that computer programs are actually protected by copyright. However, on July 2, in interim injunction proceedings between Sega Enterprises and John Richards (a video game conversion expert) and his company Trolfame, this was changed.

Granting Sega injunctions stopping Mr Richards and his company from dealing in alleged unauthorised copies of Sega's game 'Frogger', Mr Justice Goulding gave the clearest indication from any judge so far that he believes copyright protection is available for computer programs.

In his judgement he said: "On the evidence before me in this case I am clearly of the opinion that copyright under the provisions relating to literary works under the Copyright Act of 1956 subsists in the assembly code program of the game of 'Frogger'.

"The machine code program derived from it, by operation of a programmed part of the system of the computer called the assembler, is to be regarded I think as a reproduction or adaptation of the assembly code program.

"Accordingly I find that for the purpose of deciding this motion that copyright does subsist in the program."

Sega also claimed that there is artistic copyright protection for the images reproduced on the video screen of the game, both during play and during the non

playing attract mode sequence. In addition, Sega said that there is further protection for the sequence of visual images under the copyright laws which relate to cinematographic film.

The judge made no ruling on the latter two points, however. He said it was sufficient for the purpose of the injunctions to make a finding on the literary copyright issue.

As a result of this case, some home computer software producers could be caught unawares if they are making unauthorised copies of popular video games.

The first surprise for anyone who is making unauthorised copies of a game is likely to be the worst of all. It will probably come in the form of a knock on the door by solicitors acting for a company alleging their games are being pirated. Those solicitors will be armed with what in legal circles is known as an 'Anton Pillar' order.

This is a court order, granted at the High Court in private and in the absence of the party accused of piracy. It entitles those alleging piracy to go to the premises of those they are accusing, to search them and seize various items of information relating to the alleged infringement and the infringing articles themselves.

The Anton Pillar order is a legal weapon widely used in the war against all copyright piracy and particularly in the amusement, film, record and garment industries. Now, if the predictions of lawyers in the know are correct, it is a legal weapon which may very soon be aimed at those in the home computer industry.

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Classified

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The classified pages can be used for semi-display advertising. The cost for this is £10 per single column centimetre, with a minimum charge of £30.

All copy for the classified pages must be pre-paid. Cheques/postal orders should be made out to *Popular Computing Weekly*, and your advertisement should arrive at least two weeks before the publication date.

For semi-display advertising please call David Lake on 01-839 2846.

For classified entries please fill in the form below and send it, with your cheque/postal order, to Classified Department, *Popular Computing Weekly*, Hobhouse Court, 19 Whitcomb Street, London WC2.

If you have any queries regarding classified advertising please call Alastair Macintosh on 01-930 3840.

Please write your copy in bold capital letters on the lines below.

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I make this words, at per word so I owe you £.....

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Address

Telephone

Please cut out and send this form to:

Classified Department, *Popular Computing Weekly*, Hobhouse Court, 19 Whitcomb Street, London WC2

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 £10.)

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 a 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.

BBC Scroll

on BBC Micro

If you own or have seen a BBC Micro listing a program, you will know how incredibly fast it is compared with other computers, even in the high-res modes where it has to scroll 20K of memory. The main reason for this is that the computer changes the address of each line of screen memory and not the actual contents.

However, since the BBC Micro is such a versatile machine, you can perform software scrolls as well. This is required when you define text windows, however, if you define the text window as being the whole screen, eg in mode 4 or 1: VDU28,0,31,39,0

When the screen is scrolled no memory addresses are changed. However, the process is much slower than normal. Without changing memory addresses we can use the Rom software to scroll up and down.

You may wish to scroll the screen
to next page

BBC Scroll
by G. Jones

```
5 REM**LEFT+RIGHT SCROLL - G.L.J JUNE 82**
10 MODE0
20 FOR Q=0TO3STEP3
30 P%=&A00
40COPT 0
50, LSCROLL
60 LDA #0: STA &80: LDA #30: STA &81: JSR FLINE \CLEAR FIRST COLUMN
70 LDA #0: STA &80: LDA #30: STA &81: STA &83: LDA #8: STA &82
80, L1 LDY #0
90, L2 LDA (&82), Y: STA (&80), Y: INY: BNE L2
100 CLC: LDA #1: ADC &81: STA &81: STA &83: CMP #&80: BNE L1
105 \CLEAR BOTTOM RIGHT 8 BYTES
110 LDX #8: LDA #0
120, L7 STA &7FF7, X: DEX: BNE L7
130 RTS
135
140, RSCROLL
150 LDA#&78: STA &80: LDA #32: STA &81: JSR FLINE \CLEAR LAST COLUMN
160 LDA #0: STA &80: LDA #60: STA &81: STA &83: LDA #8: STA &82
170, L5 LDY #255
180, L6 LDA (&80), Y: STA (&82), Y: DEY: CPY #255: BNE L6
190 SEC: LDA &81: SBC #1: STA &81: STA &83: CMP #&2F: BNE L5
195 \CLEAR TOP LEFT 8 BITS
200 LDX #7: LDA #0, L8 STA &3000, X: DEX: BPL L8: RTS
203
205 \CLEAR SPECIFIED COLUMN TO ENSURE NO 'WRAP ROUND'
210, FLINE
220, L3 LDY #7
230, L4 LDA #0: STA (&80), Y: DEY: BPL L4
240 CLC: LDA #&80: ADC &80: STA &80: LDA #2: ADC &81: STA &81: CMP #&80: BCC L3
250 RTS
260]
270 NEXT
275 REM**DEMONSTRATION OF SCROLLS**
280 S=GET:MODE0
290 FOR L=1TO100: DRAWND(1280), RND(1024): NEXT
295 REM**SET TEXT WINDOW TO MAXIMUM**
300 VDU28,0,31,79,0
310 FOR L=1TO10: VDU30:VDU11: NEXT: REM**SCROLL DOWN**
320 FOR L=1TO20: PRINTTAB(0,31): NEXT: REM**SCROLL UP **
330 FOR L=1TO10: VDU30:VDU11: NEXT
340 FOR L=1TO10: CALL LSCROLL: NEXT
350 FOR L=1TO20: CALL RSCROLL: NEXT
360 FOR L=1TO10: CALL LSCROLL: NEXT
370 VDU26
```


Open Forum

from previous page

sideways. This may sound pointless, but it can be a very effective visual effect if nothing else. As far as I know there is no built-in software to do this, so I have had to write a program to do it.

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After assembling the code the program waits for a key to be pressed, then it demonstrates the different scrolls simply by shifting random lines about. Lines 275 to 360 can be left out, in which case 'call lscroll' will scroll the screen to the left, and 'call rscroll' will scroll to the right.

See the listing for scrolling up and down. VDU26 resets the normal scroll. If you want to learn about programming in assembler I suggest one of the things you should do is buy/borrow/steal an Atom manual, unless, that is, you want to wait for the proper BBC manual.

Reflexes

on Vic-20

This program is for the Vic-20, 3.5K, and it is called Reflexes. At the top of the screen is a cross, at the bottom is an x. You must get the cross to the x. The background is full of balls and if the cross hits the balls the screen will burst into colour with an explosion.

If you hit the x the computer will play some music. This means the cross made it without hitting a ball.

Lines 0-9 print the title page and give a red screen.

Lines 11-12 put a coloured setting on the top and bottom of the screen, 81-82 and 561-562, are also the same.

Line 13 tells the computer to gosub 2000, 2000-2380 is the music and it is used more than once in the program.

Lines 14-16 will cause the title page to move down the screen.

Lines 27-28 will clear computer and screen.

Lines 30-40 are the layout and the quantity of the balls.

Line 90 will tell the computer to goto 4000 and it will do this twice. Line 4000 is the first sound effect; it is a running scale.

Lines 100-1030 are the heart of the program. The screen is black with a purple border and the print is white.

Lines 167-200 are the key control. You can use F1 to end while the game is in play or F7 to reset the game.

The balls are drawn by pokes and so is the x and the cross. If the cross hits a ball

to next page

PROGRAM OF THE WEEK

Reflexes
by Ca Saphier

```

0 PRINT"X":POKE36879,42
1 PRINT"XXXXXXXXXX"
2 PRINT"XXXXXXXXXXXXXXXXXXXX"
4 PRINT"REFLEXES"
5 PRINT"BY"
6 PRINT"CA SAPHIER"
7 PRINT"XXXXXXXXXX"
8 PRINT"XXXXXXXXXXXXXXXXXXXX"
9 PRINT"XXXXXXXXXXXXXXXXXXXX"
10 PRINT"XXXXXXXXXXXXXXXXXXXX"
11 FORA=0T021:POKE7680+A,160:POKE38400+A,(RAND7):POKE8164+A,160
12 POKE38884+A,(RAND7):NEXT
13 GOSUB2000
14 FORA=37T0200:POKE36865,A:NEXTA:PRINT"X"
15 FORA=37T0200:POKE36865,A:NEXTA:PRINT"X"
16 FORA=0T037:POKE36865,A:NEXTA
27 CLR
28 PRINT"X"
29 V=0:M=0
30 E=INT(22*RND(1)+7702)
40 H=INT(22*RND(1)+8164):PRINT"XXXXXXXX":POKE36879,42
50 PRINT"XXXXXXXXXXXXXXXXXXXX"
60 PRINT"* 2-DOWN 4-UP *"
70 PRINT"* 6-LEFT 8-RIGHT *"
75 PRINT"* F1-END F7-RESET *"
80 PRINT"XXXXXXXXXXXXXXXXXXXX"
81 FORA=0T021:POKE7680+A,160:POKE38400+A,(RAND7):POKE8164+A,160
82 POKE38884+A,(RAND7):NEXT
90 GOSUB4000:GOSUB4000
93 PRINT"X"
100 POKE36879,12
110 FORA=1T0250
120 B=INT(4222*RND(1)+7724)
130 POKEB,81
140 NEXTA
150 POKEH,91:GETA$
160 POKEE,86
165 POKE36878,15
167 IFA$="X"THEN3200
168 IFA$="I"THEN27
169 IFA$="2"THENPOKE36876,200:POKE36876,0
170 IFA$="2"THENG=22:GOTO250
179 IFA$="4"THENPOKE36876,210:POKE36876,0
180 IFA$="4"THENG=-22:GOTO250
189 IFA$="6"THENPOKE36876,220:POKE36876,0
190 IFA$="6"THENG=-1:GOTO250
199 IFA$="8"THENPOKE36876,230:POKE36876,0
200 IFA$="8"THENG=1:GOTO250
250 M=M+1
260 POKEE,32:E=E+G
270 IFPEEK(E)=81THENGOSUB3000:GOTO550
280 POKEE,90
290 IFE=HTHENPOKE36879,11:GOSUB2000:GOTO600
300 GOTO150
550 POKE36879,8:PRINT"XXXXXXXXXXXXXXXXXXXXYOU HIT A BALL"
560 PRINT"XXXXXXXXXXXXXXXXXXXXANOTHER GAME (Y/N)"
561 FORA=0T021:POKE7680+A,160:POKE38400+A,(RAND7):POKE8164+A,160
562 POKE38884+A,(RAND7):NEXT
570 GETG$:IFG$=""THEN570
571 IFG$="Y"THEN590
572 IFG$="N"THEN3200

```


Open Forum

from previous page

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7 PRINT"XXXXXXXXXXXXXXXXXXXX"
8 PRINT"XXXXXXXXXXXXXXXXXXXX"
9 PRINT"XXXXXXXXXXXXXXXXXXXX"
10 PRINT"XXXXXXXXXXXXXXXXXXXX"
11 FORA=0TO21:POKE7680+A,160:POKE38400+A,(RAND7):POKE8164+A,160
12 POKE38884+A,(RAND7):NEXT
13 GOSUB2000
14 FORA=37TO200:POKE36865,A:NEXTA:PRINT"X"
15 FORA=37TO200:POKE36865,A:NEXTA:PRINT"X"
16 FORA=0TO37:POKE36865,A:NEXTA
27 CLR
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90 GOSUB4000:GOSUB4000
93 PRINT"X"
100 POKE36879,12
110 FORA=1TO250
120 B=INT(4222*RND(1)+7724)
130 POKEB,81
140 NEXTA
150 POKEH,91:GETA$
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168 IFA$="I"THEN27
169 IFA$="2"THENPOKE36876,200:POKE36876,0
170 IFA$="2"THENG=22:GOTO250
179 IFA$="4"THENPOKE36876,210:POKE36876,0
180 IFA$="4"THENG=-22:GOTO250
189 IFA$="6"THENPOKE36876,220:POKE36876,0
190 IFA$="6"THENG=-1:GOTO250
199 IFA$="8"THENPOKE36876,230:POKE36876,0
200 IFA$="8"THENG=1:GOTO250
250 M=M+1
260 POKEE,32:E=E+G
270 IFPEEK(E)=81THENGOSUB3000:GOTO550
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560 PRINT"XXXXXXXXXXXXXXXXXXXXANOTHER GAME (Y/N)"
561 FORA=0TO21:POKE7680+A,160:POKE38400+A,(RAND7):POKE8164+A,160
562 POKE38884+A,(RAND7):NEXT
570 GETG$:IFG$=""THEN570
571 IFG$="Y"THEN590
572 IFG$="N"THEN3200

```


Open Forum

from previous page

function. Good use is also made of three of the sound generators.

It may take a little time to enter but it is worth all the effort. If anybody is interested the high score held by yours truly is 17,810. The F1 key will move you in a lane, and the F3 key will move you out of a lane (or two). This game should provide you with some food for thought.

```
5000 POKE36878,15
5010 FORL=130T0254
5020 POKE36876,L
5030 FORM=1T040
5040 NEXTM
5050 NEXTL
5060 POKE36876,0
5070 POKE36878,0
5080 RETURN
```

Muncher
by Andrew Berti

```
7 POKE37154,127
8 IFPEEK(37137)<>94ANDPEEK(37137)<>30THEN8
800 IFPEEK(37137)=122ORPEEK(37137)=58THENL=L+G
805 IFPEEK(37137)=110ORPEEK(37137)=46THENL=L-H
810 IFPEEK(37137)=118ORPEEK(37137)=54THENL=L-G
815 IFPEEK(37152)=119THENL=L+H

0 PRINT"J":FORI=7624TO7678:READA:POKEI,A:NEXT
1 DATA0,112,64,46,26,106,10,14:V1=36878:S2=V1-3:S3=V1-2:S4=V1-1
2 DATA64,64,120,104,47,61,5,7,0,28,62,125,125,58,28,0,56,124,214,214,254,254,218,146
3 DATA0,0,28,62,58,54,28,0,24,60,90,126,36,90,66,231,16,8,110,253,253,122,126
6 POKE36869,255:PRINT"PRESS ANY KEY":S=3
8 IFPEEK(197)=64THEN8
10 PRINT"J":FORI=8120TO8143:POKEI,160:POKEI+44,160:NEXT:N=1
20 G=-1:H=0:LL=1:A=15:B=1:L=INT(RND(1)*4)+1:O=160:P=230:CH=0:M=1
90 XX=-1:YY=0:Y=20:X=10:J=X:K=Y:C=A:D=B:POKE36879,152:POKE36828,6
100 PRINT"  "
105 PRINT"  "
110 PRINT"  "
115 PRINT"  "
120 PRINT"  "
125 PRINT"  "
130 PRINT"  "
135 PRINT"  "
140 PRINT"  "
145 PRINT"  "
150 PRINT"  "
155 PRINT"  "
160 PRINT"  "
165 PRINT"  "
170 PRINT"  "
175 PRINT"  "
180 PRINT"  "
185 PRINT"  "
190 PRINT"  "
191 POKE8120,221:POKE8141,221:POKE38840,6:POKE38861,6:POKE8130,230:POKE8131,230
195 PRINT"  "
196 U=8142:POKEU,237:POKEU+30720,6:POKE38850,6:POKE38851,6
197 FORI=U+1TOU+20:POKEI,192:POKEI+30720,6:NEXTI
200 POKEU+21,253:POKEU+30741,6:POKEV1,7:POKE7679,60
210 IFS>1THENPOKE7953,60:IFS>2THENPOKE7954,60:IFS>3THENPOKE7955,60:IFS>4THENPOKE7956,60
220 IFVV=1THENFORI=1TO6:POKES2,200:FORF=1TO20:NEXT:POKES2,0:FORF=1TO20:NEXTF,I
230 IFVV=1THENVV=0
250 POKES2,0:Q=7680+A+22*B:HL=7680+C+22*D:IFPEEK(Q)=221THEN500
```


Open Forum

```

260 OP=SC:IFCH<>0THENPOKECH,160:CH=0
270 IFPEEK(Q)=221ORPEEK(Q)=192THEN500
295 IFQ=61THENS=SC+10:Q=160:POKE3,160
296 IFQ=59THENS=SC+50:Q=57:CH=HL:POKE3,230
297 IFQ=63THENS=SC+100:Q=58:CH=HL:POKE3,240
300 POKEHL,Q:POKEHL+30720,6
301 PRINT"#####SC:POKE7908,221:SC=SC+1:IFOP<1500ANDSC>1499THE
NVV=1
302 IFOP<10000ANDSC>9999THENS=SC-10000:PRINT"#####":UU=1
303 IFOP<5000ANDSC>4999THENVV=1
304 POKE3,Q:Q=PEEK(Q):POKEQ+30720,2:POKEQ,60
310 D=B:C=A:A=A+G:B=B+H:IFZX=1THENZX=2:GOTO800
375 IFZX=2THENZX=0:GOTO800
380 IFPEEK(7680+A+22*B)=230THENZX=1
400 ONNGOTO600,650,700,750
410 IFQ=RTHEN1200
420 R=7680+X+22*Y
425 IFRND(1)>.993ANDP=160THENP=63:POKE4,240
427 IFRND(1)>.98ANDP=160THENP=59:POKE4,200
428 IFRND(1)<.2ANDP=160THENP=61:POKE4,180
429 IFP=230THENC=6
430 IFP=59THENC=4
431 IFP=61THENC=5
432 IFPEEK(R)=192ORPEEK(R)=221THEN1050
433 IFP=63THENC=2
434 POKE7680+J+22*K,P:POKE38400+J+22*K,C0
438 P=PEEK(R):POKE4,Q:POKE7908,0:POKE7908,62:J=X:K=Y:X=X+XX:Y=Y+YY
461 IFJ=CANDK=DTHEN1200
465 IFPEEK(7680+X+22*Y)=230THENGOSUB1000
467 POKE2,135
470 ONMGOSUB850,900,930,960
480 IFVV=1ANDUU=0THENS=S+1:GOTO210
490 GOTO250
500 N=N+1:IFN=5THENN=1
510 A=C:B=D
520 IFN=1THENG=-1:H=0
530 IFN=2THENG=0:H=1
540 IFN=3THENG=1:H=0
550 IFN=4THENG=0:H=-1
560 GOTO310
600 B=L*2-1:GOTO410
650 A=L*2-1:GOTO410
700 B=22-L*2:GOTO410
750 A=22-L*2:GOTO410
800 IFPEEK(197)=47THENL=L-1
810 IFPEEK(197)=39THENL=L+1
820 IFL<1THENL=1
830 IFL>4THENL=4
840 GOTO400
850 Y=22-LL*2:RETURN
900 X=LL*2-1:RETURN
930 Y=LL*2-1:RETURN
960 X=22-LL*2:RETURN
1000 IFRND(1)<.1THENRETURN
1005 IFLL>LTHENLL=LL-1
1010 IFLL<LTHENLL=LL+1
1015 IFLL>4THENLL=4
1017 IFLL<1THENLL=1
1020 RETURN
1050 M=M+1:IFM=5THENM=1
1060 X=J:Y=K
1070 IFM=1THENXX=-1:YY=0
1075 IFM=2THENXX=0:YY=-1
1080 IFM=3THENXX=1:YY=0
1085 IFM=4THENXX=0:YY=1
1090 GOTO465
1200 POKE2,Q:POKE4,220:POKE7680+C+22*D,170
1240 PRINT"#####BAD ILUCK":L=16
1245 L=L-1:POKEV1,L:IFL=0THEN1290
1260 FORI=1TO60:NEXTI
1285 GOTO1245
1290 S=S-1:IFS=0THEN1400
1300 FORI=1TO100:NEXTI:GOTO10
1400 PRINT"#####GAME OVER"
1440 RUN6

```


Open Forum

Telephone Call

on ZX81

The need for this telephone call calculation program arose when British Telecom presented me with a telephone bill in excess of £100. Having no other way to check, as the meters are in the exchange, I wrote

this program to keep a check on all of my calls.

Any alterations Telecom makes in the unit time can be adjusted in lines 30 to 110; the values are in decimals of a minute. If the cost per unit alters that can be changed in line 795. The rate of VAT is in line 820. The timing is calculated in line

720 and is accurate to a couple of seconds per hour.

The S key is used to stop the timing at which point the cost of the call will be displayed.

The total bill to date will be displayed if the program has been resaved using the commands Break followed by Goto 1000.

```

10 PRINT AT 0,3;"C IAN CARSON"
11 REM "TELEPHONE"
12 FOR I=0 TO 50
13 NEXT I
14 CLS
15 LET TOT=0
16 DIM R(3,3)
17 LET R(1,1)=8
18 LET R(1,2)=2.4
19 LET R(1,3)=0.8
20 LET R(2,1)=2
21 LET R(2,2)=0.75
22 LET R(2,3)=0.26667
23 LET R(3,1)=1.5
24 LET R(3,2)=0.5
25 LET R(3,3)=0.2
26 PRINT AT 1,0;"TELEPHONE"
27 CALL CALCULATOR
28 PRINT AT 3,0;"DISTANCE 0"
29 CALL:-
30 PRINT AT 5,14;"LOCAL - ENTER A"
31 PRINT AT 7,5;"UP TO 35 MILE"
32 PRINT AT 9,6;"OVER 35 MILES"
33 PRINT AT 11,0;"REFER TO C"
34 PRINT AT 13,0;"CODE BOOK IF UNSURE"
35 INPUT R$
36 IF R$="L" THEN LET Q=1
37 IF R$="A" THEN LET Q=2
38 IF R$="B" THEN LET Q=3
39 IF R$<>"L" AND R$<>"A" AND R$<>"B" THEN GOTO 180
40 IF Q=1 THEN PRINT AT 5,30;"
41 IF Q=2 THEN PRINT AT 7,30;"
42 IF Q=3 THEN PRINT AT 9,30;"
43 PRINT AT 14,4;"DAY
44 PRINT
45 PRINT "8 AM - 9 AM"
46 PRINT "9 AM - 1 PM"
47 PRINT "1 PM - 6 PM"
48 PRINT "6 PM - 8 AM"
49 PRINT
50 LET H=0
51 PRINT "WHICH RATE C, S OR P-"
52 INPUT Z$
53 IF Z$="C" THEN LET H=1
54 IF Z$="S" THEN LET H=2
55 IF Z$="P" THEN LET H=3
56 IF Z$<>"C" AND Z$<>"S" AND Z$<>"P" THEN GOTO 340
57 IF H=1 THEN PRINT AT 21,23;"CHEAP"
58 IF H=2 THEN PRINT AT 21,23;"STANDARD"
59 IF H=3 THEN PRINT AT 21,23;"PEAK"
60 FOR O=0 TO 25
61 NEXT O
62 CLS
63 PRINT AT 1,4;"CALL DATA"

```

Telephone Call
by Ian Carson

```

460 IF Q=1 THEN PRINT AT 3,4;"DISTANCE - LOCAL"
470 IF Q=2 THEN PRINT AT 3,4;"DISTANCE - LESS THAN 35 M"
480 IF Q=3 THEN PRINT AT 3,4;"DISTANCE - OVER 35 M"
490 IF H=1 THEN PRINT AT 5,4;"RATE - CHEAP"
500 IF H=2 THEN PRINT AT 5,4;"RATE - STANDARD"
510 IF H=3 THEN PRINT AT 5,4;"RATE - PEAK"
520 PRINT AT 8,0;"TIME ALLOWED PER UNIT (SP)"
530 LET E=R(H,Q)
540 LET P=E*INT E
550 LET U=INT (P*60+0.5)
560 PRINT AT 10,9;"MINS"
570 PRINT AT 12,0;"PRESS ANY KEY TO START TIMING"
580 PRINT AT 14,0;"AND THE "
590 PRINT AT 16,0;"KEY TO STOP TIMING"
600 IF INKEY$<>"S" THEN GOTO 600
610 GOTO 590
620 FOR T=0 TO 1000000
630 PRINT AT 18,12;"TIMING"
640 PRINT AT 18,12;"TIMING"
650 PRINT AT 18,12;"TIMING"
660 PRINT AT 18,12;"TIMING"
670 PRINT AT 18,12;"TIMING"
680 IF INKEY$="S" THEN GOTO 700
690 NEXT T
700 CLS
710 PRINT AT 0,0;"
720 PRINT AT 1,0;"
730 PRINT AT 2,0;"
740 LET C=T/265.5
750 LET D=C-(INT C)
760 LET D=INT (D*60)
770 PRINT AT 5,0;"DURATION"
780 PRINT AT 8,0;"MINS"
790 PRINT AT 10,0;"SECS"
800 LET U=INT (1+(C/E))
810 PRINT AT 11,0;"UNITS CONSUMED"
820 LET U=INT ((U*1.15)+.5)
830 PRINT AT 17,0;"TOTAL (INC. VAT)"
840 LET L=L/100
850 LET TOT=TOT+L
860 PRINT AT 21,0;"TOTAL BILL"
870 PRINT AT 21,0;"£"
880 IF INKEY$<>"S" THEN GOTO 910
890 GOTO 900
900 CLS
910 GOTO 20
920 STOP
1000 SAVE "TELEPHONE"
1020 GOTO 20

```

TELEPHONE CALL CALCULATOR

DISTANCE OF CALL:-

LOCAL - ENTER L

UP TO 35 MILES - ENTER A

OVER 35 MILES - ENTER B

REFER TO CODE BOOK IF UNSURE

DAY

8 AM - 9 AM

9 AM - 1 PM

1 PM - 6 PM

6 PM - 8 AM

WHICH RATE C, S OR P- PEAK

CALL DATA

DISTANCE - OVER 35 M

RATE - PEAK

TIME ALLOWED PER UNIT (SP)

0 MINS 12 SECS

PRESS ANY KEY TO START TIMING

AND THE "S" KEY TO STOP TIMING

COST OF CALL

DURATION - 2 MINS 26 SECS

TIME PER UNIT - 0 MINS 12 SECS

UNITS CONSUMED- 13 UNITS

COST (EXC. VAT) - 56 P

TOTAL (INC. VAT) - 64 P

TOTAL BILL TO DATE £ 1.28 P

Programming

Putting more byte into the mini-micro

Elizabeth Wald explains space saving techniques on Sharp's PC1211.

The Sharp PC1211 is a remarkable computer for its size, but it does have one major disadvantage — a mere 1424 bytes of memory. However, with careful programming this can be overcome.

It is important to use variables efficiently to store data for programs as this will reduce the number of variables required, and often the length of the program. Each variable can store up to ten digits plus an exponent and signs. Therefore, if five two-digit numbers need to be stored they can be held in one variable as a decimal fraction. The routine needed to store this information is:

$A(x) = A(x) + E - m \cdot y \cdot a$ (nb E = exponent symbol)

Where $A(x)$ is the variable for storage, m is the number of digits (in this case two), y is the position within the variable, and a is the number to be stored ($m \cdot y$ must not exceed 10). For example:

10: A=12: Y=2: A(30)=A(30)+E-2*Y*A

Conversely, the following routine will extract the data and produce the result in A:

A=INT (E^m*Y*A(x)): A=A-E^m*INT E-mA

eg:

10: A=INT (E²*Y*A(30)): A=A-E²*INT E-2A

Storing the data as a decimal fraction often makes handling easier, although there are exceptions. Also, it is sometimes advantageous to store a commonly used number as the integer part of the variable — especially if it is handled differently to the data stored in the fractional part. It will therefore be easier to access by using the *Int* function.

One other way of saving time is to use one of the variables W-Z as the control variable in a *For...Next* loop. This will reduce the time taken for the loop to be performed by 0.05 seconds per iteration. The reason for this is that these four variables are stored in the same memory chip as the *For...Next* stack and are therefore slightly quicker to access.

On a similar note, Z=M is about 0.02 seconds faster than A=M, and M=A is about 0.02 seconds faster than M=Z. It therefore pays to have the higher variable on the left of an assignment, and the lower variable on the right. This does not apply to variables above Z, which seem to take longer.



Sharp's PC1211... the secret is to use variables efficiently.

As space is so precious on the PC1211, it is essential to ensure that each line of program does not require more steps than are necessary.

The first way in which this can be achieved is by using the key words efficiently. Key words are stored as one step each, irrespective of their length. It therefore may be advantageous to use them as prompts for *Input* statements or in *Print* statements.

We may decide on the prompt

10: INPUT "ENTER A LETTER", X\$

This will occupy 23 steps (two for the line number, one for the *Input* statement, 19 for the other characters, and one for the *Enter* key). If we replace the word *Enter* by the key word *Input* we reduce the number of steps by five. To do this key in:

10 INPUT INPUT "ENTER"

Then, insert an inverted comma before the second *Input* and complete the line. As an added bonus, the space is automatically inserted after *Input*. One word of warning — do not try to enter too many words as unexpected results may occur:

10 INPUT INPUT A LETTER", X\$

produces

10: INPUT INPUT ALET TER", X\$

Some key words can be omitted. *Then* is totally superfluous and the *Rem* command does not work very well as the comment must be enclosed by inverted commas if spaces are required within. *Let* can also be omitted in all circumstances bar one. The only occasion when it is required is after a numerical test in an *If* statement:

10: IF A=5 LET C=12

But note:

10: IF A\$="YES" B=2

is a valid statement, despite the description given in the manual for the *If* statement.

Other ways of saving space may seem a little unnecessary, but they may make all the difference on a long program. Lines should be as long as possible, as line numbers are stored in two steps, plus one for the *Enter* key at the end of the line, whereas the separating colon will occupy only one step.

Logic statements are particularly useful in saving space. These take the value 1 if true, and 0 if false, and can be used to reduce the need for complicated *If* statements which have the disadvantage that the next statement will need to be on the following line. They can also save time when assigning values to variables.

An example would be when directions have to be entered during a game. The numerical keyboard can be used to represent the directions by using 5 as the base position, and the other keys to represent moves in relation to it. Thus 8 will be up or north, 6 right or east, and so on around the keyboard.

If the variable D is used to enter the direction, the following can be used to assign the changes in the co-ordinates to variables X and Y:

$X = (D=6) - (D=4): Y = (D=8) - (D=1)$

Logic statements can also be used to perform the same functions as *On...Goto* and *On...Gosub* in standard Basic.

Standard ON X GOTO 100,150,230
PC1211 GOTO 150-50*(X=1)+80*(X=3)

Space can also be saved by utilising the fact that pressing *Enter* alone in an *Input* statement, will automatically send the computer to the next line. This saves the need for an *If* statement, for example by entering Y for yes and *Enter* for no. Defined keys can also be used in a similar way to transfer control to other parts of the program.

Spectrum

Learn to eat as much as you can

Sam Goodwin presents some machine code tips and a new game called snake.

Although lower case lettering often improves programs, it can also lead to trouble. Some programs will act on the upper case letter A being pressed, but they will not recognise lower case a as being the same. To avoid this problem on the ZX Spectrum you can either test both conditions:

```
100 LET IS=INKEYS
110 IF IS="A" OR "a" THEN
```

or switch on the CAPS LOCK in the program.

```
100 POKE 23658,8 : REM CAPS LOCK ON
110 IF INKEYS="A" THEN
POKE 23658,0 will switch CAPS LOCK OFF.
```

The one graphics command I miss is a *Plot* 23,45 *To* 67,89. To do this on the Spectrum you always need to know where the end point is in relation to the starting point. This is because the command used for drawing lines (*Draw*) will act from the last recorded point (The above instruction would be entered as *PLOT* 23,45 : *DRAW* 44,44.)

The following program sketches a fine system of spirals by subtracting the previous plot position from the new one so lines can be joined as absolute co-ordinates.

```
10 LET X=23677: LET Y=23678
20 PLOT 128,88
30 FOR T=0 TO 377
40 LET R= SIN (T* 3/4)
50 DRAW SIN T*R*80+128-PEEK X,
COS T*R*80+ 88-PEEK Y
60 NEXT T
```

Machine Code

All the registers can be used except for the HL pair. If you are going to change their contents during the program it is wise to restore their original contents before returning to basic.

For machine code that requires critical timing, such as printer output and sound effects, it may be necessary to disable the clock and keyboard scans. This is done with the DI instruction (Disable interrupt, code 243). The keyboard scan must be Enabled, code 251, before returning, otherwise the system will hang when a keyboard input is required.

This feature could be used to protect programs from being copied, as disabling the break key would make it impossible to stop the program without switching the computer off.

Instructions can be stored in the user definable graphics memory area. This would allow the program to be retained, even after the *New* command.

The following machine code program does a smooth horizontal scroll from right to left along the middle of the screen:

```
1d BC,window size
1d HL,lowest point
→rl (HL)
dec HL
djnz →
dec C
jr NZ →
ret
```

The machine code could be entered in the following way:

```
10 FOR A=USR "S" TO USR "U"
20 INPUT B
30 POKE A,B
40 NEXT A
```

RUN

```
1 8 0 33 255 79
203 22 43 16 251
13 32 248 201 0 0
```

(The information has been stored in an area that will remain unaffected by the instruction *NEW*.)

NEW

```
10 FOR A=0 TO 26 STEP .1
20 PLOT 255,SIN A*30+80+USR USR"S"
30 NEXT A
40 CLS : LIST : LIST
50 LET A=USR USR "S"
60 GOTO 50
```

The above program should produce a gently moving sine wave that glides across the screen, and then display the program rolling the middle section smoothly from right to left.

The one bug I have found in the Spectrum is hardly worth worrying about. In fact, it could prove to be beneficial.

It appears that when a *Control H* (back space) is printed at the beginning of a line, the previous line loses one of its bytes. The idea of being able to edit a program while it is being Run offers tremendous potential, but somehow I do not think it was an intended feature.

Finally, I have devised a game called *Snake*. You are a slowly growing snake, kept in a confined space. The object of the game is to eat as much of the food as possible, while avoiding the obstacles.

When entering this program, it is important to type in line 50 with exactly 33 spaces in the *Print* statement. The character printed in lines 186 and 230 is a user definable A.

```
5 BRIGHT 0: OVER 0
10 FOR A=USR "A" TO USR "A"+6
20 POKE A,62: NEXT A
40 LET I=0: LET P=7: INK I: PA
PER P: CLS: GO SUB 500
50 LET B=6: BORDER B: PAPER B:
PRINT "
60 FOR N=1 TO 20: PRINT AT N,3
1: " : NEXT N: PRINT AT 21,31: " ": PAPER P
70 LET FOODC=2: LET ROCK=1
80 LET SNAKE=4: LET FOOD=P*8+F
OODC: POKE 23658,6: REM CAPSLOCK
100 LET LAND=P*6+I: LET MX=1: L
ET MY=0
110 LET S=1: LET X=2: LET Y=0
120 DIM X(200): DIM Y(200)
130 FOR N=1 TO 5
140 LET IS=INKEYS
150 IF IS="N" THEN LET MX=-1: L
ET MY=0
160 IF IS="M" THEN LET MX=+1: L
ET MY=0
170 IF IS="O" THEN LET MY=-1: L
ET MX=0
180 IF IS="A" THEN LET MY=1: L
ET MX=0
190 LET X=X+MX: LET Y=Y+MY: LET
A=ATTR (Y,X)
195 IF Y<22 THEN PRINT AT Y,X: "■"
197 IF A=FOOD THEN LET S=S+5: GO TO 200
198 BEEP .01,S/4
199 IF A<>LAND THEN INPUT " Yo
u have " CRASHED": AS: RUN
200 PRINT AT 0,0: PAPER B: " 500
RE = " INT S*10
210 PRINT AT Y(N),X(N): INK I:
PAPER P: "
220 LET X(N)=X: LET Y(N)=Y
230 PRINT AT Y,X: INK SNAKE: "■"
240 NEXT N
245 PRINT AT AND*10+5,AND*20+5:
INK FOODC: "■"
246 PRINT AT AND*21+.5,AND*25+.
5: INK ROCK: "■"
250 LET S=S+AND*5
260 GO TO 130
500 PRINT AT 1,9: "SNAKE _____" "By
Sam Goodwin"
510 PRINT " You are a snake a
nd must try to eat the food but a
void hitting anything else."
520 PRINT " ■ - Rocks , ■ -
Food"
530 PRINT " To move Press 0
to go Up" " N-Left,M-Right &
A to go down"
600 INPUT AS: CLS: RETURN
```


Sound & vision



It's all a question of values, ain't it?

This is a simple yet effective program for the BBC micro model B, to show the graphs of various equations. The equation is typed in the form $Y=F(X)$. The computer then asks for what values of X you wish to equate Y with.

If you press *Return* without entering any values, the program will default to plotting over the whole range of -640 to $+640$. Note that the origin is in the centre of the screen.

The computer will draw the axis in white, marking them in steps of 100. It will then draw the original equation in blue, then scale it up or down as appropriate and draw it again in yellow.

However, funny things can happen if very large Y values are encountered, so try and keep the values sensible.

Program notes

Line 70 shifts the graphics origin from 0,0 to 640,512, i.e. in the middle of the screen, so that negative values of Y are plotted directly.

Variable D is the scaling factor; after the first plot, M contains the largest value of Y , and $D=512/M$ sets D to the required scaling value. Just in case you are not sure what the 'EVAL' in line 170 does, imagine that $A\$="2*X"$ and $X=2$ — the instruction $Y=EVAL(A\$)$ assigns the number 4 to Y .

Gwynfor Jones

Graph plot

by Gwynfor Jones

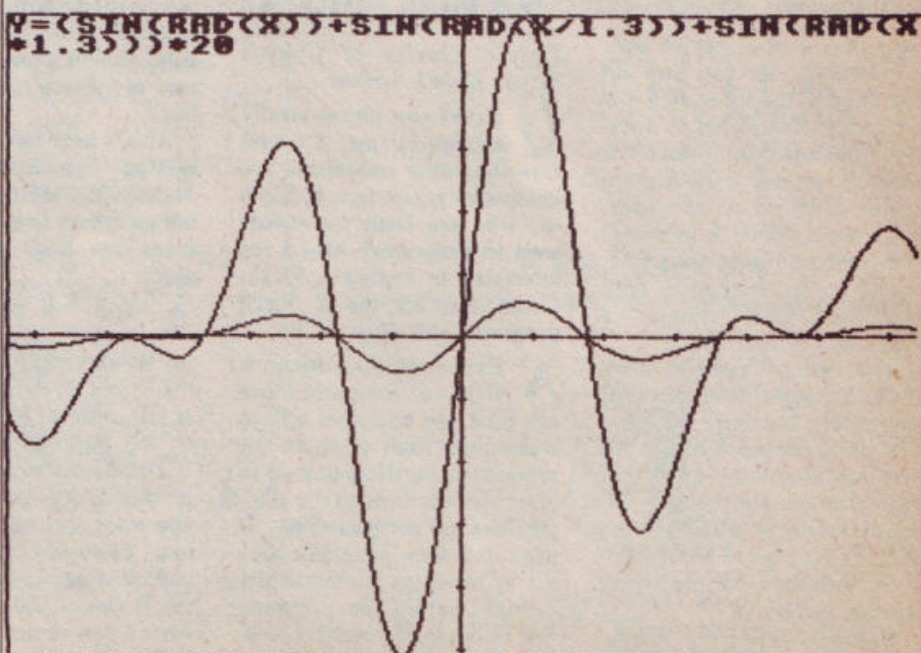
```

5 REM**GRAPH PLOT - G.L.J JUNE82**
10 MODE7
20 D=1:M=0:C=1
30 INPUT"Y="A$:"FOR VALUES OF X FROM "S" TO "F
40 IF S=0 AND F=0 S=-640:F=640
50 MODE1:PRINT"Y=";A$
60 VDU19,1,4,0,0,0
70 VDU29,128,2,0,2
80 REM**DRAW AXIS**
90 MOVE-640,0:DRAW640,0:MOVE0,-512:DRAW0,512
100 FOR L=-700 TO 700 STEP 100:MOVE L,-4:DRAW L,4:NEXT
110 FOR L=-600 TO 600 STEP 100:MOVE -4,L:DRAW 4,L:NEXT
120 REM**MAIN LOOP**
130 GCOL0,C
140 X=S:MOVES,EVAL(A$)*D
150 FOR X=S TO F STEP 4
160 IF X=0 GOTO 210
170 Y=EVAL(A$)*D
180 IF Y>65500 OR Y<-65500 GOTO 210
190 IF Y>M M=Y
200 DRAWX,Y
210 NEXT
220 IF C=2 G=GET:RUN
230 D=512/M:C=2:GOTO 130
    
```

Contribute!

You can share your own favourite Sound or Vision programs with other readers by sending lists with explanations to us at *Popular Computing Weekly*.

WRITE TO: Sound & Vision, Popular Computing Weekly, Hobhouse Court, 19 Whitcomb Street, London WC2 7HF.



Peek & poke

Peek your problems to our address. Ian Beardsmore will poke back an answer.

BUDDING MICRO STAR NEEDS SCREEN TEST

Tony Johar of Cambridge Road, Hounslow, Middlesex, writes:

Q I cannot decide which television or monitor to buy for my ZX Spectrum. I have been informed that it is possible to connect a colour monitor to the Spectrum using the existing port. Is this correct and does the Spectrum give out a PAL signal?

There are three types of Visual Display Unit that I am thinking of buying. The first is a Sony Trinitron television which is meant to be good for computers. The second is a Portatel Luxor 14in monitor, which is a cross between a television and a monitor, and has PAL and RGB inputs. I am told that it works better than an ordinary television because it does not rely on the internal modulator.

Or, should I go the full swing and buy a proper monitor? But, I am not sure if I really need it since the Spectrum does not give out the extremely high resolution graphics of the BBC computer. Will a proper monitor give me a significantly higher quality to justify its purchase, bearing in mind that the Luxor can be used as a television as well?

A This is the sort of area where one can end up spending a lot of money for little appreciable gain. A question you must ask yourself is whether or not it is wise to spend £175 on a computer, and then £300 on a monitor? The Spectrum gives out a PAL signal and is compatible with any PAL UHF colour, or black and white, set.

The Sony Trinitron does make a reasonable monitor for computers, but there are other sets which are much better. No one can doubt the quality of television picture that the Trinitron produces, but if you are looking for a good VDU facility as well then I would advise against buying it.

Portatel were very helpful when I got in touch with them, and though they had not had a

Spectrum on a Luxor, they had had very good results on their Hitachi monitors.

The Luxor has the advantage of being compatible not only with European PAL standards but also the US NTSC specifications which make it very versatile. It can be used on most of the popular home computers and I am sure that it would enhance the Spectrum. However, £300 is a lot of money to pay for a monitor.

One alternative, if you are not sure about how much computing you are going to do in the future, is to buy a cheap secondhand colour set and find an electrician to take the various circuits that accept and amplify the broadcast signal. Replace the signal amplifier circuit, the tuner circuit, et al, with a fixed frequency oscillator circuit. This would give you in effect a monitor, at a much lower price.

However, one word of warning. This is an option that you can take only if you know a good electrician. It would be very easy for someone to bodge a job like this and leave you in a worse state than before. Allow at least £50-£75 for the secondhand television and £20-£40 for the work.

REMARKABLE HELP FOR POOR HUMANS

Dafydd Davies of Cynwyl Elfed, Dyfed, writes:

Q Could you please clarify a point for me. A friend says that Rem statements are ignored by computers. If this is so, why are Rem statements used in programs? Also I am interested in buying a Vic30. Could you tell me if Vic20 programs will Run on it?

A Essentially your friend is right, a computer does not take any notice of a Rem statement. Rem is short for remark, and is there to help us poor humans through the complexities of programming. If used in a long program, they act as headings for particular routines within the program. For example, if you have written a Breakout type program you might have the statement

Rem "SET UP WALL" at the start of the section that does just that. If, when you come to Run the program the wall does not work properly, then the Rem will help you find the section which is at fault.

As to the question of the Vic20, and the Vic30 programs being compatible, until we actually get a machine we cannot be absolutely sure. It seems unlikely that the two will be directly compatible, because it is very improbable that the memory locations will be the same.

Also, the Vic10 has a reduced version of Basic, with no Dim statements. As the Vic30 is a closer relation to the Vic10 than the Vic20, it is possible that it will have this reduced Basic as well. So, any program on the Vic20 which uses a statement that is not available on the Vic30 will not Run without some sort of modification.

AVOID MAKING A BOOB WITH THE BEEB

Mark Middleton of Cannon Hill Road, Coventry, writes:

Q I have ordered a BBC micro model B. After a delay of five months, I expect it to be here soon. My friend has just bought a synthesizer, and we wondered whether or not we could connect them together. If so what port on the BBC should I use, and what sort of ribbon cable should I buy?

Also, I have had difficulty in getting *Popular Computing Weekly* in Coventry. Can you tell me where to get it, and are there any back issues available?

A You will by now have read in *Popular Computing Weekly* about the delays in the model B, though the Beeb at last seem to be catching up on the backlog.

You do not say what sort of synthesizer your friend has, nor what sort of I/O ports it has. The only synthesizer I have had any experience of is the Roland C100 series. From what I can remember, all the internal patching on that was by means of Jack plugs and,

apart from the speakers, external access was the same. This would mean that there was no directly compatible port on the BBC micro.

To my knowledge it would not be possible to directly link the two. The most likely port to use would be the RS 423, but I cannot see it being used without some sort of buffer hardware.

I must ask why you want to connect your BBC micro to a synthesizer? The synthesizer should have all the features you need. By comparison a computer is a very poor music maker and I cannot see how it can add to the synthesized sounds. Cassettes can be used to store the music in a normal audio fashion, while patch notes should be available to store the various configurations used to create the sounds.

There is a trap which, quite understandably, many people fall into. A computer is not a universal panacea that will do absolutely anything. Nor is there any real point in trying to do things with your computer just because you happen to have the bits there.

As for your problems in getting a copy of *Popular Computing Weekly*, I have passed your letter on to our distributors. In the last few weeks, now that we have become established, circulation has been increasing which has led to some local problems. Problems we are overcoming by stepping up production.

Back issues are available, except for issue two. If you write to us with a cheque or postal order for 50p per issue, we will be happy to send them to you. Mind you, the way to guarantee a regular copy is to place a regular order, or take out a subscription. It is well worth it.

STOP agonising over that nagging problem. Write to Ian Beardsmore at Peek & poke for the answer. Letters should be as brief as possible and include full name and address. Write to Peek & poke, *Popular Computing Weekly*, Hobhouse Court, 19 Whitcomb Street, London WC2 7HF.

Competitions

Is your number high or low?

by Gordon Lee

The use of logarithmic functions to find powers and roots has been seen to bring its own problems when used with *If/Then* statements (PCW July 15 Puzzle).

For a cube, the $**$ can be replaced by two separate $*$ s (ie replace $3**3$ by $3*3*3$). Unfortunately, it is not always possible to avoid using logarithmic functions — for instance, in the case of cube roots. If there is no easy way around the problem, then the conditions of the *If/Then* statement must be changed.

In theory, having found the cube root of our number, we can just test to see if it is a whole number (integer). In practice, we know that this value may be a bit out, and we have no easy way of knowing if it is slightly too high or too low. If it is too high then:

```
IF ABS(N-INT N)<0.000001 THEN ...
will work. However, if N is slightly too low:
PRINT INT (27 ** (1/3))
gives a reading of 2.
```

All is not lost. Since we know that the value to be tested might be slightly under the integer, we add a small amount — eg $1E-8$.

If the value being tested was within this value of the integer, it will now equal or slightly exceed that integer. This we can test as above. So the complete test necessary is:

```
IF ABS(N-INT(N+1E-8))<0.000001 THEN ...
```

The amount added ($1E-8$) should be more than the possible error induced by the system and less than the limit of accuracy expected for the test.

Puzzle No. 16

Professor Otto Hex, the well known mathemati-

cian, recently moved house.

In order to help him remember his new telephone number (he was rather absent-minded) he used the ages, in years, of his four offspring.

To get the number he could either add the cube of Susan's age to the cube of Billy's age or add the cube of Lucy's age to the cube of Ronnie's age.

What was Otto's new number? (He lives in a small village so the smallest possible solution is the correct one.)

Rules

The winner of the puzzle will be the reader who, in the opinion of *Popular Computing Weekly*, has submitted the best program.

Entries should be marked clearly "PUZZLE".

The closing date for the competition is Tuesday, August 17.



Solution to Puzzle No. 12

The fourth and fifth lines of the poem tell us that this is a cryptarithm, in which numbers are substituted for letters.

As there are more than ten different letters in the names given, each name should be treated separately. Each name consists of three identical letters and three different letters — though with the identical letters placed in a different position in each case. This means that we need to find eight six-digit numbers which are perfect squares which, in each case, have three identical digits in the positions indicated by the letters found in each of the names. Also the remaining three digits must be different.

The guilty party will be the one whose name 'code' number is the largest.

In the example below, Lines 30 to 50 are set to test the name Beedle. For the other names, the string locations (N\$(1-6)) in Lines 30 to 50 should be altered.

```
10 FOR N = 999 TO 317 STEP - 1
20 LET N$ = STR$(N + N)
30 IF N$(2) < > N$(3) OR N$(2) < > N$(6) THEN
   GOTO 100
40 IF N$(2) = N$(1) OR N$(2) = N$(4) OR N$(2) = N$(5) THEN GOTO 100
50 IF N$(1) = N$(4) OR N$(1) = N$(5) OR N$(4) = N$(5) THEN GOTO 100
60 PRINT N, N + N
70 STOP
100 NEXT N.
```

The largest possible squares in each case are:

Beedle = 944784 = 972^2 ; DeVeré = 190969 = 437^2 ; Farrer = 824464 = 908^2 ; Heeley = 900601 = 949^2 ; Lowell = 438244 = 662^2 ; Nanson = 151321 = 389^2 ; O'Toole = 565504 = 752^2 ; and Strutt = 902500 = 950^2 .

The largest of these is 944784 so Beedle did it.

Winner of Puzzle 12

The winner is: Ian Turtle, St John's Road, Ashby, Scunthorpe, South Humberside, who receives £10.

Solution to Crossword 12

Across: 4 Robin, 7 Spartan, 8 Screen, 10 Adana, 12 Ruin, 13 Athlete, 14 Xmen, 15 Clark, 16 Unborn, 20 Captain, 21 Angel.

Down: 1 Spiderman, 2 Ironman, 3 Dan, 5 Orc, 6 Ire, 8 Super, 9 Epidermis, 11 Chain, 12 Replete, 17 Bun, 18 Roe, 19 Man.

Winner of Crossword 12

The winner is: R. Filleul, Nunthorpe Road, York, who receives £10.

DEAR READER,

IT IS WITH GREAT REGRET THAT WE MAKE THE FOLLOWING ANNOUNCEMENT: SIDNEY PAIN, KNOWN TO MILLIONS AS 'CITIZEN' PAIN, IS MISSING.

HE WAS LAST SEEN BY HIS MOTHER CLIMBING THROUGH A HOLE IN HIS BEDROOM WALL. IT IS BELIEVED THAT HE IS SOMEWHERE WITHIN THE INTERFACE OF A MAINFRAME COMPUTER. EARLIER TODAY, A POLICE SPOKESPERSON SAID:

"WE ARE VERY CONCERNED ABOUT MR. PAIN'S SITUATION. THOSE GOBS AND GREMLINS ARE TRICKY CUSTOMERS"

A COMPUTER IS HELPING THE POLICE WITH THEIR INQUIRIES.

WILL CITIZEN PAIN
SAVE THE WORLD
AND PRESERVE THE
STATUS QUO?

STATE AS WHAT?

BUT NOW

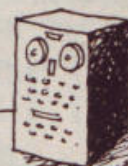
STARTING NEXT WEEK...

A.R.T.H.U.R.*

THE LIFE AND OPINIONS OF A DIGITAL COMPUTER

A NEW SAGA BY

LAURENCE LERNER + JAMES MACDONALD



*A.R.T.H.U.R. IS PUBLISHED BY THE HARVESTER PRESS, 16, SHIP STREET, BRIGHTON. TEL: 0273 723031 PRICE: £2.95

Spectrum

Spectrum is a new, rapidly expanding group of independent retailers who specialise in selling a range of popular home computers.

Our group policy is simple: we won't be beaten on price and 'know-how'. We can make this claim because our bulk buying power ensures that we select and buy at the best prices and then can pass on the benefits to you.

We guarantee if you find an item advertised and in stock at any other retailer at a better price than us, we will match that price.

You will see we quote our prices both including and excluding VAT - no hidden 15% to suddenly uplift your bill but also making our prices easier to compare with our competitors.

To ease payment we accept Barclaycard and Access as well as our own Spectrum Charge Card. Longer term credit terms are also available.

We believe our product 'know-how' is crucial to you as a customer. In every one of our centres there are personnel who have been trained by the manufacturers or distributors themselves. So we know what we are talking about on the products we sell and can help every customer, including the complete beginner, find and understand the equipment to suit his or her needs. For us it's not just a matter of simply handing over a box and leaving you on your own to figure it out. Our service includes 'hands on' experience that we can pass on to you.

After sales care is also well catered for. Our own Spectrum Service Centres will insure that should your machine 'go down' we will get it up and running as quickly as possible. We can also offer extended warranties at reasonable prices.

When it comes to mail order delivery we use Securicor for despatch to anywhere in the British Isles. The cost is low and the service is good. Further details are available from your local shop at the time of ordering.

Finally, we should point out that although not every Spectrum centre carries every advertised item, they can always be obtained quickly from our central warehouse. If you have any difficulty, please telephone Spectrum Customer Service on (0727) 66646.

Spectrum Computer Group is a division of Spectrum (UK) Ltd - Britain's largest photographic retailing group.



Developed by the Company famous for its TV and arcade games the Atari Computers have superb colour graphics and facilities for the manipulation of visuals on the screen.

In-built 'player-missile-graphics' enable the user to compose games to very professional standards. Any key on the keyboard can be made to produce any character the user wishes on the screen. Atari Computers have an extra microprocessor onboard especially to enable these unique features. There are over 200 programmable colours and tones and a wide range of programmable sounds.

Plug a 'BASIC' cartridge in and you have a comprehensive computer.

ATARI 400

£217.30

£249.90 INC.VAT

The model 400 has 16K of RAM and a touch sensitive keyboard. The 800 model has a professional style typewriter keyboard and a memory which is user expandable to 48K. Add disk drives (up to 4) and a printer and you have a system of adequate power for business uses.

ATARI 800 16K COMPUTER (EXPANDABLE)
ATARI 410 PROGRAM RECORDER
ATARI 810 DISK DRIVE
ATARI 822 THERMAL PRINTER
ATARI 850 INTERFACE FOR DOT MATRIX PRINTER
ATARI 16K RAM EXPANSION FOR 800
ATARI GAMES PADDLES (PAIR)
ATARI GAMES JOYSTICKS (PAIR)
ATARI THERMAL PRINT PAPER (2 ROLLS)
ATARI BLINK DISKETTES (5)

SOFTWARE
INVITATION TO PROGRAMMING (1)
INVITATION TO PROGRAMMING (3)
CONVERSATIONAL FRENCH
CONVERSATIONAL GERMAN
CONVERSATIONAL ITALIAN
CONVERSATIONAL SPANISH
MUSIC COMPOSER
TOUCH TYPING
ASTEROIDS
MISSILE COMMAND
PACKMAN
SPACE INVADERS
STAR RAIDERS
SUPER BREAK-OUT
VIDEO EASEL
COMPUTER CHESS
GRAPHIT
WORD PROCESSOR (DISK)
ASSEMBLY EDITOR
DE-RE ATARI

EXC VAT	INC VAT
£434.70	£499.90
£43.48	£50.00
£260.85	£299.95
£230.43	£264.99
£117.39	£134.99
£56.52	£64.99
£12.13	£13.95
£12.13	£13.95
£3.48	£4.00
£13.91	£15.99
£13.87	£15.95
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£34.74	£39.95
£34.74	£39.95
£34.74	£39.95
£34.74	£39.95
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£26.04	£29.95
£26.04	£29.95
£26.04	£29.95
£26.04	£29.95
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£21.30	£24.50
£12.13	£13.95
£86.91	£99.95
£34.74	£39.95
£17.00	No VAT

commodore



The VIC 20 really is extraordinary value for money. It does so much for so little. It's fully expandable to 27 1/2K user RAM, has a full size typewriter keyboard and plugs straight into your home TV.

COMMODORE VIC 20

£173.90

£199.99 INC.VAT

Micro soft 'BASIC' is standard but additional machine language is available via plug in cartridges. There is also a choice of other programs for chess, music and languages as well as games. Printer disk drive and other peripherals, software and books are all available to further expand your use and enjoyment.

VIC C2N cassette unit
VIC Printer (plain paper tractor)
VIC Single floppy disc drive (5 1/4")
3K RAM expansion cartridge
8K RAM expansion cartridge
16K RAM expansion cartridge
Super expander Hi Res cartridge
Joystick
Games paddles (pair)

GAMES
Programmers Aid cartridge
Machine Code Monitor cartridge
Introduction to Basic (1)
'Avenger' (ROM)
'Star Battle' (ROM)
'Jelly Monsters' (ROM)
'Super Lander' (ROM)
'Road Race' (ROM)
'Rat Race' (ROM)
'Blitz' cassette

BOOKS
Learn Computer Programming with the Commodore VIC
VIC Revealed
VIC 20 Programmers Reference Guide
VIC Computing Magazine

EXC VAT	INC VAT
£39.09	£44.95
£200.00	£230.00
£344.35	£396.00
£26.04	£29.95
£39.09	£44.95
£85.17	£74.95
£30.39	£34.95
£6.52	£7.50
£11.74	£13.50
£30.39	£34.95
£30.39	£34.95
£13.00	£14.95
£17.35	£19.95
£17.35	£19.95
£17.35	£19.95
£17.35	£19.95
£17.35	£19.95
£17.35	£19.95
£4.34	£4.99
£1.95	No VAT
£10.00	No VAT
£14.95	No VAT
£0.95	No VAT

ACCESSORIES

PRICE	SPECIAL PRICE	EXC VAT	INC VAT
Prince PC31 - 12" Green Monitor		£86.91	£99.95
SANYO			
Slim 3G Cassette Recorder (for use with Nascom)		£26.04	£29.95
CTT 3106 14" Colour TV Set		£159.96	£229.95
ACCUTRAK			
C17 Cassettes		£0.43	£0.50
Single sided, double density disks (for Commodore, Atari, Apple, Tandy etc.)		£1.70	£1.95
Double sided, double density disks (for Sharp and Superbrain)		£2.87	£3.30
Single sided, double density double track disks (for Nascom and Commodore 8050)		£2.30	£2.65
Disk Bank Interlocking cases for diskettes		£3.91	£4.50
Disk head cleaner		£13.00	£14.95
Single part 11" x 9 1/2" printer paper box of 2200 sheets		£10.39	£11.05

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18 Cheapside
Bradford BD1 4JA
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BRIGHTON
Capricorn
1 Queens Road
Brighton
Sussex
Tel: 0273 29634

CAMBRIDGE
KPI Ltd
12a Kings Parade
Cambridge
Tel: 0223 58087

CARDIFF
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18-22 High St Arcade
Cardiff
Tel: 0222 31960

DERBY
C T Electronics
The Spot
Derby
Tel: 0332 44760

GUILDFORD
The Model Shop
23 Swan Lane
Guildford
Surrey GU1 4EQ
Tel: 0483 39115

HARROW
Camera Arts
(Micro Computer Division)
24 St Ann's Road
Harrow, Middlesex
Tel: 01 427 5469

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Leeds, W Yorkshire
Tel: 0532 45445

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New Eltham
London SE9
Tel: 01 859 1516

LONDON W11
Electrolux
120 Notting Hill Gate
London W11
Tel: 01 221 7029

MACCLESFIELD
Camera & Computer Centre
118 Mill Street
Macclesfield
Cheshire
Tel: 0625 27468

MIDDLESBROUGH
McKenna & Brown
190 Linthorpe Road
Middlesbrough
Tel: 0642 248345

NEWCASTLE
Turners
29-31 High Friars
Eldon Square
Newcastle
Tel: 0632 612901

NEWCASTLE-ON-TYNE
Newcastle Camera & Computer Mart
16 Northumberland Court
Newcastle-on-Tyne
Tel: 0632 327461

NOTTINGHAM
Cameo Computers
8/9/10 Trinity Walk
Nottingham
Tel: 0602 42922

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David Saunders
Computer Centre
& Yield Hall Place
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Tel: 0734 580719

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49 Broad Street
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Tel: 01 977 4716

WALLINGTON
Surrey Micro Systems Ltd
53 Woodcote Road
Wallington
Surrey
Tel: 01 647 5636

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High Street
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we won't be beaten on prices.

Just compare them!

NASCOM



SPECIAL EDITION! UNIQUE TO SPECTRUM

The Nascom is a British designed and built microcomputer and one of the first home micros to appear in this country, some five years ago.

Since then, it has been developed into one of the most powerful and expandable systems around.

It can have up to 256K onboard memory, combined with superb colour graphics, disk drives, printers and various input/output facilities can be added.

Such is the versatility of this micro that it has been adopted for numerous commercial applications including hotel booking systems, blood grouping, weaponry and satellite tracking.

Previously looked upon as a machine for the knowledgeable hobbyist only Spectrum now bring you the opportunity to embark upon this remarkable sphere of computing in the easiest possible way. A ready to plug in and use 'SPECIAL EDITION' Nascom programmable in machine code or BASIC is now available from us. If you are serious about computing the 'SPECIAL EDITION' is your starter pack. The initial machine provides 8K of memory but a simple plug in board upgrades your computer to 56K.

THE NASCOM 'SPECIAL EDITION'	EXC VAT	INC VAT
'SPECIAL EDITION' 48K RAM BOARD	£429.95	£494.44
	£130.00	£149.50

THE NASCOM 'SPECIAL EDITION'

£429.95

£494.44 INC. VAT

SHARP

The MZ80A is the newcomer to the Sharp range with the serious user very much in mind in the design.

A complete stand-alone 48K system incorporating a profiled typewriter keyboard with numeric pad and a 9" green display screen. The "BASIC" contains a number of very useful additions over the previous models.

A full line up of peripherals further add to the versatility of this machine.

INCLUDES £75 OF FREE SOFTWARE

SHARP PERIPHERALS FOR MZ80A

- * Twin floppy disk unit (5 1/4")
- * Single floppy disk unit
- * Floppy disk interface card
- * Floppy disk cable
- * Master diskette and manual
- * 80 col printer inc. cable, I/O card and ROM
- * 80 col printer I/O card and ROM
- * 132 col printer inc. cable, I/O card and ROM
- * Expansion unit (required for disk drive and/or printer)
- * Universal interface card
- * Assembly tapes and manual
- * FDS
- * MZ80K to MZ80A converter tape

Hand held computers from Sharp give you a pocket genius at your command. We sell the well established PC1211 and the new 1500.

The PC1211 packs high performance functions with Basic language into a slim, compact body. You can extend your PC1211 with a cassette interface or printer/cassette interface.

The new PC1500 takes technology close to personal computer ability. Its compact body has 16K bytes of ROM and 3.5K bytes of RAM. With an extended alpha basic numeric. You can then go further with the 4K or 8K RAM upgrades. There's also, for the first time in hand held computers, a four colour graphic printer or a combined printer and cassette interface.

	EXC VAT	INC VAT
PC1211 Computer	£95.00	£114.75
PC1211 Cassette interface	£11.26	£12.95

SHARP MZ80A
£477.38

£548.99 INC. VAT

£75 OF FREE SOFTWARE WITH THE MZ80A



- PC1211 Cassette and printer interface
- PC1500 Computer
- PC1500 Printer/cassette interface
- PC1500 4K RAM upgrade

SHARP PERIPHERALS FOR MZ80K

- * Twin floppy disk unit (5 1/4") including I/O card, diskette, manual and cable
- * Dot matrix printer
- * Expansion interface (required for either/both above)
- * Machine code language tape and manual
- * Assembly tapes and manual
- * Basic compiler
- * Pascal
- * Double precision basic

EXC VAT	INC VAT
£60.85	£69.95
£147.78	£169.95
£130.39	£149.95
£43.43	£49.95
£702.49	£807.86
£378.91	£435.75
£96.00	£110.40
£17.57	£20.20
£36.00	£41.40
£40.00	£46.00
£40.00	£46.00
£38.00	£43.70

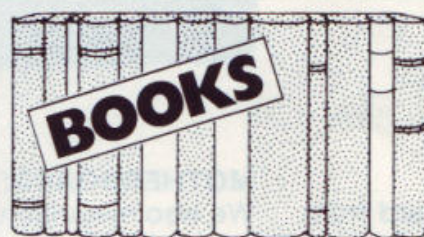
STOP PRESS! At the time of going to press we still have a few of the very popular Sharp MZ80K computer. It has 48K RAM (approx. 34.5 user when operating BASIC) a BASIC tape manual as well as an application tape and demo tape. It's an incredible package at the price.

Phone now for availability

SHARP MZ 80K

£369.57

£425.00 INC. VAT



BOOKS

We stock an extensive range of books to help you. Check below and we're sure you'll find something to whet your appetite.

- CP/M Handbook
- DON
- Programming the Z80
- Programming the 6502
- Your First Computer
- BASIC Handbook (2nd edition)
- A-Z of Computer Games
- Atari Basic
- Basic BASIC
- BASIC Computer Games
- BASIC Computer Programs for Business (VOL I)

	EXC VAT	INC VAT
	£11.50	
	£9.65	
	£11.95	
	£10.75	
	£7.75	
	£14.95	
	£5.60	
	£5.95	
	£9.95	
	£6.95	
	£8.55	

NO VAT ON BOOKS

- BASIC Computer Programs for the Home
- BASIC: A self teaching guide (2nd edition)
- Microsoft Basic
- More Basic Games
- Software Secrets (Sharp)
- Getting Acquainted with your Acorn Atom
- Instant Basic
- Why do you need a Personal Computer
- 24 Tested Games and Programs
- 33 Games for Apple - TRS-80 - PET
- Byteing Deeper into your ZX81
- Gateway Guide ZX81
- Getting Acquainted ZX81
- Hints and Tips ZX81
- Mastering Machine Code ZX81
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- ZX81 Companion
- ZX81 Pocket Book
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NO VAT ON BOOKS

DEALERS: Spectrum Computer Centres operate on an exclusive area basis and if you would like to know more about our group, contact Mike Stern or Alan Warren now on (0727) 66646.

Spectrum (UK) Limited (Unit 6)
Marlborough Building, 8, State
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Prices correct at time of going to press. E & O. E.

Spectrum

COMPUTER GROUP

FULLER FD SYSTEM £39.95

Professional Keyboard & Case for Sinclair ZX81

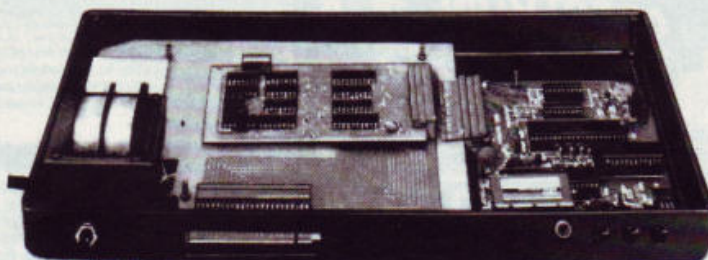
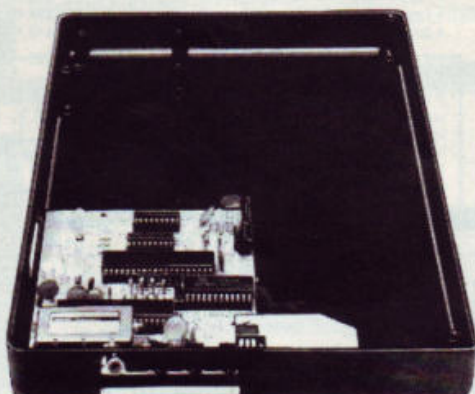


The ZX81 fits inside.

The tough ABS injection moulded plastic case measures 8" x 14" x 2½" and hooks up to your ZX printed circuit board in minutes. No technical know how or soldering is required.

KEYBOARD LAYOUT:

All the Sinclair ZX81 keys are duplicated on our layout, with extra shift and new line keys. The professional momentary action key switches have a guaranteed life of 10⁶ operations. The unit is fully built tested and comes complete with a money back guarantee.



INSTALLATION

Simply unscrew the ZX printed circuit board from its case and screw it into the FD Case.

MOTHERBOARD:

We also manufacture a mother board which allows expansion to the ZX memory and I/O facilities WITHIN the case, as well as our power supply unit and reset switch.

AD Code

Price

Qty

Amount

Fuller	FD System 42 Keyboard & case	39.95		
	FD System Motherboard	15.95		
	FD 16K. Memory Module	29.95		
	FD 64K. Memory Module	78.95		
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Mail to **FULLER MICRO SYSTEMS,**

The ZX Centre, Sweeting Street, Liverpool 2. England, U.K.

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