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Gallup Software Chart

Find out here all about the top-selling games that are currently topping the software chart.

4

News

The very latest hardware and software from the ever-expanding world of the Acorn Electron.

5

Machine Code

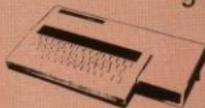
Find out about flags in Part 5 of Pete Bibby's beginner's guide to assembly language.

6

Rom Review

We test a new E00 ADFS upgrade for your Plus 3 disc drive system.

9



Adventures

More maps, hints, tips and solutions to mind-boggling puzzles from our resident man in the know.

10

In Action

Explore the fascinating world of artificial intelligence with this full Prolog compiler.

17

Software

Repton Thru Time and Barbarian are among the many new releases tested by our experts.

21

Arcade Corner

This solution to the level 1 of Ravenskull will give you a head start in the game.

25

Fox and Geese

Your Electron makes a wily opponent in this classic board game.

28



Hardware Projects

Our hardware expert turns his attention to the Plus 1's cartridge slots.

30

Hardware Review

A flexible multi-rom expansion cartridge comes under the microscope.

32

Solitaire

Can you solve this computerised version of the classic puzzle?

36



Memory Map

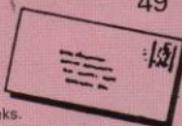
Part 4 of our exploration of the Electron's memory examines its input/output buffers.

39

Tracker

This powerful machine code disassembler will help you keep track of your programs.

49



Micro Messages

A selection from the many lively, interesting letters you have been sending us over the past few weeks.

41

Bargains galore!

Don't miss our special offers on Pages 44 and 45.

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Gallup Software Chart



THIS MONTH	LAST MONTH	TITLE (Software House)	COMMENTS	PRICE
1	1	SOCCER BOSS <i>Alternative</i>	Another month at number one for this Football Manager-type game at a budget price.	1.99
2	2	STAR FIGHT <i>Alternative</i>	Into the great unknown – a fun and simple space shoot-'em-up. Very popular thanks to its price.	1.99
3	3	COMBAT LYNX <i>Alternative</i>	Alternative scores a hat trick with this one at number three. Your mission is simply to survive in this wartime helicopter simulation.	1.99
4	●	BARBARIAN <i>Superior</i>	Highest new entry this week is this long awaited conversion – great for Yie-Ar Kung Fu fans.	9.95
5	5	PRO GOLF <i>Atlantis</i>	A good way to enter the world of professional golf without having to leave the screen.	2.99
6	●	TRIPLE DECKER 4 <i>Alternative</i>	A new compilation in the Triple Decker series. You may well have seen these games before, but they are worth adding to a collection.	1.99
7	4	FIVE STAR GAMES <i>Beau Jolly</i>	Beau Jolly are famous for their compilations – Geoff Capes Strongman, Deathstar, Twin Kingdom Valley, Repton and Combat Lynx.	9.95
8	7	WAY OF THE EXPLODING FIST <i>Mastertronic</i>	Martial arts is a perennial favourite both with software houses and gamers. This is a good budget-priced example of the genre.	1.99
9	9	FOUR GREAT GAMES <i>Micro Value</i>	Vindaloo, Wet Zone, Rig Attack and Alphasatron – your chance to play these again or add to your collection.	3.99
10	5	PSYCASTRIA <i>Alternative</i>	An old favourite which is still in the charts – join in by shooting ammo dumps while avoiding the aliens in this scrolling shoot-'em-up.	1.99
11	●	PAPERBOY <i>Elite</i>	This arcade conversion is your chance to deliver your neighbours' daily papers with the maximum of damage – beware of dogs and cars though.	9.95
12	10	AROUND THE WORLD IN 40 SCREENS <i>Superior</i>	Repton is still looming large – this time visiting the Orient, America, Africa, the Arctic and the Oceans.	6.95
13	●	GRID IRON <i>Top Ten</i>	You have been nominated as Coach of the Year – set in America this is a version of Football Manager with 3D graphics.	2.99
14	●	FOOTBALL MANAGER <i>Addictive</i>	The third soccer managing game in the charts this month – this one refuses to go away and sells and sells. An excellent simulation for football fans.	2.99
15	●	ANARCHY ZONE <i>Atlantis</i>	This new budget game is another shoot-'em-up. There are a lot of these programs around, but this is better than most.	1.99
16	●	TRIPLE DECKER 3 <i>Alternative</i>	Compilations are popular and at this price are excellent value – here are Lunar Invasion, Jam Butty and Lunar Lander.	1.99
17	●	THAI BOXING <i>The Micro Selection</i>	Basically a martial arts game which continues to pop back into the charts. Nice one at the price.	1.99
18	●	SPY CAT <i>Superior</i>	Spycatcher spoof with you trying to escape to Greenland to write your memoirs, on the way visiting No 10 and avoiding surveillance.	9.95
19	●	FOUR GREAT GAMES 3 <i>Micro Value</i>	These four are Kastle, US Drag Racing, Goal and Space Caverns. A fairly average compilation with no outstanding features.	3.99
20	●	FIVE A SIDE FOOTBALL <i>Anco</i>	Football simulations and games are definitely in abundance this month and this is your chance to play rather than manage.	6.99

electron user NEWS

Breakthrough aids program developers

A NEW wave of innovative products is on its way for the Electron thanks to a major investment by a leading company.

Surrey based Pres has bought the latest breakthrough in development devices from the States at a cost of £10,000.

Described as "a major leap forward in the field of eprom programmers", it is the first time the equipment has been used in the UK. "We feel this

will provide the key to extend the performance boundaries of the Electron once again", says John Huddleston of Pres.

"It will mean that we will be able to achieve that much more in-house in the area of programmable equipment with a much higher specification".

The device - known as the

Gang Pro - has already been used by Pres in the development of two new products for the Electron - the AP7 interface and a 32k Basic Editor.

"We are committed to serving the Electron market", says John Huddleston. "And this shows we are prepared to put our money where our mouth is to prove it".

Adventure hits snag

PROBLEMS have been hampering completion of the latest Electron game on the Go-Dax label from Maynard International (0734 302600).

Arcade adventure Cyboto should have been on the market already, but it could be the end of this month before it is available.

"It is a BBC Micro/Electron back-to-back product and we have no problems with the BBC version", said product manager Darryl Still.

"But the Electron version is taking longer. We converted it successfully but thought it looked horrible so we are trying to soup it up a bit.

"Another problem holding up production is that author Gary Pennington has been taking his 1st year exams at Middlesbrough University and hasn't always been free to help us".

Electron flower power

ELECTRONS are saying it with flowers - and business is blooming for Interflora as a result.

The international company has deployed Electron-based terminals known as Interflora Messengers in 2,500 of its outlets to handle shop-to-shop transactions.

The terminals - essentially Electron motherboards complemented by add-ons custom built by British Telecom's business equipment division - can cope with all the demands

of day-to-day business.

Staff are able to call up on-screen a simplified form to accommodate all the details a customer supplies - type of flowers, address, delivery date and even a message - and the Electron does the rest.

The details can then be passed automatically to the Interflora branch which will actually be handling delivery, via an onboard modem and custom-designed communications software.

OLYMPICS ARE COMING

IT'S time to get in shape for the Olympic Games, and Tynesoft (091-414 4611) is helping by devising a unique pentathlon.

Summer Olympiad, due for release this month, contains five events - triple jump, skeet shooting, fencing, high diving and hurdles - plus the colourful opening and closing ceremonies. Available on tape only, it costs £9.95.

Further good news for Electron users is that Tynesoft has signed a licence with DC Comics and First Star Software to publish a Superman game.



Bug-Byte's last release

Bug-Byte is back

ATTENTION all Electron games programmers - that's the urgent message from Grandslam Entertainment.

The company is making a bid for a bigger share of the leisure software market by resurrecting its Bug Byte label - but has hit a stumbling block.

"We definitely need programmers," said Grandslam's Duncan Lowthian, "then we can convert all our titles for the Electron".

Lack of personnel notwithstanding, Grandslam (01 247 6434) is promising to release six games a month - some of them for the Electron - and all at budget prices.

First on to the shelves, in September, will be Monkey Nuts, a colourful arcade style game. Price £1.99, cassette only.

Many future titles will be re-releases from the Domark and Argus Press Software stables, but Grandslam managing director Stephen Hall is hoping to include some original products.

The indirect approach

PETE BIBBY explains indirect addressing in Part 6 of his machine code series

CASTING your mind back to last month, you'll remember that in our efforts to get our machine code looping we discovered one new register and rather a lot of commands. This time things will be a little more sedate as we consolidate what we've learnt so far.

Having said that, by the end of the article we'll have dealt with three more addressing techniques and learnt how to do some simple sums. So let's meet the method behind the first two of our new addressing techniques.

This is called indexed addressing, and is much less formidable than it sounds. You'll recall that in Basic we can hold related data in single dimensional arrays. We could have an array called *example*, with

20 elements from *example(0)* to *example(19)*.

Each element of the array contains some data, and each element is indexed by the number inside the brackets – the subscript.

Now it doesn't take too much of an imaginative leap to picture our micro's memory as an array of contiguous memory locations, each capable of holding a number between 0 and 255.

We could create a sort of array by putting our data in a set of bytes one after the other.

If we know that the data starts at, say, address &70 it doesn't take much mathematical genius to figure out that the second byte will be at &71, the third at &72 and so on.

So provided we know where the table of data

starts we can use a number as an index to move along it accessing each byte in turn.

And this is what indexed addressing does. It allows you to get at – or more precisely, address – a table of data by using a pointer into it.

All you have to know is the start address of the table, and then specify a particular offset from this to get to the address you want – the effective address.

The method takes the general form:

```
[Mnemonic startAddress, offset]
```

where *startAddress* is the address of the first byte of the table, and *offset* is a value held in either the X or Y registers.

These registers, as you might guess from your

memories of instructions like INX and DEY, are ideal for the purpose of moving along an array byte by byte.

The 6502 uses indexed addressing in two ways. The first is zero paged indexed addressing, where the start address of the data lurks in – you guessed! – zero page. Program I combines the joys of zero page indexed addressing with a loop to display the alphabet.

```
10 REM Program I
20 MODE 6
30 codeStart=&2000
40 dataStart=&70
50 oswrch=&FFEE
60 ascii=&65
70 P=codeStart
80 REM Poke values into zero page
90 FOR loop=&00 TO &19
100 dataStart?loop=ascii
110 ascii=ascii+1
120 NEXT loop
130 I \ enter assembler
140 LDA #0 \ initialise index
150 \ loop \ label to jump to
160 LDA dataStart,X \ zero page indexed addressing
170 JSR oswrch
180 INX \ add 1 to value in X register
190 CPX #&19
200 BNE loop \ go back to loop
210 RTS
220 \ REM leave assembler
230 CALL codeStart
```

Program I

By now you should have no difficulty understanding how it works. The FOR...NEXT loop pokes the alphabet's Ascii codes into zero page, while the assembly code – by way of zero page indexed addressing using the X register – teases out the letters from this table. Figure I shows how the effective addresses are calculated.

As you'll find, page zero tends to be a bit cramped, with memory locations at a premium. Because of this, large tables of data normally live in main memory.

In this case absolute indexed addressing is used. As can be seen from Figure II and Program II, this is just a variation of the above.

A glance at the assembly listing produced shows that

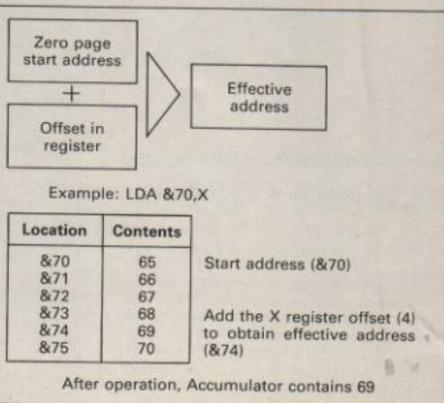


Figure I: Zero page indexed addressing

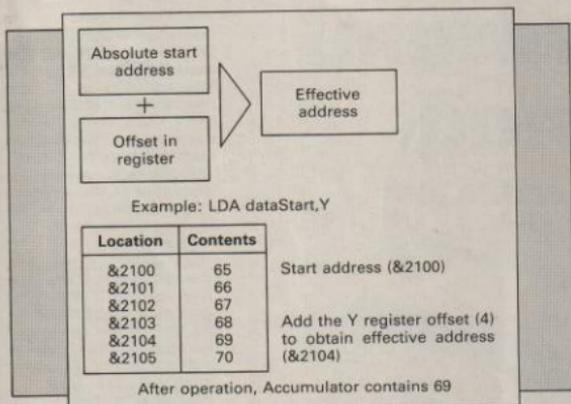


Figure II: Absolute indexed addressing

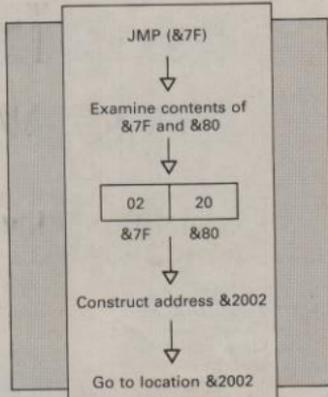


Figure III: How indirect addressing works

the price of this is that absolute indexed addressing uses one more byte than zero page indexed addressing. Sometimes such things count!

After you've thrilled to the way that Program II prints out the alphabet in reverse, using the Y register and a cunning DEY to calculate the offset from an absolute address, take a look at the branch in line 190.

Until now we've always used a compare instruction to condition the flags in the status register prior to our program's deciding whether to take a flying leap or not. So where's the compare?

The answer is that there isn't one. The point is that quite a few of the 6502's instructions affect one or more flags - though the compares are a sort of

catch-all.

In this case the DEY instruction sets or resets the negative flag of the status register as appropriate, just in time for the following BPL to decide on whether to jump or not. So, as you might surmise, there's a lot about the instructions that we've been using that I've not told you.

While I'm admitting things, I might as well point out that I've not been totally honest about all the addressing methods we've covered either.

Not all of them will work with every instruction. In fact, remembering which flags are set by which instructions and which addressing methods can be used with them isn't easy.

As you get further into assembly language pro-

gramming you'll find that you'll learn the most common ones. However, there'll always be some you don't know, and in that case you have to have recourse to a reference book containing the pertinent details.

By now you should know enough about assembler to pick your own, but look around before you buy, as prices vary wildly.

Let's now proceed to the third addressing method we'll meet this time - indirect addressing.

Pure indirect addressing is only ever used with the JMP command which, as you might guess, tells the program to jump to an address. When JMP is used in indirect addressing mode, this address is always enclosed inside brackets.

This tells the assembler that we don't want to jump literally to that address, but rather take the contents of that address and the byte following, and use the resulting 16 bit number as the actual destination address.

This may seem a bit odd, but if you think of it as something like *go to the cupboard in the corner and in it there's a piece of paper which will tell you where the treasure is buried* then that's indirect addressing - you're told where to find the

address of where you want to go to. The command takes the form:

```
JMP (indirectAddress)
```

where the brackets tell the microprocessor that indirect addressing is being used, and that the final destination address is held in the two bytes forming the locations *indirectAddress* and *indirectAd-*

Turn to Page 8 ▶

```

10 REM Program II
20 MODE 6
30 codeStart=&2000
40 dataStart=&2100
50 oswrch=&FFEE
60 ascii=65
70 P%codeStart
80 REM Poke values into mem
   ory
90 FOR loop=&000 TO &19
100 dataStart?loop=ascii
110 ascii=ascii+1
120 NEXT loop
130 [ \ enter assembler
140 LDY #&19 \ initialise in dex
150 .loop \ label to jump to
160 LDA dataStart,Y \ absolute indexed addressing
170 JSR oswrch
180 DEY \ take 1 from value in Y register
190 BPL loop \ go back to loop unless Y contains a negative number
200 RTS
210 [ REM leave assembler
220 CALL codeStart
    
```

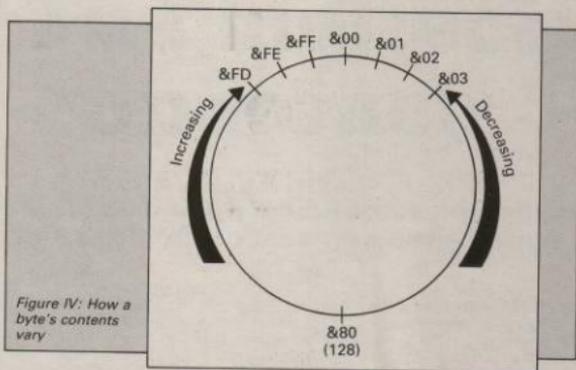
Program II

```

10 REM Program III
20 MODE 6
30 codeStart=&2000
40 dataStart=&2100
50 7&7F=&02: &80=&20:REM the address of the loop label
60 oswrch=&FFEE
70 ascii=65
80 P%codeStart
90 REM Poke values into mem
   ory
100 FOR loop=&000 TO &19
110 dataStart?loop=ascii
120 ascii=ascii+1
130 NEXT loop
140 [ \ enter assembler
150 LDY #0 \ initialise index
160 .loop \ label to jump to
170 LDA dataStart,X \ absolute zero page addressing
180 JSR oswrch
190 INX \ add 1 to value in X register
200 JMP (&7F) \ indirect addressing
210 RTS \ this is never reached!
220 ]
230 CALL codeStart
    
```

Program III

Programming



◀ From Page 7

dress+1.

Notice that although the address of only one location is given, the 6502 is clever enough to figure out that the full two-byte address is held in that location and the one following it. And, of course, it's stored in the usual low byte, high byte form.

Figure III shows diagrammatically how indirection works, while Program-III indicates a little of what it can do.

Now we'll leave addressing techniques for this month and have a look at some of the simple sums promised last time. Program IV uses a sledgehammer to crack a nut by using assembly language to add one and two.

The program itself should cause you no problems,

```

10 REM Program IV
20 MODE 6
30 result=&70
40 first=1
50 second=2
60 codeStart=&2100
70 PZ=codeStart
80 [
90 .sum
100 CLC \ Clear Carry flag
110 LDA #first
120 ADC #second
130 STA result
140 RTS \ stop
150 CALL sum
160 PRINT sum
170 PRINT first; " + ";second;
    is ";result
    
```

Program IV

```

10 REM Program V
20 MODE 6
30 result=&70
40 INPUT "Number please " #
    first
50 ?&2100=first
60 INPUT "Another number pl
    ease " #second
70 ?&2101=second
80 codeStart=&2102
90 PZ=codeStart
100 [
110 .sum
120 CLC \ Clear Carry flag
130 LDA #first
140 ADC #second
150 STA result
160 RTS
170 [
180 CALL sum
190 PRINT
200 PRINT; first; " + ";second;
    is ";result
    
```

Program V

want to include a carry if there is one.

For the moment however, the rule is CLC before adding. If you don't and the carry flag is set, your sums can go wrong.

To see what I mean, replace the CLC in line 100 with SEC, which actually sets the carry flag - SET Carry - and then run Program IV again. You'll see that the answer - 4 - is one too many, as the carry bit has been included.

Program IV is a bit limited, but Program V is rather more useful.

While this is easy enough to follow after what we've covered, it can produce seemingly wrong results. Try running the program and adding 128 to 128. Is 128 plus 128 really zero? Obviously not.

What's happened is easily explained. The contents of a byte act a bit like those of a car's odometer - the display

that gives a car's mileage. When you get past the maximum (999,999 on the odometer, 255 on the byte) the contents of both become zero. The carry bit in the status register is set to one to show what's happened.

Another way of looking at it is that when you go past a byte's maximum size you've gone round the clock and are back at zero.

The same thing happens when you try to decrease a byte below zero - it obstinately goes back round the clock. One from zero gives &FF, two below zero is &FE and so on. Figure IV shows what happens.

Program VI, the last for this month, shows how subtraction works. The secret is to always set the carry flag with SEC before using SBC - Subtract with Carry - to take a value away from that in the accumulator.

The result ends up in the accumulator. If, after a subtraction, the carry flag is still set, then the result is positive or zero. If it is clear, then a borrow has occurred and the result is negative.

And that's where we'll finish for now. We've learnt some important techniques, even though we've only just scratched the surface of their usefulness. Can you use them to add - or subtract - numbers greater than 255, or print out messages? Play around with what we've learnt.

● Next month, in the final part of this series, we'll be addressing ourselves to some routine, but important assembly language tasks.

```

10 REM Program VI
20 MODE 6
30 result=&70
40 INPUT "Number please " #
    first
50 ?&2100=first
60 INPUT "Another number pl
    ease " #second
70 ?&2101=second
80 codeStart=&2102
90 PZ=codeStart
100 [
110 .subtract
120 SEC \ Set Carry flag
130 LDA #first
140 SBC #second
150 STA result
160 RTS
170 [
180 CALL subtract
190 PRINT
200 PRINT; first; " minus ";
    second; " is ";result
    
```

Program VI

ONE of the major faults of the otherwise excellent advanced disc filing system in the Acorn Plus 3 and Pres Advanced Plus 3 is the large amount of memory it requires for its workspace.

When the ADFS is initialised either on power-up or after a Control+Break reset, it grabs 3.75k of memory.

This means that in Modes 0 to 2 only 4,864 bytes are free, which isn't much, so many games and other programs and utilities simply won't work when transferred to disc.

Now this problem has been overcome by Pres, the company that has taken over production of the Plus 3 in a slightly modified form.

This is a major achievement, and many Electron owners will be jumping for joy at the news. The solution isn't that expensive, either.

The new E00 ADFS is supplied on a 3.5in or 5.25in disc, so you'll need either an original Acorn or Pres Plus 3 already if you are to make use of it. In addition, you'll also need the Pres Advanced Battery Backed Ram (ABR) cartridge.

If you've already got ABR it'll cost you just £17.19 for the E00 ADFS on 3.5in disc, but £50.95 if you haven't. This sounds expensive, but the ABR has many other uses apart from the ADFS.

Installing it is easy – simply plug in the ABR cartridge and boot the disc supplied. In use it appears to be no different to the standard Acorn ADFS, but one or two minor changes are worth noting.

A couple of serious bugs in the Acorn ADFS have now been fixed. The most obvious is that the ZYSYSHELP file is no longer written to a freshly formatted disc.

The old ADFS was unreliable when writing to the first few tracks of a disc, so this was a "fix" and simply involved writing a file full of garbage to the suspect part. The ADFS would then skip it.

Now you get the bonus of an extra 14k of disc space as Pres' version 1.26 of the ADFS correctly accesses all

Improving on perfection

ROLAND WADDILOVE reviews
the new memory miser
E00 ADFS from
Pres



parts of the disc.

The other small but important improvement is that the cursor is switched off when you compact the disc – I've lost track of the number of files I've corrupted by compacting discs with that blinking cursor.

The main advantage of the E00 ADFS is the fact that no memory is lost over a tape system. You can now load and run those long adventures and other programs straight from disc.

Memory-based databases have more room to store data, word processors have extra space for text, spreadsheets can be bigger and so on.

An extra bonus is that the Winchester hard disc code has been taken out of the rom, and the space used by adding the code to access the Pres Advanced Quartermeg Ram cartridge as a ram disc.

The disc containing the rom image also has the Help, Welcome and Library directories from the Welcome disc supplied with the Plus 3.

So far so good, but are there any disadvantages? One point which I found

annoying was the fact that the ABR cartridge takes up a slot in the Plus 1, and on top of this both 16k banks of the sideways ram are occupied.

Acorn Plus 3 owners won't be bothered too much by this as they still have a spare cartridge slot. However, the Pres Plus 3 interface plugs into the other Plus 1 cartridge slot.

This, unfortunately, means that the cartridge slots are all occupied and nothing else can be used. So View and Viewsheet are out, plus all the other peripherals and add-ons that make use of these slots.

The manual consists of a single sheet of paper, printed on just one side. However, this is all that is needed, as the E00 ADFS can only be used with a Plus 3, and a manual will have been provided with that.

The E00 ADFS and ABR costing £50.95 will give you 20,992 bytes free in Mode 6, and 8,704 bytes in Mode 0. An alternative would be to upgrade your Electron with a Slogger Master Ram

Board costing £59.95.

This will give you 25,344 bytes of memory in Mode 6, also the same in Mode 1, or any other for that matter. In addition to this, it will also speed up your micro to give you almost BBC Micro performance.

To sum up, if you've already got ABR, then the cost of the ADFS is a small price to pay for the extra memory and convenience of an E00 disc filing system.

If you haven't got ABR and simply want more memory for disc-based programs you've got a difficult decision on your hands: Should you buy the ABR and E00 ADFS, or stick with the original ADFS and upgrade with a Master Ram Board? The choice is yours.

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Adventures by Pendragon

Opening up a whole new experience

DURING the past year many readers, including Steven Wyeth, Peter Youde, Anne Kerr and Michelle Hurds have asked for a list of BBC Micro adventures which will run on Electrons fitted with Slogger's Master Ram Board in 64k mode.

The following list is not definitive, but will help fill many shopping lists with two dozen good quality BBC Micro adventures.

Temple of Terror, Adventure Soft.

Masters of the Universe, Adventure Soft.

Gateway to Karos, Acornsoft.

Kingdom of Hamil, Acornsoft.

Seventh Star, Acornsoft.

Quondam, Acornsoft.

Castle Blackstar, CDS.

Castle Dracula, Ducksoft.

Adventure Quest1, Level 9.

Colossal Adventure, Level 9.

Dungeon Adventure, Level 9.

Emerald Isle, Level 9 (no graphics).

Lords of Time, Level 9.

Snowball, Level 9.

Price of Magic, Level 9.

Red Moon, Level 9.

Return to Eden, Level 9.

Worm in Paradise, Level 9.

Pen and the Dar, Mosaic.

Saga of Eric the Viking, Mosaic (no graphics)

Colditz Adventure, Superior

Gideon's Gamble, Superior

Lost City, Superior

Star Trek Adventure, Superior

Please note that with some games you will need to by-pass the loading screens. Others may load with unsightly Mode 7 characters.

The Master Ram Board opened up a whole new experience in adventures for me, and my Electron is almost permanently switched into 64k mode.

I would like to hear from anyone who has been able to run either *The Hobbit* or *Lord of the Rings* on their Electron.

A couple of months ago in the final part of the *Enthar Seven* solution I mentioned that I could find no obvious use for the blue flower.

A missive from Rob O'Leary of Robico informs me that not unlike a certain throat sweet, the flower enabled me to breathe more easily when I was in the vicinity of a certain rotting corpse.

Alan Davidson writes to ask where he can buy the old *Magus* Software games. *Magus* has now been defunct for two years and to my knowledge only produced three adventures: *Village of Lost Souls*, *Locks of Luck* and *What's Eeyore's?*

Robico released a re-visited *Lost Souls* last year. You may be able to pick up copies of the other two games by writing to Glen McCauley at 4 Toronto Close, Durrington, Worthing, West Sussex.

Be prepared for outstanding news regarding new releases, next month. Until we need more ram, happy adventuring!

Adventurer's Glossary

(continued from last month)

- Keys:** Try different keys in different locks.
- King:** Be humble and a reward may await you.
- Kitchen:** Examine all cupboards and work surfaces. Take care eating food, it may be poisoned.
- Knife:** Keep it sharp. Used for cutting and killing.
- Ladder:** Its use must be obvious - never neglect it and carry it with you for escaping from tricky locations.
- Lake:** Find a boat or build a raft.
- Lamp:** An important source of light.
- Leaves:** Clear them and search.
- Ledge:** Be careful if you traverse it.
- Level:** Push or pull with care.
- Library:** Search or examine the shelves and read the books.
- Logs:** Chop them. Remember that most wood floats.
- Lucky charm:** Could be a rabbit's foot, a horseshoe or a four-leaved clover. Will have magical properties.
- Luminous gem:** A treasure or a source of light?



Readers' Hall of Fame

Village of Lost Souls – Peter Youde (continued from last month)

Collect the last few items for the final assault. Go SE, NE, OUT, N, NW, NE, IN, NE, get the pitchfork then SW, NW, N, NW, W. Get the boots and move N, GET SALT, SW, E, S, S, SE, OUT, SW, E, SW, SE, S, E, SE and get the bucket.

Return to the ornamental well and throw everything down it. Travel SE, E, NE, W, NW, SW, W, W, W, W, E, E, E, E, SW and drop everything.

Go NE, W, W, W, W, W, NE, S, SE, S, IN, NE, GET ALL, SW. Examine the tapestry (clue to play BAGDAD), OUT, N, NW, N, W, E, E, E, E, SW. Open the tin, fill it with paint.

Go SE, drop the mattress, tie the rope to the well and drop everything again. Move NW, GET ALL, SE, DROP ALL, NW, GET ALL, SE, DROP ALL.

Go down the well yourself. Go DOWN and release the rope. Open the door at the bottom then GET LYRE, PLAY BAGDAD, DROP LYRE, WEAR GAUNTLETS, OPEN DOOR, DROP GAUNTLETS.

Destroy the smug aura and enter. GET CHALICE, THROW WATER, DROP CHALICE, WEAR BAND AND RING, GET SPADE TIN WAX HAMMER PITCHFORK BOOTS AND SALT, IN. Dig a hole in the snow in case you miss your jump and get fur skin.

SE, DOWN, WEAR SKIN, OUT, N, DIG, IN, UP, UP. Go to the crevasse and jump across E, JUMP NE. Then cross the room of fire to the pillar of ice E, WEAR BOOTS, E, DROP RING AND BOOTS, E, E, E, NE.

Free the helmet and go to meet the Satyr. SPRINKLE SALT, WEAR HELMET, UP, PUT WAX IN EARS, UP, S. Prepare to destroy the mirror. OPEN TIN, IN, THROW PAINT. To finish the game, break the mirror with the hammer.

Stranded – A complete solution by A.C. Davidson

Go W, TAKE FUEL, then N, D, W, N and climb the tree. Take the parachute then go D, S, E, S, S, E, N and take the lockpick.

Travel N, W, U, U, S, JUMP, take the laser, JUMP, S and shoot the robot. JUMP, PICK LOCK, DROP FUEL, PULL LEVER. Go N, W, N, W, N, PICK LOCK, E, E, and take the suit.

Travel W, W, S, S, E, E, E, S, S, TAKE CRYSTAL, N, N, W, W, W, N, PICK LOCK, N, DROP CRYSTAL, PUSH RED, S, S, W, S, TAKE KEY, N, E, N, N, PUSH WHITE, S, S, UNLOCK DOOR. SUCCESS!

Penragon: I hadn't realised just how small this adventure is until I read this solution.

Circus – Part 1 of a solution by Miss S.A. Lockyer

Go E, E, TAKE SHOVEL, DIG, DROP SHOVEL, W, W, S, WALK ROAD. Then travel S, S, open the boot. TAKE FLASHLIGHT, TAKE SPANNER, N, N, WALK FIELD. Go N, DROP SPANNER, DROP CAN, DROP KEYS, LIGHT FLASHLIGHT.

Enter the tent and move N, W, EXAMINE FREEZER, TAKE FISH, E, S, E, E, SWIM, FEED SEALION, TAKE SNORKEL. Go W, W, W, kick the chest and examine it.

Take and wear the slippers, then E, N, CLIMB LADDER, ENTER TRAPEZE, SWING TRAPEZE. CUT CANVAS, ENTER TRAP, SWING TRAP, D, E, CLIMB LADDER.

ENTER TIGHTROPE, N, TAKE BAR, ENTER TIGHTROPE, S, D, W, N, W. Examine the cannon, read the sign then take and wear the helmet. ENTER CANNON, PULL LEVER, N, remove and drop the slippers, then drop the penknife and snorkel.

Go W, OPEN DOOR, ENTER DOOR, open and examine the locker and take the hacksaw. (More next month)

Castle Frankenstein – Part 1 of a solution by Emma Rutherford

At the inn go down through the trapdoor, PULL RING then journey E, N, W, W, W, S, S, E, E, E, N, N, W, N, N. Get the key then go W, FILL BOTTLE, E, S, S, E, S, S, S, S, W, W, W. Travel N, N, E, E, E, S, W, S, E, UP, and you're back in the storeroom.

From the end of the inn road go N, N, E, S, get the lamp, E, N, N, N, E, E, E, E, then S to the blind man's cabin and collect the paraffin and violin.

Go up the mountain path to the graveyard. Get the spade and dig the disturbed grave to get the coin. Return to the shop and buy the tin hat.

Go up the mountain path and from the pit go D, N, E, E, N, N, W, W. Get the mask and go E, E, S, U, U, U, S, S, E, E, then dig the EARTH. Travel U, U, and you're back to the mountain path.

Go past the graveyard, up the steep slope, but ensure that you are wearing the tin hat. Ignore the iron ring and go around to the back of the castle. Find the wooden door and go W, W, W, U, U. Pull the ring then go W, W, S, W and get the rod. Travel E, N, E, E, N, D, D, E, E.

You are now at the wooden door. Unlock it, prise it open and open it. Go in and get the knife from the dining room. Go back outside, up the stones and pull the ring.

Climb up the battlements and kill Ygor with the knife. Remember to get the knife after committing this ugly deed. (More next month)

Turn to Page 12 ▶



Problems Solved

This month I am not going to give any answers to readers' questions, but instead help you to solve your own problems.

One question I often get asked about adventures is what the experts do when they get stuck.

The answer, I suspect, is that they cheat. A simple program called a disassembler can be used to examine the memory after the program has loaded.

It will give a list of the words the program recognises and the statements it gives during the course of the adventure.

However, it won't work on every occasion. Some adventures, especially large machine code ones, use compaction techniques, while others are tokenised.

Of course these underhand methods are strictly a last resort, they're

not for the real he-men among you, and old Pen-dragon certainly would never stoop to using them ... would he? But that doesn't mean that he wouldn't come to the aid of anyone in distress.

So let's look at the basics first. A disassembler is a program that examines each address in memory, translates the machine code it finds there into assembly language and prints on the screen the address, the assembly language, the machine code and the Ascii code equivalent. For instance:

```
2000 JSR &4142 20 4C 41 LA
```

While this does give you the words you are trying to find, it is very tedious to use, since you have to read the words vertically.

Program I, gives a listing

of the Ascii codes, translated into letters across the screen rather than down the side of it.

Since it only lists the letters, both compaction and tokenising techniques will be beyond it.

```
10 VDU12;14
20 INPUT*START ADDRESS F
OR CHEATING*,AS
30 INPUT*END ADDRESS FOR
CHEATING*,BS
40 A=VAL(AS):B=VAL(BS)
50 FOR C=A TO B
60 D=7C
70 IF D<=65 OR D>=90 AND D
<=97 AND D>=122 THEN D=46
80 PRINT CHR$(D);
90 NEXT C
```

As you can see, it is very short. This is important since you have to fit it into memory alongside the adventure.

You should type it in and save it on a blank cassette. When you want to use it,

load it in at PAGE = &0E00 and then *LOAD the main program in at &0F00.

This will enable you to type in RUN without the program having been overwritten.

Use the Shift key to scroll the screen and remember that it is important to type in the address as a hexadecimal number. That is, &0E00 and not 0E00.

One last tip. Some software houses alter the value of the codes. Sometimes you can bypass this by trying different values. For instance, insert a new line that alters the value of D such as:

```
75 D=D&42
```

or:

```
75 D=D/3
```

Happy hacking!

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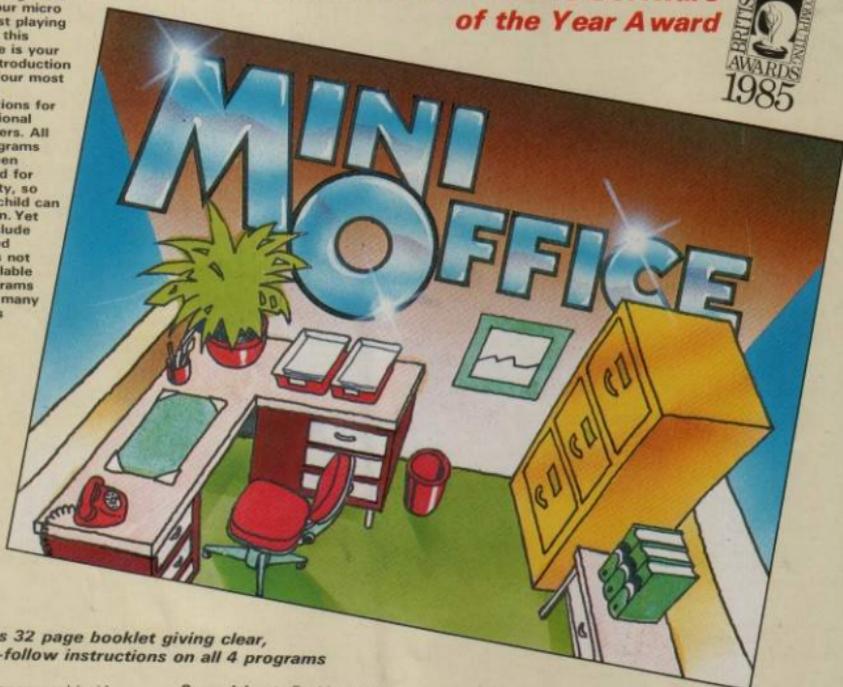
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CAN a computer really think for itself? It's a question often asked by laymen, and most are disappointed when told that the answer still evades even the best scientific minds.

How can such a seemingly innocent question pose such formidable problems for the theorists?

The reasons are many, and the problems involved immensely complex. But in this two-part Computing In Action we shall be taking a look at some of the ideas behind current artificial intelligence (AI) research, with one objective in mind – to try and get the Electron to learn something by itself.

With our target already neatly defined, let's kick off by examining some of the basic ground rules of AI theory. Fundamental to the whole subject is the fact that a computer knows nothing that is not already programmed into it.

This sounds obvious, but there are still an amazing number of people who do not realise this.

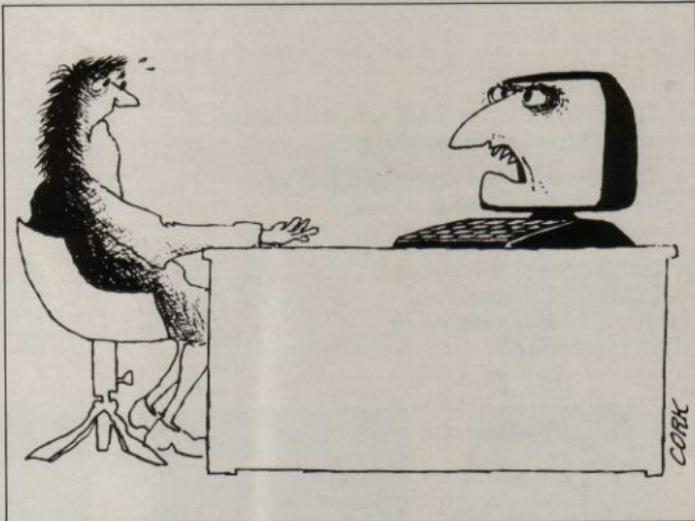
Your Electron, for instance, knows π is equal to 3.14159265, but only because that value is programmed into the Basic rom. You can argue that it also knows the square root of any given number, but this is, of course, computed using a pre-programmed algorithm.

Another rule of AI is that any computer program can be made to exhibit apparent intelligence by a clever enough programmer.

You have probably heard of – or perhaps played with – a version of the famous psychiatrist program Eliza, written in the 1970s by a professor who wanted to demonstrate just this point.

Eliza plays the part of your friendly psychiatrist who listens patiently to your problems and worries, and answers with apparent concern.

Eliza is capable of sustaining an intelligent conversation for just as long as you let it. In fact, all the program is doing is examining your input for key words and phrases – which



I think, therefore I am

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are already programmed into an array – and pulling out a matching reply from another array.

And by answering questions with countering questions – the classic approach favoured by most analysts – the human participant is unwittingly manoeuvred into continuously supplying fresh stimulus to the conversation, which would otherwise die out very quickly.

A good choice of keywords, coupled with the right usage of Basic's RND function, will certainly fool a

lot of people. Indeed, an old AI maxim is as follows:

Place a human in an isolated room with a computer terminal, and run an Eliza type program on the terminal. If the human is incapable of discerning whether he or she is in communication with another human or a computer program through the terminal, then the program is, to all intents and purposes, human itself.

If this sounds trite, imagine all of the possible questions, jokes, political discussions and so on with

which the human could quite easily test the terminal.

If the program continues to fool the human, then surely we must have an intelligent computer. But is it really thinking for itself, or following such a complex route of programmed responses that it appears to be?

The simplest answer, which cuts through some of the jargon that professional AI researchers would have you understand first, is that

Turn to Page 19 ▶

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Maths Hike
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Pelmanism
Towers of Hanoi



HANGMAN

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ODD MAN OUT

Find the word that does not fit - before your time runs out

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◀ From Page 17

if such a computer had not been programmed to look for certain phrases, and answer with pre-set responses – no matter how complex and devious – then that computer should be considered as intelligent.

Mind you, whether such a program is actually self-aware – the property which separates sentient beings from mere animal awareness – is probably best left well alone as the subject matter of the AI theorists.

This quite simply means that for a program to qualify in any way as intelligent, it

in Action features a very stripped-down version of the Prolog language. Although widely popularised as a cult language with which to produce AI programs, Prolog is simply a clever way to teach the computer associations between various things.

Prolog is what is known as a relational database. That is to say, it is not programmed in the conventional fashion associated with a language. Instead, you teach it the relationship between several different objects, according to the rules of the language.

Gradually, a model of

WORD=WORD	Define a relationship
LIST (CLAUSE)	List all or some definitions
KILL CLAUSE	Remove all matching definitions
? WORD	Ask for conclusion to be made
TRACE WORD	Ask for logic chain to be shown
IS WORD=WORD	Test relationship for truth
CLEAR	Wipe database
SAVE filename	Save database
LOAD filename	Load saved database

Table 1: List of MiniLog keywords

must be capable of learning something for itself.

And so we return to our original objective of teaching the Electron to learn one or more facts off its own bat.

There are several ways of achieving this, none of them easy. I must state, before going any further, that anything we may try is likely to be a half-way compromise between pre-stored information and actual intelligent deduction.

This is because the sheer difficulty of how to approach the task usually results in clumsy, partially hard-wired rules being added just to get the program working.

There have, to date, been several successful demonstrations of self-learning computer programs, but only a very few genuinely contain no in-built precepts or assumptions.

And the results of these few genuine programs – while intensely exciting to the computer scientist – tend to look pretty dull to the casual observer.

This month's Computing

interlinked facts is built up inside the computer, of which eventually quite complex questions may be asked.

Consider the following two statements:

A cat is feline.
Felines are tree climbers.

The logical conclusion from these two statements, although we have not said so in as many words, is:

A cat is a tree climber.

Prolog accepts facts similar to those above, although they have to be phrased carefully according to exact syntax requirements.

It is then capable of following the facts to their logical termination, and will arrive at the same conclusion that we have.

The listing is a version of Prolog called MiniLog, and at less than 3k in length you wouldn't expect it to be as capable as its bigger parent – but you may be surprised as to just what it can do.

When it is run, you are faced with an environment similar to Basic. There is a

system prompt:], and you are not restricted in what you type. However, MiniLog is fussy about almost all of it.

Operating system commands may be entered freely, but beware of *COMPACT and similar memory-corrupting commands.

A relationship between two words is entered by typing the words, separated by an equals sign. For example, to enter the equivalent of "A cat is feline", type:

CAT=FELINE

And to add the second definition "Felines are tree climbers", type:

FELINE=TREE-CLIMBER

Note the use of the minus sign. There must be no spaces between parts of a definition, so use this or the underscore in place of the spacebar. To force MiniLog to follow the logic of its new definitions, type:

? CAT

And you should be answered with:

CAT=TREE-CLIMBER

Now type in the following definitions:

FELINE=MAMMAL
FELINE=QUADRUPED
FELINE=CARNIVORE
MAMMAL=GESTATE
MAMMAL=VERTEBRATE
QUADRUPED=FOUR-LEGGED
QUADRUPED=LAND-ANIMAL
CARNIVORE=MEAT-EATER

Now we have a complete set of definitions – or

clauses – for a cat entered into MiniLog. You should begin to see how the language works. Table 1 contains a complete list of the MiniLog commands, and you can test some of them now.

Type LIST, and every definition entered so far will be displayed, whereas typing LIST FELINE will just show all definitions beginning with FELINE=:

FELINE=MAMMAL
FELINE=QUADRUPED
FELINE=CARNIVORE

But now to test MiniLog's logic tracing abilities more thoroughly. Typing ? CAT should now produce:

CAT=TREE-CLIMBER
CAT=GESTATE
CAT=VERTEBRATE
CAT=FOUR-LEGGED
CAT=LAND-ANIMAL
CAT=MEAT-EATER

As you can see, MiniLog has made several logical conclusions from the information supplied to it concerning the word CAT.

We only actually stated that CAT=FELINE, but the definition of FELINE has been followed down through all of the following definitions, with MiniLog making all of the correct logical conclusions.

However, the intermediary steps have not been listed. We are not shown, for instance, that a definition of MAMMAL was involved in the final results. The command TRACE is provided for just this purpose.

Type TRACE CAT, and the

Turn to Page 20 ▶

<i>Bad link attempt</i>	Produced by any unrecognised input
<i>No room for link</i>	There is only room for 100 definitions
<i>Can't find reference</i>	MiniLog cannot find the named reference
<i>Too many references</i>	The chain of logic has become too involved
<i>Bad question</i>	An IS question has been incorrectly phrased
<i>Bad filename</i>	A space has been omitted after a SAVE or LOAD
<i>No database to save</i>	Nothing in memory

Table 2: MiniLog error messages

ACTION

◀ From Page 19

complete chain of logic will be listed, showing all definitions which have a sub-definition as GROUPS, while the sub-definitions are shown as MEMBERS.

But we can do much more than this. MiniLog can actually test any named relationship for logical truth. Add the following two definitions:

```
DOG=CANINE
CANINE=MAMMAL
CANINE=QUADRUPED
CANINE=CARNIVORE
```

And then type:

```
IS DOG=TREE-CLIMBER
```

You should almost immediately receive the answer FALSE. This is because MiniLog follows the clause for DOG right through to its conclusion, but nowhere will it find a link between DOG and TREE-CLIMBER. However, typing:

```
IS DOG=FOUR-LEGGED
```

will illicit the response TRUE, because we have linked DOG to QUADRUPED via the definition of CANINE. Type TRACE DOG to see the complete chain of logic in action.

You can delete whole clauses at a stroke with the KILL command. Typing KILL CANINE=, leaving the link between DOG and FOUR-LEGGED broken once more.

There is room for 100 separate definitions, although if a trace is operating on a database of over 80 the chain of logic may become so involved that you receive the message:

```
Too many references
```

This is because MiniLog builds a tree structure of the definitions involved whenever a conclusion, trace or question is requested, and it is possible for it to run out of room.

CLEAR wipes the current database completely. After a short pause the prompt will reappear, and all of the

definitions will have gone. You can save the current database with:

```
SAVE filename
```

and re-load it at a later date with the LOAD command. Play about with MiniLog, and test its ability to follow various chains of logic.

Don't restrict yourself to animals - the program may

fall far short of Prolog's versatility, but there are still a large number of different ideas you can try.

MiniLog is fully error-trapped, and all error messages and their meanings are shown in Table II.

The conclusion, unfortunately, is that MiniLog - and all similar relational databases, Prolog included - exhibit totally unintelligent

behaviour. MiniLog is incapable of telling you just why a dog is not a tree climber as the dog itself - our quest for real intelligence must continue.

● Next month we'll take a stab at making the Electron intelligent, with a self-teaching noughts and crosses program that learns by its mistakes - or does it?

```
10 REM Mini Prolog
20 REM By Chris Nixon
30 REM (c) Electron User
40 REM
50 ON ERROR GOTO 450
60 MODE6:PROCSetup
70 REPEAT:PROCprompt:UNTI
Lend1
80 PRINT"MiniLog abandon
ed.":END
90 DEFPROCSetup:limit:=10
0:DIM link$(limit,1),stack$(
50):PROCClear
100 CLS:COLOUR0:COLOUR129:
PRINTTAB(8,1)" Electron Mini
Prolog :COLOUR1:COLOUR128:
PRINTSTRINGS(39,")
110 end:=FALSE:VDU28,0,24,
39,3:ENDPROC
120 DEFPROCClear:FORLX=0TO
limitX:link$(LX,0)=STRINGS(1
5,")::link$(LX,1)=STRINGS(1
5,")::NEXT:FORLX=0TO50:stac
k$(LX)=STRINGS(15,")::NEXT:
maxX:=8:ENDPROC
130 DEFPROCPrmpmt:VDU93:IN
PUT$AS
140 ILEFTS(AS,1)=?" PROC
tree(1):ENDPROC
150 ILEFTS(AS,5)="TRACE"
PROCTree(2):ENDPROC
160 ILEFTS(AS,4)="FIND" P
ROCFind:ENDPROC
170 ILEFTS(AS,2)="IS" PRO
Ctest:ENDPROC
180 ILEFTS(AS,4)="KILL" P
ROCKill:ENDPROC
190 ILEFTS(AS,4)="LOAD" P
ROCLoad:ENDPROC
200 ILEFTS(AS,4)="SAVE" P
ROCSave:ENDPROC
210 ILEFTS(AS,4)="LIST"
PRClist:ENDPROC
220 IF AS="CLEAR" PROCClea
r:ENDPROC
230 IF AS="BYE" endX:=TRUE:
ENDPROC
240 IF LEFTS(AS,1)="#" OSC
LI AS:ENDPROC
250 IF AS=" ENDPROC
260 IF maxX=limit PROCerr
or(2):ENDPROC
270 P1=INSTR(AS,"=):IF P
1=# PROCerror(1):ENDPROC
280 link$(maxX,0)=MIDS(AS,
1,P1*1):link$(maxX,1)=RIGHT
$(AS,LENAS-P1)
290 IF LENlink$(maxX,0)=0
OR LENlink$(maxX,1)=0 PROCer
ror(1):ENDPROC
300 maxX=maxX+1:ENDPROC
310 DEFPROClist:IFmaxX=0 E
NDPROC
320 P1=INSTR(AS,'):IFP1>
0 MS=RIGHT$(AS,LENAS-P1)
330 FORLX=0TOmaxX-1:IFP1=0
THEMIF link$(LX,0)=MS PRINT
"link$(LX,0)"="link$(LX,
1),1)
340 IFFP=0 PRINT "link$(L
X,0)"="link$(LX,1)
350 NEXT:ENDPROC
360 DEFPROCerror(EX):RESTO
RE 370:FORLX=0TOEX:READ EB:
EXT:PRINTES:ENDPROC
370 DATA ERRORS!
380 DATA "Bad link attempt"
390 DATA "No room for link"
400 DATA "Can't find refer
ence."
410 DATA "Too many referen
ces."
420 DATA "Bad question."
430 DATA "Bad filename."
440 DATA "No database to s
ave."
450 IF ERR=17 PRINT"Brea
k":GOTO70
460 REPORT:PRINT" at line
":ERL:GOTO70
470 DEFPROCtree(OX):IFmaxX
=0 PROCerror(3):ENDPROC
480 P1=INSTR(AS,'):IF P1
=0 PROCerror(3):ENDPROC ELSE
O=RIGHT$(AS,LENAS-P1)
490 FX=LX:0=ptrX=0:REPEA
T:IFlink$(FX,0)=0O5 FX=1:stac
k$(ptrX)=link$(LX,1):ptrX=ptr
X+1:IFptrX=50 PROCerror(4):
UNTI1:=1:ENDPROC
500 LX=LX+1:UNTI1LL=maxX:}
F F=# PROCerror(3):ENDPROC
510 P1=#:REPEAT:FX=0:MS=st
ack$(PX)
520 TX=0:LX=0:REPEAT:IFlin
k$(LX,0)=MS PROCfound:IF ptr
X=50 ENDPROC
530 LX=LX+1:UNTI1LL=maxX:}
F OX=1 AND FX=0 PRINT" OS"
=" MS
540 PX=P1+1:UNTI1LP=ptrX:}E
NDPROC
550 DEFPROCtest:IFmaxX=0
PROCerror(3):ENDPROC
560 P1=INSTR(AS,"=):IF P
1=# PROCerror(5):ENDPROC
570 MS=MIDS(AS,4,P1-4):M
2S=RIGHT$(AS,LENAS-P1):TX=0:
FX=0:LX=0:ptrX=0:REPEAT:IFl
ink$(LX,0)=MS FX=1:stac$(p
trX)=link$(LX,1):ptrX=ptrX+1:
IFptrX=50 PROCerror(4):UNTI
```

```
L1:=1:ENDPROC
580 LX=LX+1:UNTI1LL=maxX:}
F FX=0 PRINT"LAST":ENDPROC
590 P1=#:REPEAT:FX=0:MS=st
ack$(PX):IFMS=MS UNTI1MS=M2
S:PRINT"TRUE":ENDPROC
600 LX=0:REPEAT:IFlink$(L
X,0)=MS FX=1:stac$(ptrX)=lin
k$(LX,1):ptrX=ptrX+1:IFptrX=
50 PROCerror(4):UNTI1L=1:UNT
I1:=1:ENDPROC
610 LX=LX+1:UNTI1LL=maxX:P
1=ptrX+1:UNTI1LP=ptrX:PRINT"FA
LSE":ENDPROC
620 DEFPROCload:P1=INSTR(A
S,')::IF P1=# PROCerror(6):
ENDPROC
630 CHS=OPENIN RIGHTS(AS,L
ENAS-P1)
640 L1=#:REPEAT:INPUT#CHS,
link$(LX,0):INPUT#CHS,link$(
LX,1):LX=LX+1:UNTI1 EOF#CHS:
CLOSE#L:maxX=LX:ENDPROC
650 DEFPROCsave:IFmaxX=0 P
ROCerror(7):ENDPROC
660 P1=INSTR(AS,'):IF P1
=# PROCerror(6):ENDPROC
670 CHS=OPENOUT RIGHTS(AS,
LENAS-P1)
680 FORLX=0TOmaxX-1:PRINT#
CHS,link$(LX,0):PRINT#CHS,li
nk$(LX,1):NEXT:CLOSE#ENDPR
OKS
690 DEFPROCfound:IF OX=2 A
ND TX=0 PRINT"Group : MS:TX"
=1
700 IF OX=2 AND TX=1 PRINT
SPC2#member : link$(LX,1)
710 FX=1:stac$(ptrX)=link
$(LX,1):ptrX=ptrX+1:IFptrX=5
0 PROCerror(4):UNTI1L=1:UNTI
L1:=1:ENDPROC
720 ENDPROC
730 DEFPROCkill:}P1=INSTR(A
S,')::IF P1=# ORmaxX=0 PROC
error(3):ENDPROC
740 MS=RIGHT$(AS,LENAS-P1)
:PX=0:REPEAT
750 FX=0:LX=0:REPEAT:IF li
nk$(LX,0)=MS PROCshunt
760 LX=LX+1:UNTI1LL=maxX O
R FX=1
770 UNTILFX=0:IF PX=0 PROC
error(3)
780 ENDPROC
790 DEFPROCshunt:FORTX=LX+
1 TOmaxX:link$(TX-1,0)=link
$(TX,0):link$(TX-1,1)=link$(
TX,1):NEXT:maxX=maxX-1:FX=1:
PX=1:ENDPROC
```

Repton takes his time

Product: Repton Thru Time

Price: £6.95

Supplier: Superior Software Ltd.,
Regent House, Skinner Lane, Leeds
LS7 1AX.

Tel: 0532 459453

OUR little green friend is back again in a new set of 40 screens. Repton Thru Time covers various periods of history ranging from prehistoric and Egyptian, through Victorian, the present day and into the future.

All the screens are Repton 3 standard and will load into any version – but you get the game and screen designer as usual so if you haven't any of the earlier versions you don't need to worry.

You start up with the prehistory screen set where Repton is wearing an animal skin and searching for the ultimate invention – the wheel.

On his way he eats the green berries and avoids the red ones; the



dinosaurs need crushing by the altered boulders.

Spirits have become pterodactyls and seek out their caves before turning into berries.

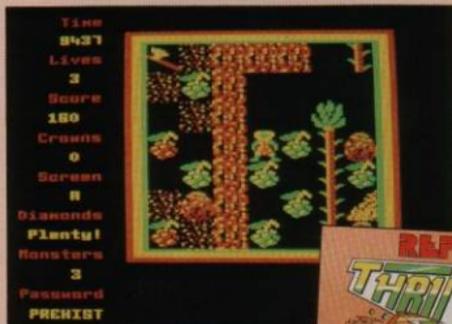
The first screen was nice and easy, reminding you gently of all the usual Repton tricks – but don't make any mistakes because you can only get out of the start area once before it becomes blocked.

Repton moves next into the Egyptian period with very brightly designed characters.

The first screen has an original start with two wicker baskets at either side of Repton falling and opening to reveal serpents. It certainly grabs your attention.

The spirits are now mummies seeking out their tombs. The rest of the screens are occupied by pyramids, scorpions and scrolls which you need to collect.

The next set of screens cover the



A prehistoric Repton

Victorian era. The character designs are less clear with Repton in a frock coat and most of the supporting blocks being gaslights.

There's a little social comment since the creeping fungus is represented by smoking factories. But again there's a nice easy run at first with a good stiff gradient as the screens progress.

There's another tricky start in the present day screen set. The usual Repton key is represented by the Excess card of which there are two next to where you start. There are no diamonds (cans of coke) available and no boulders (suitcases) to shift; all you can do is collect the cards – and take a really good look at the map before you do.

The monster has become a traffic warden and ale houses are the safes, spirits are represented by flying newspapers, which don't seem to quite fit with the rest of the screen concept.

The final set of screens is called Future and they are really hard. Empty spaces and earth are now stars,



Guide your green friend to safety



whereas skulls and fungus are black holes. Time capsules look like teleports and are called time wars.

The first screen would be easy if the characters were anywhere near normal – but as it was it took me ages to finish.

Pushing around the robots was easy enough, but you can't tell at a glance how they are being supported. Out of crashed spaceships come the BEMs – bug-eyed monsters – spirits are a different type of alien which convert Tie fighters into crystals, and if you grab a laser gun Daleks get changed too.

This Repton group of screens is reputed to be the last that's going to be produced – I wonder...

Steve Turnbull

Sound	7
Graphics	8
Playability	9
Value for money	8
Overall	8

Bubbling with fun

Program: *American Suds*

Price: £4.00

Supplier: Riverdale Software, 95 Prin-
ton Avenue, Manchester M9 3JW.
Tel: 061-795 4549

REGULAR readers will be aware as to how impressed I was with Riverdale's first release, *Suds*. Now hot on its heels comes the sequel, entitled oddly enough, *American Suds*.

Bufs of *Dynasty*, *Dallas*, *Hill Street Blues* and the rest will find all their favourite characters here, albeit in slightly disguised form – only the names have been changed to protect the guilty. This must be the spoof to out-spoof all spoofs.

You begin this four-part adventure on the concourse of a major British airport and soon realise that you are reliving part of Mel Brookes' hilarious *Airplane*. An airline pilot wanders by, muttering: "My name is not Shirley".

Once you have mustered a variety of artifacts, discovered the amusing password to the computer and collec-

ted your boarding pass, you can begin the adventure in earnest. Providing, of course, you survive the customs.

Once aboard the aircraft you may wish you had never bothered, as the gags come thick and fast. The humour is sick at its worst and at times outrageous. A tube of rubber solution, a spanner and a silk sheet are all you need to leave this flying deathtrap, but it will take some experimentation and head-scratching to manoeuvre your escape.

You must sign a contract in blood and step back in fashion if you wish to progress to part two and star alongside JR (Just Revolting) in the new series of *Dullus*.

In the remainder of this laugh-along type-in, you will meet Captain Gorilla of the Kill Street precinct and discover that smoking really is good for you.

I found getting into the shed to be the most perplexing problem of the entire game. I eventually became enlightened to the fact that a nihilist approach to examination was most rewarding. The funniest sketch has to

be that involving the mice and the Pie Wiper of Hamelin, but I'll leave you to unearth the true humour for yourself.

My one and only criticism is a familiar grouch on my part – the adventure is written using *The Quill*. All the usual limitations of parser, input and room description apply here, as they do in other *Quill*ed games. However, this adventure succeeds on every other score and will keep you in stitches for many hours.

Author David Edwards is fast becoming the unchallenged master of this genre of text adventures. I rate *American Suds* as more polished and funnier than anything from the Melbourne House stable and only perhaps equalled by Magus' majestic *Locks of Luck* and Riverdale's own *Suds*.

Pendragon

Presentation.....	7
Atmosphere.....	7
Frustration factor.....	9
Value for money.....	10
Overall.....	9

Disc-based adventures

Program: *Countdown to Doom*

Price: £9.95 (40T and 80T 5.25in disc)

Supplier: Topologika, PO Box 39, Stilton, Peterborough PE7 3RL.
Tel: 0733 244882

I HAVE never been much of a science fiction fan, but *Countdown to Doom* was always one of my favourite Acornsoft adventures. Now released in a totally rewritten and revamped form by its author Peter Killworth, this game is definitely worth a second look.

It is presented in a stylish black folder with an excellent hint sheet and superb pamphlet on playing adventure games.

The adventure has been greatly enlarged with extra locations and excruciating puzzles, a new parser and layered atmosphere at each location.

You play the role of a pilot of an interplanetary spaceship which has crash landed on the planet Doomawangara, a world at its best inhospitable and at its worst your graveyard.

It has a weird climate that varies from desert to jungle, glacier to swamp, and is the home of many crashed treasure ships.

Your task is to find spares to repair your ship so you can escape from this galactic hell hole. The problems are

manifold and even if you have solved the original Acornsoft version of this game, that is no guarantee you will be successful this time.

The discs still need to be collected and inserted in the order in which you found them, and the blob is still present, but is encountered much later on in the game.

The goggles are essential protection and the rat must not be harmed. Other than that, everything else in the adventure has changed almost beyond recognition.

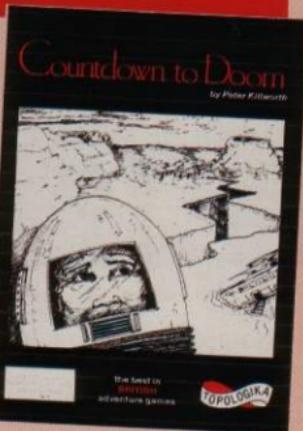
The beginning is complex, the main part of the adventure riddled with new problems and the end-game is quite novel.

The quest basically involves collecting an assortment of items and then deciding upon their correct use.

Even experienced adventurers will find themselves resorting to the hint sheet on more than one occasion and planning a new strategy or approach.

Peter Killworth has gone to great extremes to make the whole experience more polished and enjoyable. The constant disc-access slows down manoeuvres, but is worthwhile payment for a bigger and better game.

I wholeheartedly recommend this adventure, whether or not you have played the Acornsoft original. New



versions of *Acheton* and *Kingdom of Hamil* are promised and I await them with anticipation.

Pendragon

Presentation.....	10
Atmosphere.....	9
Frustration factor.....	8
Value for money.....	8
Overall.....	9

Costly addiction

Product: Tetris

Price: £8.99 (cassette), £12.99 (disc)

Supplier: Mirrorsoft, Athene House,
66-73 Shoe Lane, London EC4P 4AD.

Tel: 01-377 4645

TETRIS

MIRROR
Soft



WHEN I first read Mirrorsoft's rather spartan description on the packaging of its latest release, my first thought was that it looked like a rather simple game which would have all the appeal of a plate of soggy cabbage. Yet after only five minutes I was hooked. It's a very long time since I have sat up all evening, playing just one game.

First you enter your skill level – between 0 (novice) and 9 (super-human). I would suggest that you have a few practice games at the novice level first. But be warned. By the time you've finished practising, you'll be well and truly addicted.

One slightly annoying aspect is that immediately you select the level, the game starts. I would prefer a short countdown period first – just two seconds to position my hands over the correct keys would be useful, particularly at higher levels when things tend to be fast and furious.

The challenge starts with a shape which appears at the top of the playing field and begins to drop towards the bottom. As it is falling you can move it left or right or rotate it so that when it reaches the bottom it is positioned where you want it.

Now dexterity and quick thinking enter the scene. Immediately the first shape reaches the bottom, another – which can also be manoeuvred and rotated – appears at the top and starts to fall.

The idea is to manipulate the continuous supply of seven different shapes so that they fit together almost like a jigsaw puzzle – the object being to form complete, unbroken lines horizontally across the playfield.

When a line is completed it disappears and everything above it drops down into the empty space.

The difficulty lies in the fact that if a line has a space in it, it won't drop down. The game ends when the shapes have reached the top of the playfield, which is 20 lines high.

The scoring system is arranged so that you get a number of points for every shape which fits into the playfield and extra points for forming complete lines.

Your score is also modified by the level of the game – the higher the level, the higher the score. The lowest level is slow and you have plenty of time to manoeuvre the shapes – the highest level is so fast that you hardly



have time to realise what shape has appeared before it reaches the bottom.

As well as your score several other statistics are constantly displayed and updated on the screen. The useful ones are the total number of completed lines, the number of shapes which have been placed and the current level.

The inclusion of a table which tells you how many times each shape has appeared seems pointless. My guess is that when the game was prepared for release, someone decided the screen looked a bit empty so they decided to fill it up with something that would make things appear more complicated than they actually are.

The level of play increases after you have completed a number of lines. For instance, if you start at level zero the game automatically speeds up to level one once you have completed 11 lines. Level two starts at 21 lines, and so on. You can increase the level yourself by pressing the A key.

There are three other useful keys which you can use: X shows the next

shape that will appear, Z drops the current shape to the bottom extremely quickly and S allows you to turn off the sound, which comprises just a simple beep emitted when a shape reaches its resting place.

I noticed a small glitch when I tried to type in my name on the high score table. The delay before a depressed key started repeating must have been reduced for some reason and when typing in DESMOND I tended to end up with DESSMONND or some other strange mutation.

My only real criticism, however, has nothing to do with the game itself. I would like to know how Mirrorsoft can justify the exceptionally high prices for a game which looks to be a relatively simple piece of coding. And it's only fast enough to be fun on a Turbo Electron.

Desmond

Sound.....	6
Graphics.....	7
Playability.....	10
Value for money.....	5
Overall.....	9

This could slay you

Product: Barbarian

Price: £9.95 (tape)

Supplier: Superior Software, Regent House, Skinner Lane, Leeds LS7 1AX.

Tel: 0532 459453

AFTER the blaze of publicity that preceded this game's release, with an expensive advertising campaign featuring two rather well-built and scantily clad models, I was really looking forward to a game full of excitement and action.

I wasn't disappointed. This game is similar to Yie-Ar Kung Fu, only this time the figure you control uses a sword instead of his hands to fight opponents.

In this one or two player game the scenario is a fight against the 10 evil minions of the sorcerer Drax - and finally the sorcerer himself - in order to free the beautiful Princess Mariana. At first the opposition is easy to dispatch but as they get more proficient the task gets harder.

You can select your preferred keys for both players or you can play the game with a joystick. From there you are presented with the choice of combat practice or starting the game itself: The Fight to the Death.

The former gives you the choice of a demonstration which shows the 16 different fighting moves you can make, or you can practice against a passive opponent. The latter is useful, and it was while I was busy hacking away at some poor, helpless chap that I discovered it's possible to decapitate an opponent, which in turn leads to the most entertaining sequence in the whole game:

This involves a goblin-type creature which normally comes on at the left-hand side of the display once a combatant is dead, crosses the screen and exits at the right-hand side dragging the body behind him. If there's been a decapitation, the goblin collects the body as usual but casually

punts the head off screen.

While still in combat practice mode you can opt for either one or two player modes. In the first you are pitted against a warrior who you must defeat in order to have the privilege of fighting another, slightly more proficient, one.

This goes on until either you defeat 10 of them or, as is more likely, one of them beats you. A fight ends when one of the combatants has taken 12 hits or is decapitated. In the two-player mode you each control a warrior and fight against each other. The same victory conditions apply,



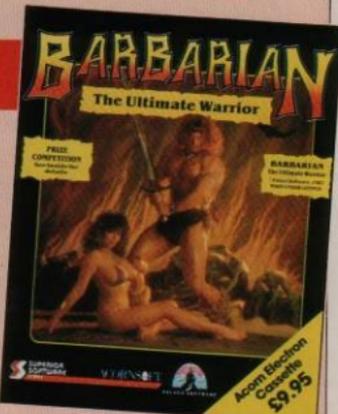
Fight to the death

but you also have the added pressure of having to complete the duel in 90 seconds.

If you do, by some miracle, manage to defeat all of the computer opponents you can enter Superior's own Barbarian competition.

The Fight to the Death is almost exactly the same as the combat practice mode. Again you can watch a demonstration, fight a passive opponent or a second player. The only difference is that if you opt for the Fight to the Death in one-player mode, you get to fight the evil sorcerer Drax after defeating the 10 Conan look-alikes.

Combat is punctuated by the sound of swords biting into flesh and the satisfying *thunk* as your warrior head-



butts his opponent. These few sound effects can be turned off. There is no signature tune, which some would say is a blessing, but I find Superior's tunes are better than most and it's unusual for them not to bother with one.

My only disappointment was with the graphics. I've no grumble with the quality - which is excellent - but I was disappointed with the quantity. There seem to be only four screens, and the two arena ones featured on the packaging are the only ones I've come across in Fight to the Death mode.

You begin fighting in front of someone sitting on a throne. In the second bout you face your opponent in front of Drax and the captive Mariana - who, by the way, bears no resemblance to the young lady featured on the packaging. Then it's back to the man on the throne again and so on.

The other two screens only appear in the combat practice mode. Again they alternate, this time featuring two wilderness scenes, the first in daylight and the second at night.

Another point is that your adversaries are exact clones of your warrior except that yours is wearing a white vest. Even so, there have been a few times when I've smugly watched one of the warriors making mincemeat out of the other congratulating myself on some nifty swordwork, only to realise that it's the bad guy who was doing the hitting.

If you are a fan of games which simulate physical combat, martial arts and the like, you will find Barbarian an excellent addition to your collection. To it's credit, Barbarian has little for me to criticise.

Desmond



The goblin undertaker

Sound.....	5
Graphics.....	9
Playability.....	9
Value for money.....	8
Overall.....	8

Let's finish off Snapper

BEFORE I get this month's column under way I would like to correct an error that appeared in the listing of the Snapper upgrade we printed in the March 1988 column.

The original listing included the line:

1788 ENDPROC

but unfortunately this disappeared somewhere on the long trek between my disc and the finished page.

I would also like to answer and expand on Peter Davey's letter - Micro Messages May - commenting on my call in the February issue for games to take advantage of the Slogger Master Ram Board.

I mentioned at the time that Pendragon has been bringing news of BBC Micro adventure games that work with the Electron + MRB. Because most adventure games are text-only, they use legal operating system printing routines - there's no reason for them not to.

However, as Mr Davey rightly pointed out, arcade games hinge on graphical output and inevitably poke the screen memory directly in order to save time.

In a case where the screen memory is resident in shadow ram, or on the "wrong" side of

the Tube in a dual-processor system, this technique would not work, because the game would be manipulating the wrong area of memory.

Accessing the screen legally invariably slows everything down, and I would not have made my point but for the fact that the MRB provides more than just extra memory - it also incorporates Slogger's Turbo Driver.

This very useful add-on - which is, incidentally, available separately - boosts the running speed of the Electron up to that of big brother.

The MRB has a three-way switch: Normal, Turbo and Shadow Ram plus Turbo Driver. Therefore any decrease in speed from the legal screen calls would be offset by the increase in machine speed.

The MRB has become a standard add-on for any Electron owner wanting to extend the power of his machine, and I hope that programmers and software houses will consider the 64k Electron as a viable and supportable machine in its own right.

Certainly software needs to progress all the time, and there are few enough BBC Micro games that take advantage of the many near-standard memory expansions available for that machine, so let's hear it for the Electron.

THIS month's column is composed almost entirely of lists of passwords. To start you off, here are the passwords for Repton's intercontinental jaunt, Around the World in Forty Screens.

Taking a trip with Repton

A	AMERICA 52465	ARCTIC 25363	ORIENT 10019
B	CURTAIN 57036	DIAMOND 20049	THRUST 47727
C	VAMPIRE 2457	RUBBISH 44028	COLONEL 29389
D	CREATED 2560	MANAGER 10455	PERSONS 29842
E	LUNATIC 16961	PACKAGE 10279	CRICKET 48573
F	MAXIMUM 15699	PRIVATE 43587	TUNNELS 13365
G	COMPOSE 56696	CAPITAL 8380	INTENSE 34674
H	COLOURS 10568	DUNGEON 21510	GALLERY 36424

A	OCEANS 34645	AFRICA 53997
B	MAGENTA 44092	WELCOME 54996
C	ELECTED 15334	WORKING 36857
D	DISEASE 14536	FIREMAN 13942
E	THEATRE 14089	KESTREL 25155
F	DREAMER 16710	REFRACT 26421
G	CURRENT 55086	ADDRESS 39304
H	GENERAL 13003	RECEIVE 51901

Codes with Impact

THESE are the 80 screen editor codes for Audiogenic's Impact.

1: AEMYPP	28: LKCOH	55: NCFAA
2: GWIYP	29: BEPOA	56: MSBAA
3: ICEYP	30: AKLQM	57: KAOAA
4: LMA YA	31: HCHQG	58: GIKAI
5: HCN YI	32: PCDQH	59: OWGAN
6: HOJYA	33: BKMIP	60: IACAE
7: COFYP	34: AEIIA	61: LSPA I
8: CYBYA	35: MIEIK	62: AELAA
9: FQOYI	36: GAAIA	63: PWHAI
10: IGKYA	37: GANIA	64: OMDAM
11: JMGYA	38: MSJIA	65: IQMAI
12: MECYP	39: IEFIL	66: PEIAP
13: BAPYA	40: DEBIA	67: JUEAM
14: JELYA	41: AKOIE	68: BUAAK
15: KCHYA	42: LAKIA	69: BSNAH
16: JIDYA	43: KCGIA	70: PCJAI
17: OEMQP	44: KQCIA	71: CCFAI
18: BMIQP	45: NSPIH	72: CIBAI
19: HUEQA	46: BGLIA	73: LEOAE
20: LMAQM	47: BUHJI	74: HCKAH
21: KWNQI	48: EADIP	75: FCGAH
22: GKJQA	49: EOMAK	76: LYCAH
23: JEFQA	50: LAIAD	77: EIPAD
24: FGBQA	51: JGEAM	78: JSLAB
25: HSOQQ	52: FWA AF	79: JIHAP
26: DOKQE	53: PCNAF	80: FADAK
27: MOGQP	54: GUJAI	

Turn to Page 26 ▶

◀ From Page 25

David Taylor has written in to ask for maps for Ravenskull. Level one appeared in the first Arcade Corner in the September 1987 issue of

Electron User and level two appeared in the December 1987 issue — both available from the back-issues department.

Ravenskull: Level one
 — Superior Software

THIS month we take a departure from the norm, and present a full step-by-step solution to level one of Ravenskull. To finish each of the four screens, you must collect each piece of treasure and then pick up the quarter of the crucifix.

First you must take the green and blue key just to the left of your starting position, then travel anticlockwise around the outer wall of the castle until you come to the spiked gate on the extreme left-hand side.

Make sure that you are standing just in front of the gate and use the key to open the top section. Drop the key outside — it is of no further use to you — and go inside.

Go downwards and take the pickaxe, then return to the main entrance. Head North and explore the surrounding area, making sure that you pick up the scroll and all the treasure. Use the scroll straight away, then abandon it.

It actually opens the back door to the castle — next to where you found the pickaxe — so you can get back into the castle if you are unfortunate enough to get killed.

Go up at the crossroads until you can see the Ravenbee buzzing backwards and forwards. Wait just below it until it has just passed you, then follow it and duck into the little alcove.

Run out as soon as it has passed you and make your way to the North-west corner of the castle.

Take great care not to fall into the acid pools: One careless step and you will be thrown back outside the castle.

Take the green and magenta key in the Northwest corner and collect the three pieces of treasure from the far end of that passage, then return to the main entrance of the castle.

Go to the East: You will come to another crossroad with a roundabout in the middle. The other three exits are blocked by spiked gates. Walk up the path leading North and use the G/M key to open the gate.

As before, you might as well drop this key around the roundabout because, like most of the objects that you will find throughout the game, it can only be used once. Move North, not forgetting to collect the lone treasure, until you come to the four gates.

Enter the first on the right; pick up the scroll and use it. Do not go straight up, or the second door on the right will close, blocking off your only means of returning here.

When you use the scroll you will be transported to the bottom right-hand corner of the castle. Drop the scroll where you reappear, then take the pickaxe that is at the end of the passage to your left.

Make your way North, collecting all the treasures, until you eventually come out through the door above the one through which you found the second scroll.

Don't go straight across, but go down one

pace so that you are standing in front of the wall between the two left-hand rooms.

Use both pickaxes to dig out this wall, so you can get into either room and back out again without going through the doors. Go into the upper room, take the treasure and the magenta and blue key and drop both pickaxes.

Go back down to the roundabout and use the M/B key to open the lower gate. Don't go down just yet — collecting the treasure piece immediately below you will cause a spiked gate to appear immediately to your right, blocking off a large section of the game.

Instead, clear all the treasure pieces from the right and left-hand passages. When you get to the bottom of the passages down the left-hand side just above the Ravenbee, wait as before, then follow it and go up when you come to the second break in the wall.

Collect the treasure and move to the bottom left-hand corner of the castle, and collect the scroll.

Don't use it yet, but go back to the right avoiding the Ravenbee and duck up the entrance surrounded by acid pools — the one you bypassed on the way in. Collect the treasure, and return to the roundabout.

Stand in front of the right-hand gate and open it with the scroll. Beware — this one reappears as soon as you have gone through.

Collect all the treasure and the pickaxe before going down: Make absolutely certain you have got everything, because two boulders slam together as you pass, blocking off your retreat.

Pick up the two treas-

ure pieces from the room with the two Ravenbees: Take great care — it's not easy. Walk around this room, not forgetting the treasure piece, until you come to the left-hand side of the Ravenbee room. The coffins in the room below will do you no harm — they're just a bit unnerving.

Go up and take the first turning on the right. Don't go straight up, because the two spiked gates will move to block off both the right-hand entrance and the way back. Pick up the scroll and drop it behind you. Don't use it: It is a trap and will kill you instantly.

Follow this path to its conclusion, then use the pickaxe to take out the section of wall immediately above you. Go through and drop the pickaxe, then pick up the treasure and the second green and blue key.

Go through the spiked doors and collect the treasure in front of you. This will cause another spiked door to appear behind you, but don't worry — you've completed that section. Go down and pick up the last two pieces of treasure, then return to the roundabout.

Go North and duck into the first room you come to (just before the four rooms with the slamming doors). Use the key to open the door, go through and pick up the first piece of the crucifix: You have now completed level one of Ravenskull.

If, when attempting to pick up the crucifix, you get the message *treasure?*, it means that somewhere along the way you have missed one or more of the pieces of treasure.

Unfortunately, this almost certainly means that you will have to start the assault on Castle Ravenskull all over again.

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Wild goose chase

Fox your Electron in this classic board game by CHRIS NIXON

FOX and Geese is a computerised version of the popular board game, but with one or two enhancements.

One player takes the part of the goose, represented by a white pawn, while a second player controls four foxes, represented by black pawns.

The object is simply to prevent the goose from breaking through the line of foxes and reaching the other side of the board.

The goose starts at the top of the board, and the foxes start on the last row at the bottom.

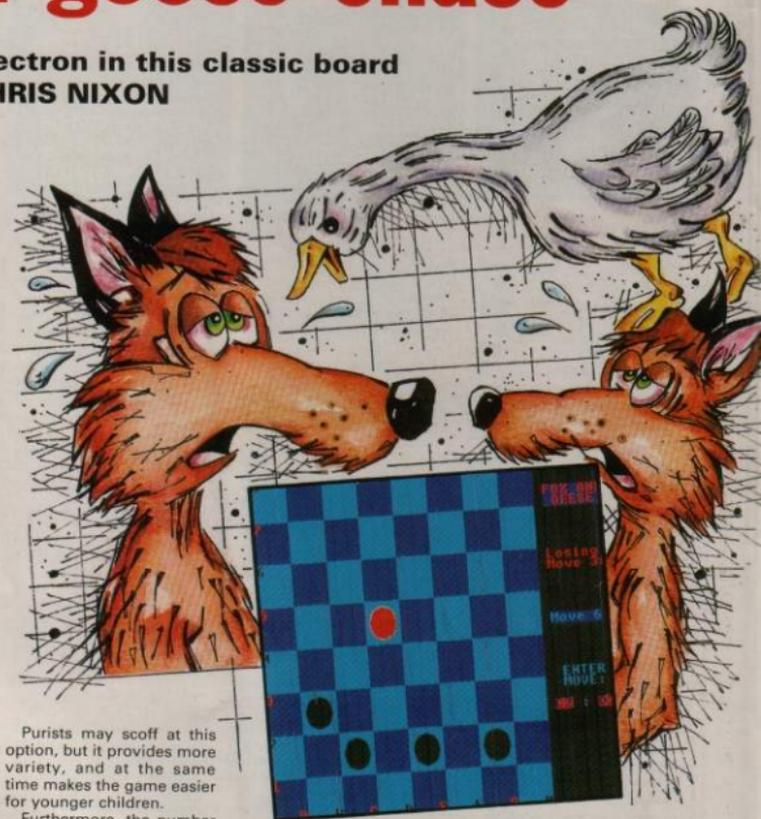
If the four foxes manage to corner the goose so that it cannot move, you have won the game.

In this computerised version, the Electron takes the goose's part, and you have to prevent its passage across the board.

Moves are very simple — all pieces can move just one square diagonally, but the foxes cannot normally move backwards. The first variation in this version is that you will lose by default if you fail to trap the goose within a set number of moves.

This limit on moves is chosen at the start of each game by selecting a difficulty level between one and five. One represents a maximum of 30 moves — for a relatively easy game — while five allows you only 20.

The second difference is that you have a choice as to whether your foxes can move forwards only, or backwards as well.



Purists may scoff at this option, but it provides more variety, and at the same time makes the game easier for younger children.

Furthermore, the number of foxes in play may be set to either three or four, providing yet another level of difficulty. These three options together allow the game to be better matched with individual playing skills.

Once your choices are made, the board will be drawn and the maximum moves allowed displayed. You will then be asked for your first move.

Input is made in the same way as with modern chess computers, that is, a grid reference system is used

where a letter and number represent the horizontal and vertical position of the target piece.

To make this easier, the bottom row of the board is marked with the letters A to H, and the left hand column with the numbers one to eight. Enter the letter representing the piece's column first, followed by the row number.

There is no need to press Return after each entry, as the keyboard is read using the GET function. The Electron will reply very quickly

to your move, and will check at this point whether it has been successfully hemmed in.

If it has, the game will be awarded to you. Otherwise, it moves the goose and checks to see whether it has reached the far edge of the board yet. If so, you lose.

Nine separate rules are built into the goose's strategy, and you may be surprised as to just how wiley it can be. The rules tell it to avoid obvious traps, but if you are patient and devious, you can surprise it.

```

10 REM Fox and Geese
20 REM by Chris Nixon
30 REM (c) Electron User
40 REM
50 IF PAGE=6000 THEN 100
60 *FX12,0
70 *Wk,0 *T: *FOR11=0*TO*O
P=PAGE:STEP1:11:600:1:PAGE
:NEXT:IMAGE:600:MOLD:MINUM
80 *FX138,0,128
90 END
100 PROCSetup:REPEAT:MOVE1
:VDU23,8200,0,0,0:PROCnewga
me:PROCboard
110 REPEAT:PROCplay:UNTIL
win% OR lose%
120 COLOUR3:COLOUR128:CLS:
IF lose% PRINT "WIN!":FORL
=100 TO 100 STEP 5: SOUND1,
-10,LS,1: NEXT ELSE PRINT "YOU
WIN!":FORL=100 TO 200 S
TEPS: SOUND1, -10,LS,1: NEXT
130 REPEAT:ANTHORGAME?
(CY / N):PRINT:GS:GETS:UNTI
L60="YORG6=N":UNTILGS="N"
140 END
150 DEFPROCSetup:DIM board
%(7,7),fox%(3,1)
160 VDU23,232,0,3,15,31,63
,63,127,127
170 VDU23,233,126,255,255,
255,255,255,255
180 VDU23,234,0,192,248,24
8,252,252,254,254
190 VDU23,235,127,255,255,
255,255,255,127
200 VDU23,236,255,255,255,
255,255,255,255
210 VDU23,237,254,255,255,
255,255,255,254
220 VDU23,238,127,127,63,6
3,31,15,3,0
230 VDU23,239,255,255,255,
255,255,255,126
240 VDU23,240,254,254,252,
252,248,248,192,0
250 ENDPROC
260 DEFPROCnewgame:VDU19,1
,A,0,0,0,19,2,6,0,0,0,19,3,1

```

```

,0,0,0
270 COLOUR2:COLOUR129:FORY
(1103:PRINTTAB(12,Y):STRING
5(17,7):NEXT:PRINTTAB(14,2
)FOX AND GEES:COLOUR3:COL
OUR128:PRINT"SP3By Chris
Nixon (c) Electron User"
280 COLOUR2:PRINTTAB(4,12)
"Counters move backwards (V
/N)":PROCkey("V"):PRINTGS:
IFGS="v"back%+TRUE ELSE bac
k%+FALSE
290 PRINT "SP3"Three or
four counters (3/4/1):PROC
key("34"):PRINTGS:max%+ASC(G
3)-49
300 PRINT "SP3"Difficult
y (1=easy 5=hard):?:PROCke
y("12345"):PRINTGS:max%+18
+(10-ASC(G3-49))*2
310 FORX=0 TO max%:fox%(X,
0):X+2:=1:fox%(X,1)=0:board
I(fox%(X,0),fox%(X,1)):N
EXT:fox%+4:=5:fox%+0:move%
+1:win%+FALSE:lose%+FALSE
320 CLS:COLOUR3:COLOUR
PRINTTAB(33,2)FOX ANDTAB(3
3,3) GEES:VDU28,33,25,39
,0
330 ENDPROC
340 DEFPROCplay:PROCPlay%
:PROCCount:move%+move%+1:
Ifmove%+max%V lose%+TRUE:EN
DPROC ELSE ENDPROC
350 DEFPROCboard:FORX=0 TO
7:FORX=0 TO7:COLOUR:COLOUR(X,Y
3):NEXT:NEXT
360 VDU5:GC0L3,2:FORX=0 TO
7:MOVEX%+128+96,31:PRINTCHR
S(65+X):NEXT
370 FORY=0 TO7:MOVEV,Y+12
8:128-PRINTCHR(49+Y):NEXT
380 FORL=0 TO7:PROCpiece
e(fox%(L,0),fox%(L,1),1):N
EXT:PROCpiece(gx%,gy%,2):END
PROC
390 DEFPROCsquare(X%,Y%):G
COLB,(CX+MOD2)EOR(Y+MOD2))+1
:MOVEX%+128,Y%+128:PLOT1,0,1
:24:PLOT1,124,0:PLOT81,-124,-
124:PLOT81,124,0:board%(X%,Y
2)=0:ENDPROC
400 DEFPROCpiece(X%,Y%,TX)
:VDU5:MOVEX%+128+17,Y%+128+1
1:1:FT%+2 GC0L3,3 ELSE GC0L0
,0
410 VDU232,233,234,10,0,8,8
,8,235,236,237,10,0,8,8,238,2
39,240:VDU4:board%(X%,Y%):TX
:ENDPROC
420 DEFPROCwipe(X%,Y%):GC0
LB,POINT(X%+128+8,Y%+128+4):
VDU5:MOVEX%+128+17,Y%+128+11
:VDU232,233,234,10,8,8,8,23
5,236,237,10,8,8,8,238,239,2
40:VDU4:board%(X%,Y%):ENDP
ROC
430 DEFPROCPlay%:REPEAT:C
OLOUR3:COLOUR128:CLS:PRINT"L
osing Move ";max%V:COL
OUR2:COLOUR129:PRINT"Move ";
move%V:COLOUR128:PRINT"E
NTER"" MOVE:"":CHR$13

```

```

440 COLOUR1:COLOUR131:PRO
key("ABCDEFHG"):PRINTGS:Y%
+ASC(G8)-65:PROCkey("1234567
8"):PRINTGS:COLOUR2:COLOUR
128:PRINT " ?"
450 COLOUR1:COLOUR131:Y%+
ASC(G8)-69:PROCkey("ABCDEFHG
"):PRINTGS:Y%+ASC(G5)-65:P
ROckeY("12345678"):PRINTGS:Y
2:ASC(G8)-69
460 IF board%(X1,Y1)<=1
OR board%(X2,Y2)<=0 OR ABS
(X2-X1)<=1 OR (back% AND A
B%Y2-Y1)<=1) OR (NOT bac
k%)AND Y2<=Y1) UNTIL
470 UNTILTRUE:fox%=-1:REPE
AT:fox%+fox%+1:UNTILfox%(X1
,0)=X1X AND fox%(fox%,1)=fo
x%:PROCwipe(X1,Y1):PROCpiec
e(X2,Y2,1):fox%(fox%,0)=X2
1:fox%(fox%,1)=Y2:ENDPROC
480 DEFPROCkey(AS):REPEAT:
GS=GETS:PI=INSTR(AS,GS):UNTI
LPI=0: SOUND1, -10,198,2:ENDP
ROC
490 DEFPROCComputer
500 REM **** RULE 1 ****
510 choice%+RND(2)
520 IF choice%2 IF gx%>0
IF gy%<1 IF board%(gx%-1,gy%
-1)=0 PROCwipe(gx%,gy%):gx%
=gy%-1:gy%+Y%:1:PROCpieceg
%,gy%,2):lose%+TRUE:ENDPROC
530 IF gx%<1 IF gy%<1 IF b
oard%(gx%+1,gy%+1)=0 PROCw
ipe(gx%,gy%):gx%+X%+1:gy%+Y%
-1:PROCpiece(gx%,gy%,2):lose
%+TRUE:ENDPROC
540 IF choice%1 choice%2:
GOTO520
550 REM **** RULE2 ****
560 choice%+RND(2)
570 IF choice%2 IF gx%>1
IF gy%<1 IF board%(gx%-1,gy%
-1)=0 IF board%(gx%-2,gy%-2)
=0 PROCwipe(gx%,gy%):gx%+X%
-1:gy%+Y%:1:PROCpiece(gx%,g
y%,2):ENDPROC
580 IF gx%<6 IF gy%>1 IF b
oard%(gx%+1,gy%+1)=0 IF boar
d%(gx%+2,gy%+2)=0 PROCwipe(g
x%,gy%):gx%+X%+1:gy%+Y%:1:
PROCpiece(gx%,gy%,2):choice%
590 IF choice%1 choice%2:
GOTO570
600 REM **** RULE3 ****
610 IF gx%>2 IF gy%>1 IF g
y%<7 IF board%(gx%-1,gy%+1)=
0 IF board%(gx%-3,gy%+1)=2 I
F board%(gx%-2,gy%+1)=1 IF b
oard%(gx%,gy%-2)=1 PROCwip
e(gx%,gy%):gx%+X%+1:gy%+Y%+1
:PROCpiece(gx%,gy%,2):ENDPRO
C
620 IF gx%<5 IF gy%>1 IF g
y%<7 IF board%(gx%+1,gy%+1)=
0 IF board%(gx%+3,gy%+1)=1 I
F board%(gx%+2,gy%+2)=1 IF b
oard%(gx%,gy%-2)=1 PROCwip
e(gx%,gy%):gx%+X%+1:gy%+Y%+1
:PROCpiece(gx%,gy%,2):ENDPRO
C
630 REM **** RULE4 ****
640 IF gx%>0 IF gy%<1 IF b
oard%(gx%-1,gy%+1)=0 IF boar
d%(gx%,gy%-2)=0 PROCwip
e(gx%,gy%):gx%+X%+1:gy%+Y%+1:PR
OCpiece(gx%,gy%,2):ENDPROC

```

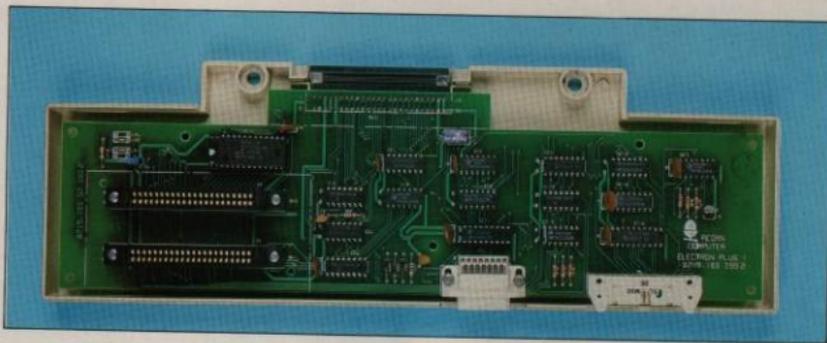
```

650 IF gx%<7 IF gy%>1 IF b
oard%(gx%+1,gy%+1)=0 IF boar
d%(gx%,gy%-2)=0 PROCwip
e(gx%,gy%):gx%+X%+1:gy%+Y%+1:PR
OCpiece(gx%,gy%,2):ENDPROC
660 REM **** RULE5 ****
670 IF gx%>1 IF board%(gx%
+1,gy%+1)=0 IF board%(gx%+2,g
y%+1)=0 IF board%(gx%+2,gy%+2)
=0 IF board%(gx%,gy%-2)=1 PR
OCwip
e(gx%,gy%):gx%+X%+1:gy%+Y%+1:PR
OCpiece(gx%,gy%,2):ENDPROC
680 IF gx%<6 IF gx%>0 IF g
y%>1 IF gy%<7 IF board%(gx%-1,gy%
+1)=0 IF board%(gx%+2,gy%+2)
gy%+1 IF board%(gx%+2,gy%+2)
=1 IF board%(gx%,gy%-2)=1 PR
OCwip
e(gx%,gy%):gx%+X%+1:gy%+Y%+1:PR
OCpiece(gx%,gy%,2):ENDPROC
690 REM **** RULE6 ****
700 IF gx%>1 IF gy%>1 IF g
y%<7 IF board%(gx%-2,gy%+2)=
1 IF board%(gx%+1,gy%+1)=0 P
ROc
wip
e(gx%,gy%):gx%+X%+1:gy%+Y%+1:PR
OCpiece(gx%,gy%,2):ENDPROC
710 IF gx%<6 IF gy%>1 IF g
y%<7 IF board%(gx%+2,gy%+2)=
1 IF board%(gx%+1,gy%+1)=0 P
ROc
wip
e(gx%,gy%):gx%+X%+1:gy%+Y%+1:PR
OCpiece(gx%,gy%,2):ENDPROC
720 REM **** RULE7 ****
730 IF gx%>6 IF gy%<7 IF b
oard%(gx%-1,gy%+1)=0 IF boar
d%(gx%+1,gy%+1)=0 IF board%(
gx%,gy%-2)=1 PROCwip
e(gx%,g
y%):gx%+X%+1:gy%+Y%+1:PR
OCpiece(gx%,gy%,2):ENDPROC
740 IF gx%>1 IF gy%>7 IF b
oard%(gx%+1,gy%+1)=0 IF boar
d%(gx%+1,gy%+1)=0 IF board%(
gx%,gy%-2)=1 PROCwip
e(gx%,g
y%):gx%+X%+1:gy%+Y%+1:PR
OCpiece(gx%,gy%,2):ENDPROC
750 REM **** RULE8 ****
760 choice%+RND(2)
770 IF choice%2 IF gx%>0
IF board%(gx%-1,gy%+1)=0 PR
OCwip
e(gx%,gy%):gx%+X%+1:gy%+Y%+1:PR
OCpiece(gx%,gy%,2):ENDPROC
780 IF gx%<7 IF board%(gx%
+1,gy%+1)=0 PROCwip
e(gx%,g
y%):gx%+X%+1:gy%+Y%+1:PR
OCpiece(gx%,gy%,2):ENDPROC
790 IF choice%1 choice%2:
GOTO770
800 REM **** RULE9 ****
810 choice%+RND(2)
820 IF choice%2 IF gx%>0
IF gy%<7 IF board%(gx%-1,gy%
+1)=0 PROCwip
e(gx%,gy%):gx%+X%+1:gy%+Y%+1:PR
OCpiece(gx%,gy%,2):ENDP
ROC
830 IF choice%1 choice%2:
GOTO820
840 win%+TRUE:ENDPROC

```



Turn to port is a good move



In Part I of his latest project, JOE PRITCHARD introduces the Plus 1's cartridge expansion ports

WE take our leave of the analogue to digital converter of the Plus 1 for a while, as we begin a study of its cartridge slots.

These are designed primarily to hold rom cartridges, allowing the Electron to make use of rom software, even though it hasn't got the spare rom sockets possessed by the BBC Micro.

The boffins at Acorn obviously considered cartridges to be a good idea, as they incorporated similar cartridge slots – which are almost identical in specification – into the BBC Master.

Some games, several languages and some applications programs such as Iso-Pascal and View have been available on cartridge format for a long time, and have proved quite popular with Electron users.

This is because cartridge-based programs don't require any of the Electron's internal ram for program

storage – it's left completely free to hold any data needed by the rom software.

However, while the cartridge slots were originally intended for this purpose alone, they can be used for many other applications, thanks to a variety of control signals being present in each slot.

All the address lines of the 6502 microprocessor and the data bus – the internal connections which carry numbers and program instructions around the innards of the computer – are present in the cartridge ports.

Indeed, the connections made available to us are very similar to those on the BBC Micro's 1MHz bus, and several hardware manufacturers have made good use of this fact to produce cartridges that contain additional useful peripheral devices, such as I/O ports and joystick adaptors.

In fact, I reviewed the

Project Expansions I/O port in the March 1987 issue of *Electron User*, and this device was designed to be plugged into a cartridge slot.

Hardware add-ons can also be connected to the Electron via the expansion slot that the Plus 1 plugs into, so why not use this for interfacing instead? The reasons are:

- Some of the connections available at the slots are only available from the Electron by combining other signals together. If we used the edge connector, we'd have to do this ourselves, thus making our circuits more complicated.

- You've probably noticed that after plugging in the Plus 1, the expansion slot is no longer available for anything else. There are ways around this, but it's much easier to leave it alone and use the cartridge slots.

Before proceeding fur-

ther, some new terminology needs to be introduced. When discussing the signals available to us at the cartridge ports, the following terms will be used:

- **High:** A signal at logic one, or 5V.

- **Low:** A signal at logic zero, or 0V.

- **Active high:** A signal that is normally at 0V, but which goes high when in use.

- **Active low:** A signal which is normally high, but which goes to 0V when it is in use. In diagrams, an active low signal is often written with a horizontal line above the name of the signal.

- **Address line:** A connection to the 6502 microprocessor used to address the memory map of the computer.

The Electron, as you're probably aware, has 65536 bytes of memory available, with roughly half taken up by ram and half by rom.

Sixteen address lines are

needed to handle this, labelled A0 to A15, and a particular memory location is selected by placing a pattern of 5V and 0V signals upon these address lines, where 5V represents a one and 0V represents zero.

The actual address selected by a given pattern on the address lines is given as follows:

Assume that A1, A2, and A7 are all 1 while the other address lines are all set to 0.

The address selected is $2^1 + 2^2 + 2^7$, which is address 134 in memory. If A15 had also been set to one, the address selected would be $2^1 + 2^2 + 2^7 + 2^15$, which is 32902.

● **Data line:** A connection to the 6502 microprocessor in the Electron used to carry data or program instructions between the memory and the 6502. There are eight, labelled D0 to D7.

● **Control line:** These are signals generated by the 6502 to organise the workings of the computer. For example, a particular control line will determine whether a selected address is to be read from or written to.

● **Memory pages:** The Electron memory is said to be split into pages. Don't confuse this with paged ram or paged rom. An Electron memory page is 256 bytes long, so page zero is from address zero (&00) to 255 (&FF), page one from 256 (&100) to 511 (&1FF) and so on.

Sorry about all that - I don't intend to turn the article into a dictionary of computing terms. Let's now move on to examine a cartridge slot in detail.

Physically, the connection method used is a double sided, 22 way, 0.1 inch pitch edge connector. Anything that is to plug into the cartridge slot must be built in such a way that the connections on the add-on circuit are linked to the correct pins on the cartridge slot.

If you examine the business end of any rom cartridges, you'll see that manufacturers achieve this by using a double sided

printed circuit board and bringing the connections out to the edge of the board.

Normal 0.1 inch veroboard cannot be used to make the connection, because the copper strips are only on one side - the cartridge slot needs connections to be made on both sides of any circuit board inserted into the slot.

Don't worry, though. When we come to look at some practical circuits, I'll describe some construction techniques that will allow us to make full use of the slot without difficulty.

Those of you who are micro veterans will remember the 16k ram packs available for the ZX81. These interfaced to the machine in the same way that cartridges do with the Plus 1, but were notoriously prone to crashes as the ram pack wobbled, causing intermittent connections.

Fortunately the cartridge slot in the Electron isn't prone to this sort of problem, as the Plus 1's body offers support to cartridges plugged into the machine.

Most reference books refer to the side of the slot that is closest to the keyboard as the near - or B - side and the side closest to the back of the Electron as the far - or A - side.

The most useful connections available are:
A22, B22 - the zero volt lines. All add-ons connect their 0V lines to one of these points. These are internally linked to one another, and to the digital and analogue grounds of the ADC.

A1, B1 - the +5V lines. These are used as the power sources for add-ons that are to be using the cartridge slot.

The Electron power supply is capable of sourcing about 50mA for simple circuits, but for more complex devices it's a good idea for them to provide their own power.

B9 - the -5V line. Some devices, such as analogue to digital converter chips, require a -5V as well as a +5V supply. This, however, can only give us 20mA, and you should take care when

using it.

A20 - the +5V line. This isn't the same as the 5V lines discussed above - the 5V offered here is via a 4.7k resistor.

All eight of the 6502 data lines are made available to the user at the cartridge slot. These are arranged as follows:

D8	D19
D1	D21
D2	D28
D3	D3
D4	D9
D5	D8
D6	D7
D7	D6

These lines assume a value of 5V when carrying logic one, and 0V when carrying logic zero. However, they cannot supply much current, and the only things which we can safely connect to them are suitable logic chips, which I'll discuss next month.

Under no circumstances should you try and use the data lines to drive things like LEDs or relays directly, or through transistor switches. At best you'd crash the computer, at worst you could quite easily seriously damage the Electron.

The values on the data lines are changing all the time, flipping from zero to one, as different pieces of data are passed around the computer system.

In addition, sometimes the data lines will be carrying data from the memory to the 6502, and at other times they will be carrying information from the 6502 to memory. The eight data lines are collectively called the data bus.

Although the 6502 has 16 address lines, they're not all brought out to the cartridge slot.

Instead, we get the lines A0 to A13 and two extra address lines, called NPFC - Not Page &FC - and NPFD - Not Page &FD.

The address lines A0 to A13 function as described above, and they always carry information away from the 6502 processor to the rest of the computer system. Collectively they are

referred to as the address bus.

A8	-	B18
A1	-	B17
A2	-	B16
A3	-	B15
A4	-	B14
A5	-	B13
A6	-	B12
A7	-	B11
A8	-	A5
A9	-	B5
A18	-	B2
A11	-	B4
A12	-	A7
A13	-	A6

NPFC - pin A14 on cartridge slot - goes from 5V to 0V whenever the 6502 uses memory page &FC, which includes all addresses from &FC00 to &FCFF.

On an Electron, some of this page is used by the system and other parts of it are left on one side for the user to add his or her own devices into this area.

Thus by combining this signal together with some of the address signals using suitable logic gates, we can design a circuit that shows up at a particular location in page &FC. This is known as memory mapping a hardware device.

Of particular interest to us are the addresses from &FCB0 to &FCBF, which are provided to cater for the addition of a 6522 VIA, of the type used by the BBC Micro in its user port.

Also of interest are the addresses from &FCF0 to &FCFE, which are available for anything we care to think of. All other page &FC locations have been earmarked by Acorn for a particular function.

NPFD goes low whenever a memory address in the range &FD00 to &FDFF is accessed by the Electron. This page is intended to be used as an extended memory space, allowing access to 64k of ram or rom in 256 byte chunks. However, this memory is painfully slow to use.

● *Next month we'll look at control signals, and see how we can build a very simple input port to allow the Electron to read digital signals from the outside world via a cartridge slot.*

ONE of the first, and now the most common, way of expanding the basic Electron and Plus 1 is with a rom expansion board of some sort.

There are two main types: Those that fit inside the Plus 1, like the AP6, reviewed in the May 1988 issue of *Electron User*, and those that plug into one of the two cartridge sockets.

This latter type is by far the most common, and now Jafa Systems has added its own cartridge – the Romplus-144 – to the half dozen or so already available. So what advantages does this offer?

The problem with rom expansion boards that plug into the cartridge slots is that only two roms can be mapped into each. The rear socket can hold roms zero and one, while the front socket can hold roms two and three.

The Jafa cartridge, constructed in matching Acorn cream plastic, contains nine sockets. One houses the Romplus-144 operating system, and in the review cartridge another contained a 32k ram chip – an optional extra.

This leaves seven sockets free for your roms. However, the Electron will only allow two roms per cartridge slot. The purpose of the Romplus operating system – which occupies one position – is to control selection of one of the seven other roms, or the ram chip.

There are several new star commands, and *HELP ROMEX prints a list, plus all the roms present. To select a rom *RSELECT is used. This resets the Electron, so care is needed when using it.

The Help message of any rom can be printed with *RHELP, and a command passed to a non-selected rom with *RCOMMAND. A rom can be disassembled with a fairly basic utility called with *RDISASSEMBLER, and can be saved to disc or tape with *RSAVE.

You can load rom images into the 32k ram chip with *RLOAD, and then the chip

can be selected like any other rom.

Two 16k roms can be loaded into the 32k ram with *RSUBSTITUTE, and this command locks out the Romplus operating system, enabling both ram-based roms to be initialised.

The 32k ram in the Romplus can be used as a ram disc, emulating the rom filing system. Its small size severely limits its usefulness, but for what it's worth, you can *BUILD text files, print them with *TYPE, copy from/to tape or disc with *COPY and *DUMP, and delete files with *DELETE.

These commands are filing system sensitive. So if you've selected the disc filing system, the ram commands are ignored, and are only used when the rom filing system is selected with *ROM.

Alternatively, you can use the ram as a 16k printer buffer. It is selected with the command *RBUFFER, and

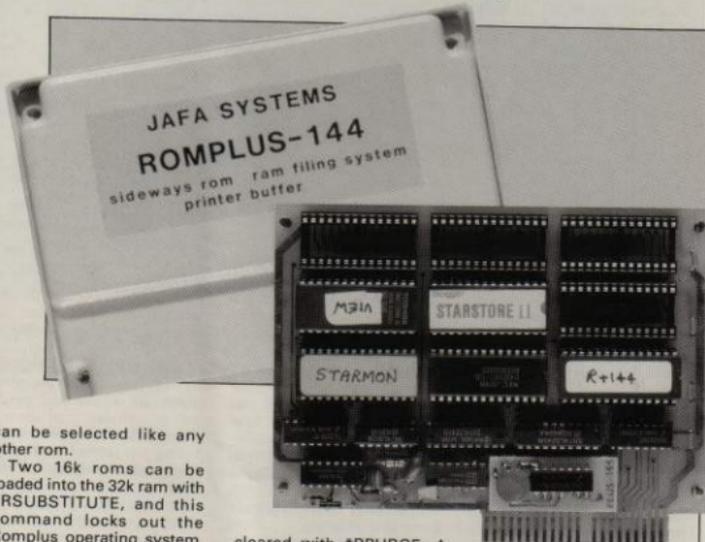
cleared with *RPURGE. A large printer buffer enables you to carry on working while printing a large text file or program listing.

I liked the Romplus-144, though it does have its faults. Like all other cartridge-based rom expansion units, it takes up a valuable slot that you might need for a disc drive, user port and so on. And the screws in the Romplus case were so large I had to remove them to get it to slide into the slot.

A utility for saving roms isn't included with the hardware, and this could pose problems for some users trying to save cartridges like View, or Logo to disc. However, Jafa can provide one for an additional £2. I would like to

E-x-p-a-n-d-i-n-g horizons

ROLAND WADDILOVE examines a new rom expansion cartridge



see this included with the hardware, particularly the Romplus with ram option fitted.

A minor improvement could be made when cataloguing the ram disc. The free space in bytes is printed in hex, and would be better in decimal.

These niggles are quite minor, and the Romplus-144 is an excellent add-on for anyone wishing to expand the capabilities of their Electron and Plus 1.

Product: Romplus-144
Price: £39 + £15 for ram option
Supplier: Jafa Systems, 9 Lon-Y-Garwa, Caerphilly, Mid-Glamorgan CF8 1NL
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SOLITAIRE has always been one of my favourite puzzles. Unlike some other patience-type games usually involving cards, it never seems to lose its attraction.

It comes in a variety of forms, ranging from a large plastic dish with depressions in which you place marbles, to small pocket sets which use plastic pegs.

Here is yet another version of Solitaire, this time in a computerised form to allow its many delights and frustrations to be experienced on your Electron.

The idea is simple. You fill the board with 32 pegs, but leave the middle hole empty. Then each peg must be removed by jumping an adjacent peg over it into an empty hole.

To solve the puzzle properly, the last peg must end up in the centre hole, which was left empty at the start of

In solitary pursuit of a solution

Put your logic to the test with **CHRIS NIXON's** version of a classic puzzle

the game. But this is not as easy as you might think.

I have never, in more than 12 years, managed to complete Solitaire properly. The best I have ever managed is to get down to the last peg. Perhaps that just says something about my brain power, or rather lack of it.

Mind you, I never tire of trying to find that elusive

sequence of moves which will lead to the solution. And now you can try it too, but don't blame me if you get frustrated — the author cannot accept responsibility for any dented or flattened Electrons resulting from usage of this program.

When you run the program the screen will go blank for a short while before the board appears. This delay might seem rather long if you don't have a Turbo board fitted, but it's actually only about 30 seconds.

When the board appears,

you will see the number of pegs remaining displayed at the top left of the screen. This is initially 32, and will drop with each peg taken.

At the top right of the screen is the high score tally. When you get stuck — that is, no more pegs can be taken — pressing Q will reset the board ready for a new game, and update the high score if you managed to remove more pegs than the number shown.

To remove a peg, place the white square cursor over an adjacent peg and press Return. Then move the



CONTROLS

Cursor left	Left
Cursor right	Right
Cursor up	Up
Cursor Down	Down
Return	Select/place peg
Space	Deselect peg
Q	Quit



cursor two positions in any direction to an empty hole, so that there is a peg between the cursor's position and the peg you are moving.

You will see that the peg you selected has turned white, and will stay this colour until you press Return to move it to its new position. The middle peg will vanish from the board, and the peg indicator at the top left of the screen will drop by one.

If you select a peg which

is physically impossible to move, due to there being no empty hole for it to land in, press the spacebar to deselect it. This is necessary because the program doesn't check whether a

selected peg can jump over another or not until you actually try it.

The computer will award

a win if you manage to get it down to the last peg - I felt it was too mean to insist that it should end up in the middle hole as well.

PROCEDURES

setup	Initialise game
newgame	Start new game
board	Draw the pegs
play	Move a peg
score	Print remaining pegs
hiscore	Print high score
text	Print outlined text

VARIABLES

board%()	Holds peg positions
XM%	Cursor X coordinate
YM%	Cursor Y coordinate
OX%	Peg X coordinate
OY%	Peg Y coordinate
X1%	New peg X coordinate
Y1%	New peg Y coordinate
B%	High score
M%	Number of remaining pegs

```
10 REM Solitaire
20 REM By Chris Nixon
30 REM (c) Electron User
40 ONERROR GOTO 1290
50 MODE1:VDU23;8202;0;0;
```

```
60 PROCsetup:REPEAT
70 PROCnewgame:REPEAT
80 PROCplay
90 UNTILwin% OR lose%
100 IF lose% FORSX=196 TO
```

```
100 STEP:5:SOUMT,-10,SX,1:N
EXT ELSE FORSX=100 TO 196 ST
EPS:SOUM1,-10,SX,1:NEXT
110 IF M%-B% B%=M%
```

```
120 PROCscore
130 UNTILB
140 DEFPROCsetup
150 FORXC=1103:VDU19,CX,0,
```

```
0,0,B:NEXT
160 VDU23,126,60,126,255,2
55,255,255,126,60
170 VDU23,225,255,255,255,
255,255,255,255,255
```

```
180 DIBOARD%(7,7)
190 PROCtext(3,0,"S O L
T A I R E",360,980)
```

```
200 PROCtext(2,0,"By Chris
Nixon",410,980)
210 PROCtext(2,0,"(c) Elec
tron User",360,840)
```

```
220 PROCtext(2,1,"PEGS",10
,800)
230 PROCtext(2,1,"LEFT",10
,760)
240 PROCtext(1,3,"HIGH",11
0,800)
```

```
250 PROCtext(1,3,"SCORE",1
086,760)
260 GCOLB,3
270 MOVE SIN(0)*360+620,C0
S(0)*360+392
280 FORA=0 TO *PI STEP2*PI
```

```
/60
290 DRAWLIN(A)*360+620,COS
(A)*360+392
300 NEXT
310 GCOLB,1
320 FORYZ=392 TO 752 STEP4
330 PLOT 77,620,YZ:NEXT
340 FORYZ=392 TO 32 STEP-4
350 PLOT 77,620,YZ:NEXT
```

```
360 *FX4,1
370 *FX15
380 BI=32
390 DATA 2,2,1,1,1,2,2
```

```
400 DATA 2,2,1,1,1,2,2
410 DATA 1,1,1,1,1,1,1
420 DATA 1,1,1,0,1,1,1
430 DATA 1,1,1,1,1,1,1
440 DATA 2,2,1,1,1,2,2
450 DATA 2,2,1,1,1,2,2
```

```
460 ENDPROC
470 DEFPROCnewgame
480 win%=FALSE:lose%=FALSE
490 XM%=0:YM%=3:MX=32
500 RESTORE:FORYZ=0T06
```

```
510 FORX=0T06
520 READBOARDC%(X,Y)
530 NEXT:NEXT
540 COLOUR129:PROCboard:VD
```

```
U20
550 COLOUR129:PROCscore
560 PROCscore:ENDPROC
570 DEFPROCboard
580 COLOUR129:COLOUR0
```

```
590 FORY=0T06:FORX=0T06
600 IBOARD%(X,Y)=1:COLO
UR2:VDU31,XI+3*10,YI+3*10,22
4
```

```
610 IBOARD%(X,Y)=0:COLO
UR0:VDU31,XI+3*10,YI+3*10,22
4
```

```
620 NEXT:NEXT:PROCpiece
630 GCOLB,3
640 MOVE 480,532:PLOT1,-15
0,0
```

```
650 MOVE 480,532:PLOT1,0,1
50
660 MOVE 760,532:PLOT1,0,1
50
670 MOVE 760,532:PLOT1,150
0,0
```

```
680 MOVE 480,262:PLOT1,-15
0,0
690 MOVE 480,262:PLOT1,0,-
150
700 MOVE 760,262:PLOT1,0,-
150
```

```
710 MOVE 760,262:PLOT1,150
,0
720 ENDPROC
730 DEFPROCpiece:COLOUR3
740 VDU31,XM+3*10,YM+3*1
0,225
```

```
750 SOUM1,-10,148,1:ENDPR
OC
760 DEFPROCfill
770 IF board%(XM,YM)=0 C
OLOUR0
780 IF board%(XM,YM)=1 C
OLOUR2
```

```
790 IF board%(XM,YM)=3 C
OLOUR3
800 VDU31,XM+3*10,YM+3*1
0,224
```

```
810 ENDPROC
820 DEFPROCplay
830 FX=0:REPEAT:PROCscan:U
NTILboard%(XM,YM)=1 OR los
e%:IF lose% ENDPROC
```

```
840 board%(XM,YM)=5:SOUN
D 1,-10,196,1:OX%=XM:OY%=Y
M:FX=1
```

```
850 REPEAT:PROCscan
860 UNTIL (ABS(OX%-XM)=2
AND OY%=YM) OR (OX%=XM AND
ABS(OY%-YM)=2) OR lose% OR
GX=32
```

```
870 IF lose% ENDPROC
880 IF GX=32 THEN 850
890 IF XM=OX% X1%=OX%+1:Y
1%=OY%
```

```
900 IF XM=OX% X1%=OX%+1:Y
1%=OY%+1
910 IF YM=OY% X1%=OX%:Y1%
=OY%+1
920 IF YM=OY% X1%=OX%:Y1%
=OY%+1
```

```
930 IF board%(X1,Y1)<1
OR board%(XM,YM)<0 THEN 8
50
940 SOUND1,-10,196,1:COLO
UR0
```

```
950 VDU31,OX+3*10,OY+3*1
0,224
960 VDU31,X1+3*10,Y1+3*1
0,224
```

```
970 board%(XM,YM)=1
980 board%(OX,Y)=0
990 board%(X1,Y1)=0
1000 M%=M%-1:IF M%=1 win%=T
RUE
```

```
1010 PROCscore:ENDPROC
1020 DEFPROCscan
1030 REPEAT:REPEAT:GX=GET
1040 UNTIL(GX>135 AND GX<14
0) OR GX=13 OR GX=81 OR GX=3
2
```

```
1050 IFGX=81 lose%=TRUE
1060 IFGX=136 PROCleft
1070 IFGX=137 PROCright
1080 IFGX=138 PROCdown
1090 IFGX=139 PROCup
1100 UNTILGX=13 OR GX=32 OR
lose%
```

```
1110 IF GX=32 AND FX=1 boar
d%(OX,OY)=1:COLOUR2:VDU31,
```

```
OX%+3*10,OY%+3*10,224 ELSEIF
GX=32 THEN 1030
1120 ENDPROC
1130 DEFPROCleft:PROCfill
1140 XM%=XM%-1:IF XM%=-1 XM
%=4
```

```
1150 IF board%(XM,YM)=2 T
HEN 1140
1160 PROCpiece:ENDPROC
1170 DEFPROCright:PROCfill
1180 XM%=XM%+1:IF XM%=7 XM%
%=0
```

```
1190 IF board%(XM,YM)=2 T
HEN 1180
1200 PROCpiece:ENDPROC
1210 DEFPROCdown:PROCfill
1220 YM%=YM%-1:IF YM%=-7 YM%
%=0
```

```
1230 IF board%(XM,YM)=2 T
HEN 1220
1240 PROCpiece:ENDPROC
1250 DEFPROCup:PROCfill
1260 YM%=YM%+1:IF YM%=1 YM
%=6
```

```
1270 IF board%(XM,YM)=2 T
HEN 1260
1280 PROCpiece:ENDPROC
1290 REPORT:PRINT "at line
";ERL:END
```

```
1300 DEFPROCtext(C1X,C2X,AS
,X2,Y2)
1310 GCOLB,C1X:VDU5
1320 FOR Y1=Y2-4 TO Y2+4 S
TEP4
```

```
1330 FORX1=X2-4 TO X2+4 S
TEP4
1340 MOVE X1,Y1:PRINTAS
1350 NEXT:NEXT:GCOLB,C2X
```

```
1360 MOVE X2,Y2:PRINTAS
1370 VDU4:ENDPROC
1380 DEFPROCscore:GCOLB,0
1390 MOVE 480,710:DRAW150,71
0
```

```
1400 PLOT85,40,650:PLOT85,1
50,650
1410 PROCtext(3,0,"STRMX%
",40,700)
1420 ENDPROC
```

```
1430 DEFPROCscore:GCOLB,0
1440 MOVE 1140,710:DRAW1250
,710
1450 PLOT85,1140,650:PLOT85
,1250,650
```

```
1460 PROCtext(3,0,"STRS%+
",1140,700)
1470 ENDPROC
```

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Electron Memory Map

Part 4

PAGES &400 to &C00 of the Electron's memory are placed under the microscope this month.

The information in these locations tends to fall into one of three main categories – language work-space, sound processing and the main system

buffers. Therefore we've sorted the information into three separate tables, while preserving the sequential order of locations.

A point worth noting is that although the Electron has only one sound channel, all four channel buffers are used.

TABLE I: Language workspace

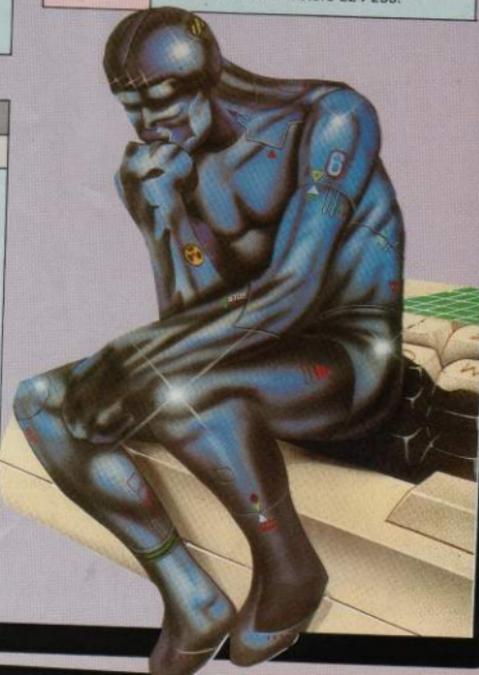
Address	Use
&400-&46B &46C-&47F &480-&4EC &4F6-&4F7 &4F8-&4F9 &4FA-&4FF &500-&5A3	Integer variables @% to Z%. Temporary floating point storage area. Start of variable linked list. Start of PROC linked list. Start of FN linked list. Unused.
&5A4-&5B7	FOR/NEXT loop parameters – up to 10 blocks of 15 bytes each.
&5B8-&5CB	REPEAT/UNTIL loop start address low bytes – up to 20.
&5CC-&5E5	REPEAT/UNTIL loop start address high bytes.
&5E6-&5FF &600-&6FF &700-&7FF	GOSUB return address low bytes – up to 20 GOSUB return address high bytes. String buffer or CALL parameter block. Input buffer.

TABLE III: Main system buffers

Address	Use
&840-&84F &850-&85F &860-&86F &870-&87F &880-&8BF &8C0-&8FF &900-&9BF &9C0-&9FF &900-&9FF	Sound buffer channel 0. Sound buffer channel 1. Sound buffer channel 2. Sound buffer channel 3. Printer buffer. Envelopes 1-4. Envelopes 5-16. Speech buffer (unused on the Electron). CFS output buffer (RS423 output buffer if interface is connected). CFS input buffer (RS423 input buffer if interface is connected). Soft key buffer.
&A00-&AFF	User defined characters 224-255.
&B00-&BFF &C00-&CFF	

TABLE II: Sound processing

Address	Use
&800-&803 &804-&807 &808-&80B &80C-&80F &810-&813 &814-&817 &818-&81B &81C-&81F &820-&823 &824-&827 &828-&82B &82C-&82F &830-&833 &834-&837 &838 &839 &83A &83B &83C-&83F &83D &83E	Not used Sound queue occupancy flag. Current amplitude. Number of amplitude phases processed. Absolute pitch value. Number of pitch phases processed. Number of steps to process. Duration. Interval multiplier. Envelope number/auto repeat parameter. Length of remaining note interval. Sync hold parameter. Sound chip current pitch setting. Pitch deviation. Number of channels required for sync. Current amplitude step. Current target amplitude. Number of channels on hold for sync. Sound parameter calculation workspace. Low order frequency parameter as sent to sound generator. High order frequency parameter as sent to sound generator.



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MICRO MESSAGES

I WISH to commend you upon the continuing excellence of Electron User, and thank you for maintaining a high level of interest each month.

The magazine has grown with its readers, as we have grown in our competence and understanding.

As secretary for the Assemblies of God churches in the West Midlands I find my work immensely helped by the use of View and Desk Diary, and by the many useful articles and routines from your magazine.

As an Electron user I feel as if I am part of an exclusive club, which is, of course, now not likely to get very much larger. Should we have some sort of special handshake, a secret greeting, or wear a badge I wonder?

However, I feel your record of excellence was blemished in the June and July 1988 issues by the Superior Software advert

Blemished by a barbarian

for the game Barbarian.

I must admit to having a dislike anyway for games which take pseudo-pagan ideas as their themes, but in a secular society and a free country I have no wish to interfere with anybody's choice of entertainment. My choice is simply not to buy.

My real complaint is against the pictorial content of the advertisement which I suspect many people will find to be offensive, and particularly insulting to women.

Here we are, using late 20th century technology to depict women in their Stone Age (and not so remote) roles. I doubt whether many women today appreciate the prospect of having to be res-

cued by a Michael Hesaltine lookalike.

Another complaint concerns the almost total absence of decent clothing worn by the young lady.

Superior's software has been just that in the past - superior to most others, and its advertisements for Repton, Spy Cat and so on have been entertaining and also amusing.

I appreciate that this company is a major advertiser and you no doubt do not wish to jeopardise your account. However, maybe this letter - and those from many other readers, I hope - will add weight to your attempts to persuade Superior to think again, since I suspect your feelings

to be much the same also. - J. Clark, Wolverhampton, West Midlands.

● This is the only letter we have received complaining about this advert. Can we take it then, that the rest of the readership are quite happy with it?

Write in to Micro Messages and let us know your views on the subject.

Fascinating

curves

I WAS trying to draw a curve on my computer and typed in this program:

```
10 MODE 4
20 LET A:=700
30 LET B:=700
40 LET C:=700
50 FOR C=1 TO 700
60 MOVE B,AC
70 DRAW B,C
80 LET A2=A+1
90 LET B2=B-1
100 LET C2=C-1
110 NEXT C
```

It not only worked, but a lovely pattern appeared. I am only nine and I hope you can publish my program. - Daniel Bhugon, - Cheshire.

Seeking ADFS

on an AP4

HELP! I have just realised that the Advanced Plus 4 which I bought is not an AP4. The chips inside it are WD1770, Advanced Electron DFS, and HM626ALP -

Turn to Page 42 ▶

Tackle dirty keys

I THINK that Electron User is brilliant, but as everyone has said it all before I won't labour the point.

I have a bit of advice for Electron users: If, after a while, your keys get a bit dirty, especially Shift, Return and the letter E, I have found a way of cleaning them.

First dampen your fingers, then wipe the keys with a little Blue-tac, and keep rolling it until the keys are clean. I needed just one

small piece of Blue-tac to remove three year's dirt, and it took just over 15 minutes to clean the whole keyboard.

I have another suggestion: In the software pages you not have a summary of the software not good enough for a full review, with just the name of the supplier and the marks, and perhaps a comment?

Also, why not have a readers' Top 10, and a

readers' Vile Pile? Something like in Pendragon's adventure section, but for arcade games. - Richard Blythe, Newquay, Cornwall.

● We tried the Blue-tac, but couldn't get it to clean the keys on one of our very old and grubby Electrons.

Mr Sheen however, brought it up a treat. Don't spray it directly on the keyboard though, spray it on a duster and then gently wipe the keys and case.

◀ From Page 41

which I suppose controls everything in the AP4.

When I switch on the message printed is ACP 1770 DFS. How do I get the ADFS working, or is the Advanced Electron DFS not in fact ADFS?

The user guide tells you how to switch on the ADFS by pressing Break+A, or by typing:

```
+ADFS
```

but it won't work, even with my friend's ADFS discs. — John Ross, Edinburgh.

● The AP4 uses the DFS filing system — the same as in the old BBC Micro. The AP3 uses the ADFS filing system as used in the BBC Master Compact and Archimedes.

DFS discs are formatted in a special way, completely different to the way in which the ADFS formats discs. So the AP4 can't read ADFS discs and the AP3 can't read AP4 discs.

Top lopped

I AM having problems seeing the top line of graphics on my TV. Could you tell me if there is a command to lower the display? — J. Longshaw, Packmoor, Staffordshire.

● This is a very common problem and one we've answered before. Nothing can be done with the Electron. However, it is quite easy to adjust the height of the picture on your television.

Don't try it yourself though, as there are very high voltages inside the TV. Ask a qualified engineer to do it for you.

Missing

resistors

ON recently opening my computer to clean the keyboard I noticed that the positions R15 and R16 on the

ALL programs printed in this issue are exact reproduction of listings taken from running programs which have been thoroughly tested.

However on the very rare occasions that mistakes may occur corrections will be published as a matter of urgency. Should you encounter error messages when you type in a program

they will almost certainly be the result of your own typing mistakes.

Unfortunately we can no longer answer personal programming queries concerning these mistakes. Of course letters about suggested errors will be investigated without delay, but any replies found necessary will only appear in the mail pages.

Electron's power supply board were empty, but that wires were actually soldered to the board as though the resistors had just been removed.

Please could you tell me whether these positions should contain resistors, and if so, supply the necessary details for replacing them. — N. D. Harris, Halesowen, West Midlands.

● If your micro runs perfectly well without them then we'd suggest leaving it alone. Also, it's not necessary to open the Electron's case to clean the keyboard.

None of ours have been cleaned and they have worked perfectly since the day they were bought.

Sounds

exciting

I HAD only just started reading your excellent magazine when I noticed a friend had Volume 1 Number 1 and it had Sounds Exciting in it. But now, much to my disappointment, it's gone. Please bring it back. I have a little program for it if it ever does:

```
10 REM Nutty Noises
20 FOR k=1 TO RND(255)*R
ND(4) STEP RND(10)
30 ENV. 1,2,k,k,k,k,k,k,
126,8,8,-126,126,126
40 SO. 1,1,53,100
50 NEXT
```

— Christopher Whitworth (9), East Markham, Nottinghamshire.

Illegal

practices

THERE is one matter concerning the laws that protect copyrighted games that I would like to have cleared up. Please tell me, is it, or is it not illegal to transfer copyrighted games from tape to disc?

If it is illegal, then how is it that Slogger can sell its tape to disc roms? And in Peter Donn's advert for Image V2 in Electron User it says that Image must not be used to copy one cassette that is copyrighted to another cassette.

But it seems to say that it is all right to use Image to put software on disc. Please could I have the facts? — Daniel Moore, Boscombe, Bournemouth.

● It is illegal to make a copy of any commercial software unless expressly given permission to do so by the person or company holding the copyright. So tape to tape and tape to disc is definitely out.

Slogger is not copying software, it is selling a toolkit rom — so is not breaking the law. Anyone using the rom to copy software is breaking the law.

It's a bit like a hardware shop selling a crowbar, which is then bought by a burglar to force his way into a house. The shop isn't breaking the law; the burglar is.

The Image advert speci-

cally states that you can only use the product to copy your own software (that you have written yourself), and that any person using the program for illegal purposes runs the risk of being prosecuted.

Electron

and Brother

While at the recent Electron and BBC Micro User Show I bought a Brother HR5 printer from Crown Computer Products.

When I got home I discovered there wasn't a manual with it, so I rang Crown Computers who said they would post one to me.

My problem is that I connected the printer to my Electron and attempted to print the alphabet. It tried, but it printed two of one letter, then missed one and printed two of the next, missed one, printed two of the next and so on.

I have tried everything I can possibly think of to get it to print the right letters, but it won't. — Louise Page, Retford, Nottinghamshire.

● We have a Brother HR5 here and it works perfectly without any modification at all. We would suspect the printer lead first.

If possible, try a friend's printer lead with your micro and printer. If this doesn't work the printer may be faulty, though this is unlikely as they are generally quite reliable beasts.

No Electron

editor

IN your guide to software and hardware products in the June 1988 issue of Electron User you listed Fleet Street Editor by Mirrorsoft.

I made a telephone enquiry to them and was told they do not do an Electron version of this pro-

gram. On obtaining the BBC Micro version I discovered that although I could load the software, I soon got stuck with some of the function keys.

For instance, after selecting an icon it is necessary to deselect it by pressing the Tab key.

I was stuck at this point and failed to deselect it until I pressed Break. I could not find a way of using this excellent program on the Electron.

Did you make a mistake in listing this in your guide, or am I missing something. — Roger Newton, Birkenhead, Merseyside.

● This product should not have appeared in the product guide. If Fleet Street Editor reads the keyboard directly using a negative INKEY value then you are stuck.

If however, it is reading the Ascii value produced with a positive INKEY, GET or INPUT then use Control-I to generate the same Ascii code as the Tab key on the BBC Micro.

Silence

please

IN the June 1988 issue of Electron User Philip Tee asked how to switch off the sound when playing games. I was particularly interested in the reply because I find the sound effects of Mr Wiz very annoying — especially when someone else is playing.

As you probably know, there is no facility for turning off the sound built into the game. I tried the suggested remedy of typing in *FX210,1 and it stopped the sound effects during loading.

However, it also freezes the game at the beginning of the first screen, making it unplayable. Is there an alternative way to silence the game and still play it? — G. B. Taylor, Sidcup, Kent.

● The only solution is a hardware modification —

Poking into Plus 1

I HAVE read several letters in Micro Messages on the subject of disabling the Plus 1 when a Turbo or Master Ram Board is fitted.

No account seems to have been taken of the fact that Slogger has produced more than one version of the operating system.

Here is an example which demonstrates the shortcomings of recommending a particular fixed value poke to the file vector &212&213 when disabling the Plus 1:

```
*FX163,128,1
?&212=&55
?&213=&F2
?&2AC=0
```

Although this file vector poke works with Slogger's os 2.0, it crashes os 3.0 when a CHAIN''' command is subsequently issued.

All such fixed value pokes

Version	Osfile address Vector &FFDD	Contents &212 Default	Contents &213 Default
Acorn 1.0	&F1D6	&D6	&F1
Slogger 2.0	&F255	&55	&F2
Slogger 3.0	&F203	&03	&F2

Table 1: Osfile addresses

suffer from the disadvantage that they only apply to one particular version of the machine operating system. This is illustrated by Table 1.

It is to be expected that the absolute addresses of os routines may vary in different editions of the os rom, and consequently the default contents of the in-direction vectors (&200 to &234) which point to those routines will correspond to their changed addresses.

The following method correctly disables the Plus 1

regardless of the os version:

```
*FX163,128,1
T%=&FFB7 AND &FFF
?&212=T%?&12
?&213=T%?&13
?&2AC=0
```

where T% represents the address of the default vector table. The address of the default vector table within the os rom can vary from version to version, but its address is always held in &FFB7.

either open the Electron and unplug the speaker, or extend the wires outside the case and add a switch.

There is a better solution though — the Electron Sound Master, available using the order form on Page 45 — will enable the sound to be switched on or off, and you can use Walkman style headphones with it too.

This means you can play games with full sound without disturbing the rest of the family.

Speedy

solution

I AM the proud owner of an Acorn Electron to which I have added a Plus 3, T2P3 and a Star NL-10 printer.

At the last UMIST Electron and BBC Micro User Show I bought the NTQ system from PMS. It took me half an

hour to install the two roms. I find this a very useful piece of software with which to produce my letters.

There is only one fault with the system — it is very slow indeed. The manual does say this, and to solve the problem it recommends the use of either the Master Ram Board, or the Turbo Driver, though it shows no preference.

Could you tell me which is more important: A bigger memory and/or a faster processor. Would the E2P 65C02 second processor do just as good a job? — N.E. Regan, Newcastle-Under-Lyme, Staffordshire.

● The Master Ram Board also incorporates the Turbo Driver and you can switch between them, so this is better than just a Turbo Driver alone.

The second processor will also add memory and speed up the Electron, but unfortunately it is incompatible with all games software.

Data maker

problems

AFTER reading your excellent series on graphics programming, and having bought the disc accompanying the series, I decided to write a game.

However, there is one point about the data maker that I can't successfully alter. As stated in the article, Maps II uses a fast sprite print routine, although the data maker does not work with it.

Can you publish a data maker that outputs data compatible with it? — Owain James, Newport, Gwent.

● We have had several requests for more information on this subject, so Roland has written an extra article to go with his series. This will appear in next month's Electron User.

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Going down the right track

MARK BOLTON presents a machine code disassembler that boasts some really powerful features

IT has been a long time since *Electron User* last published a machine code disassembler, so here is a new, all assembly language version with a lot of useful features not normally found in a magazine listing of this type.

When Stuart Low reviewed Slogger's *TREK disassembler in the February 1987 issue of *Electron User*, I was immediately impressed by its many powerful facilities.

These included the ability to disassemble backwards, and to trace the program flow of any code it disassembled. I therefore decided to write a smaller version, suitable for publishing as a listing.

Tracker is written entirely in assembly language, making the whole disassembly process much faster. Furthermore, it has the ability to follow the path of any JMP or JSR it comes across, allowing you to follow a piece of code right through all of its sub-routines and branches.

If at any point the disassembly proceeds past &8000 into the current paged rom area, you are immediately prompted for the one you want to disassemble.

This is an invaluable feature, as up to 16 roms may occupy this area at some time. As Basic normally occupies this space, it may not be the rom you are interested in examining.

Enter Program I and save it using a suitable filename other than TRACKER. When run, a machine code file called Tracker will be saved to disc or tape; this is the disassembler proper.

The bottom of the screen will fill with random bytes during assembly, as this is where the machine code is being stored in order to leave the user ram free for holding the code to be disassembled.

Type *TRACKER to load and run the utility, and the screen will again fill with data. A neat bordered text

window will appear at the top of the screen to prevent the disassembler being overwritten with text while the program is being used.

Below is an illustration showing Tracker in action, with the function and purpose of various parts of the screen described.

Above the text window are the words JSR, JMP, RAM and PTR. Three of these indicate the state of selectable options available from Tracker, and are highlighted when selected

by pressing the appropriate key. All the keys used to control Tracker are shown in the table below.

The Tracker control options are described in detail below:

● The JSR option, when enabled, will pause disassembly whenever a JSR &XXXX is encountered with the message: *Follow? (Y/N)*.

Pressing Y will cause Tracker to recommence disassembly at the address specified after the JSR, while the N key will cause

the program to move on to the next instruction.

Tracker stores the current address each time a JSR is followed, so that when an RTS is encountered you will be returned to the point immediately following the calling JSR.

● The JMP option works in the same way as the JSR option. The only difference is that because a direct jump is involved, no return address is stored and any

Turn to Page 51 ▶

Key	Action	Key	Action
A	Enter a new address from which to continue disassembly	J	Toggle the JSR option on and off
B	Move backwards 256 bytes	M	Toggle the JMP option on and off
F	Move forwards 256 bytes	P	Toggle the printer on and off
		Escape	Exit from Tracker

The control keys

Follow JSR option (off) JSR

Follow JMP option (off) JMP

Currently inside user ram RAM

The disassembly window

Printer option (off) PTR

```

72C1 AD 08 02 LDAR#208
72C4 85 08 STAR#9
72C6 89 09 LDAR#208
72C8 8D 08 02 STAR#208
72CB AD 09 02 LDAR#209
72CE 85 09 STAR#9
72D0 89 72 LDAR#72
72D2 8D 09 02 STAR#209
72D5 58 CLI
72D6 4C 57 77 JMP#7757
  
```

Ascii representation of the code

Follow? (Y/N)

Asking whether to follow the JMP instruction

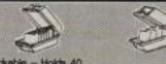
Tracker program occupying screen memory

Tracker in action

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◀ From Page 49

subsequent RTS instructions will just be disassembled and ignored, unless the JSR option is also enabled.

● The PTR option is the printer enable function. Pressing P — as shown in Table 1 — highlights this option, and all further output will be sent to the printer as well as the screen. Of course, the program will halt if the printer is off-line or disconnected.

● Finally, the RAM option is not so much a function as an indication of which area of memory is currently being disassembled.

It is always highlighted, and will show the words RAM, ROM or MOS depending on whether you are currently below &8000, between &8000 and &BFFF, or at/above &C000.

Toggled options

If you have a Plus 1, you may find that one or more of these options are set seemingly at random when you first *RUN Tracker. This is not a problem, as they can immediately be toggled to the required state.

Disabling the Plus 1 is one way to ensure this doesn't happen in the first place, and if you have Pres's new AP2 rom, the marvellously useful *KILL command will do the job for you.

When you first *RUN Tracker, the current contents of the integer variable D% are used to determine the initial address at which disassembly will start, and unless set up beforehand it will contain a useless value.

Therefore to examine memory at the required address press A, which will cause Tracker to prompt you to enter a new address at which to re-commence disassembly.

You can also press Escape and set D% to any address, followed by *GO. You will be placed back into Tracker, with the disassembly start-

ing from the new address. Here is an example:

```
(Escape)
D%=&2000
*GO
```

The use of D% as an initial start address is extremely useful when debugging your own machine code. As soon as you find a bug, just set D% to an address near to the suspect portion of code, and type *TRACKER.

There is another new star command available when

Tracker is installed — *RID. You must use this command when you've finished a session with Tracker, to reset the Oscil vector at &208-&209 back to its original state.

Because Tracker sets this vector up to point into its own star command checking routine, forgetting to type *RID will cause your Electron to crash at the next star command, if the data area at the foot of the screen has been wiped by changing

mode. Pressing Break will also properly reset the Oscil vector, and Control+Break is preferable if you want a complete system reset.

Tracker is fully compatible with the Slogger Master Ram Board, and will work perfectly in 64k mode.

It's probably better to use Tracker in 64k mode, because there will be no clutter at the foot of the screen, due to the fact that the screen memory is held in another bank of ram.

```
10 REM TRACKER
20 REM Machine Code
30 REM Disassembler
40 REM By Mark Bolton
50 REM
60 MODE6
70 addr=&70:temp=&72:op=&
74:ane=&75:fo=&78:inc=&79:in
dex=&7A:counter=&7B:code=&7C
:temp2=&79:rom=&7F:stat=&80:
x=&81:y=&82:loc=&83:sr=&84
:jmp=&85:ptr=&86:f lag=&87:
old=&88:spinter=&86:hot=&14
80 FOR LDR to 2 STEP2
90 P%=&72CB:COPT L%
100 jnt SEI:LDAA@28:STA o
Ld:LDAA@cmd MOD256:STAR20
8:LDAB209:STA old1:LDAA@cmd
and DIV256:STAR209:CL1:endi
nt JMP star
110 .command STAR2F:STY&F3
:LDY@1:LDL LDR(F2):YCMP c
om1-Y:ysBne .command2:INY:CPY
#3:BNE lp1:JMP star
120 .command2 LDY@1:lp2 L
DA(F2):YCMP com2-1:YBNE c
omand3:INY:CPY#4:BNE lp2:JMP
P rid
130 .command3 LDY&F2:LDY&F
3:JMP(oid)
140 .com1 EQUUS'GO':.com2 E
QUUS'RD'
150 jrid SEI:LDAA@ld:STAR20
8:LDAA@1+1:STAR209:CL1:JSRvd
u26:LD@12:JMP&FEE
160 .hex PHA:LSRA:LSRA:LSR
A:LSRA:JSR hex2:PLA
170 .hex2 AND#&F:SED:CLC:A
0C#&09:ADC#A@0:CLD:JMP&FEE
180 .char STYtemp2:STA&60:
LDAA@A:LDX#&60:LDY#0:JSR&FEE
1
190 LDAA#25:JSR&FEE:LDAA#25
5:JSR&FEE:LDAA#0:JSR&FEE:LD
X#1:JSR vdu:INX:INX:JSR vdu
200 INX:JSR vdu:INX:JSR vdu
:INX:INX:JSR vdu:LDAA#0:JSR&
FEE:JSR&FEE
210 LDA stat:BEQ endv:LDY@
6:VLP LDAA@F:YEGOR255:STA
&C#8:Y:DEY:CPL vlp:endv LDY
temp2:LDAA#255:JMP&FEE
220 vdu LDAA#60,X:Y:JMP&FEE
230 vduJ31 LDAA#31:JSR&FEE
:TXA:JSR&FEE:TYA:JMP&FEE
240 .main_loop
250 JSR get_info:JSR ptr_o
n:JSR address:LDAA#0:STA stat
:JSR aneom1:LDAA#0:JSR xpos
260 JSR bytes:LDAA#1:STA st
at:JSR aneom1:JSR act1:LD
AA#10:JSR&FEE:LDAA#3:JSR&FEE
E:JSR ptr_off:JSR follow:JSR
&FEE:CPM#27:BEQ stop
270 CPM#ASC'@':BNE cont2D
EC addr1:JSR string:EQUUS' -
~ Back ~':BRK:JSR&FEE7:JMP
main_loop
280 .cont2 CPM#ASC'@':BNE
cont3:INC addr1:JSR string:
EQUUS' ~ Forward ~':BRK:JSR
&FEE7:JMP main_loop
290 .cont3 CPM#ASC'@':BNE
cont4:JSR toptr:JMP cont0
300 .cont4 CPM#ASC'@':BNE
cont5:JSR toqtr:JMP cont0
310 .cont5 CPM#ASC'@':BNE
cont6:JSR toqtr:JMP cont0
320 .cont6 CPM#ASC'@':BNE
cont7:JSR input:JMP main_loo
p
330 .cont7 :.cont0
340 CLC:LDAA@rd:ADCinc:STA
addr:LDAA@rd+1:ADC#0:STAaddr
+1
350 JMP main_loop
360 .stop JSR ptr_off:BRK:
BRK:EQUUS'STOP:BRK
370 get_info
380 LDY@0:STY counter:JSR
read:STA op
390 LDAA#table1 MOD256:STA
temp:LDAA#table1 DIV256:STA t
emp1
400 .gdp LDAA(temp),Y:CMP o
p:BEQ found
410 CLC:LDATemp:ADC#3:STAT
emp:LDATemp+1:ADC#0:STATemp
+1:INCCounter
420 LDA counter:CPM#152:BN
E glp
430 LDAA#0:STA fd:STA index
:RTS
440 .found LDAA#&F:STA fd
450 LDY@1:LDAA(temp),Y:STA
code:DEC code:INY:LDAA(temp),
Y:STA index
460 LDAA#table2 MOD256:STA
temp:LDAA#table2 DIV256:STA t
emp1:LDAA code:BEQ skip
470 LDY@0:VLP LDAA temp:C
LC:ADC#3:STA temp:LDAA temp+1
:ADC#0:STA temp+1:INY:CPY co
de:BNE flp
480 .skip LDY@0:.lp2 LDAA(t
emp),Y:STA wne,P:INY:CPY#3:B
NE lp2
490 RTS
500 .read JSR what:STY&90:
LDAA addr+1:CPM#&80:BPL read2
:JMP read5
510 .read2 CPM#&C8:BMI rea
d3:JMP read5
520 .read3
530 STY temp2:CLC:LDAA addr
:ADC temp2:STARF6:LDAA addr1
:ADC#0:STARF7:LDY rom:JSR&F
F0:LDY@00:RTS
540 .read5 LDAA(addr),Y:RTS
550 .address LDA addr+1:JS
R hex:LDAA addr:JSR hex:LDAA#3
2:JMP&FEE
560 .bytes LDY@0:.bpl JSR
read:JSR hex:LDAA#32:JSR&FEE
:INY:CPY inc:BNE bpl:LDAA#16
570 .kpos STA temp2:.xlp L
DA#134:JSR&FEE4:CPX temp2:BP
L endx:LDAA#32:JSR&FEE:JMP x
lp:.endx RTS
580 .aneom1 LDA stat:BNE
aneom1:JMP number
590 .aneom
600 LDA fd:BNE ane2:JSR st
ring:EQUUS'no such code':EQUB
0:RTS
610 .ane2 LDY@0:.m1p LDA w
ne,Y:JSR&FEE:INY:CPY#3:BNE
m1p.mn3
620 LDA index:BNE ml:JMP A
0
630 .n1 CPM#1:BNEm2:JMP A1
640 .n2 CPM#2:BNEm3:JMP A2
650 .n3 CPM#3:BNEm4:JMP A3
660 .n4 CPM#4:BNEm5:JMP A4
670 .n5 CPM#5:BNEm6:JMP A5
680 .n6 CPM#6:BNEm7:JMP A6
690 .n7 CPM#7:BNEm8:JMP A7
```

Turn to Page 52 ▶

◀ From Page 51

```

700 .n8 CMP#8:BNEN9:JMP A8
710 .n9 CMP#9:BNEN10:JMP A9
720 .n10 CMP#10:BNEN11:JMP A10
730 .n11 CMP#11:BNEN12:JMP A11
740 .n0 RTS
750 .ascii LDA#36:JSR
LDY#0:alp JSR read:CMP#32:
BPL asc2:LDA#ASC":JMP asc3
760 .asc2 CMP#127:BN1 asc3
:LDA#ASC":

```

```

770 .asc3 JSR&FEE:INV:CPY
inc:BNE alp
780 RTS
790 .LD A0#32:JSR&FEE:LD
AA#ASC":JMP&FEE
800 .A1 JSR hash:JSR amp:L
DY#1:JSR read:JMP hex
810 .A2 JSR amp:LDY#1:JSR
read:JMP hex
820 .A3 JSR amp:LDY#1:JSR
read:JSR hex:JSR comma:JMP p
x

```

```

830 .A4 JSR amp:LDY#2:JSR
read:JSR hex:DEY:JSR read:JMP
hex
840 .A5 JSR amp:LDY#2:JSR
read:JSR hex:DEY:JSR read:JSR
hex:JSR comma:JMP py
850 .A6 JSR amp:LDY#2:JSR
read:JSR hex:DEY:JSR read:JSR
hex:JSR comma:JMP py
860 .A7 JSR brack1:JSR amp
:LDY#1:JSR read:JSR hex:JSR
comma:JSR px:JMP brack2
870 .A8 JSR brack1:JSR amp
:LDY#1:JSR read:JSR hex:JSR
brack2:JSR comma:JMP py
880 .A9 JSR amp:LDY#1:JSR
read:STA temp:CMP#8#1:BN1 B9
:SEC:LDA#&FEE:SBC temp:STA te
mp+1:SEC:LDA addr:SBC temp+1
:PHA:LDA addr+1:SBC#0:JSR hex
:PLA:JMP hex

```

```

890 .B9 CLC:LDA#2:ADC temp
:STA temp+1:CLC:LDA addr:ADC
temp+1:PHA:LDA addr+1:ADC#0
:JSR hex:PLA:JMP hex
900 .A11 JSR brack1:JSR amp
:p:LDY#2:JSR read:JSR hex:DEY
:JSR read:JSR hex:JMP brack2
910 .LDA RTS
920 .jx LDA#ASC":JMP&FEE
E:py LDA#ASC":JMP&FEE:l
brack1 LDA#ASC":JMP&FEE:l
brack2 LDA#ASC":JMP&FEE

```

```

930 .comma LDA#ASC":JMP&
FEE:inc LDA#ASC":JMP&FEE
E:hash LDA#ASC":JMP&FEE
940 .number LDA index:CMP#
1:BEQ 12:CMP#2:BEQ 12:CMP#3:
BEQ 12:CMP#7:BEQ 12:CMP#8:BE
9 12:CMP#9:BEQ 12
13:CMP#4:BEQ 13:CMP#5:BEQ
13:CMP#6:BEQ 13:11 LDA#1:S
TA inc:RTS

```

```

12 12:LDA#2:STA incRTS:
13 LDA#3:STA incRTS
970 .str PLA:STA temp:PLA:
STA temp+1:LDY#0:BEQ ps2:ps
LDA(temp):Y:BEQ ps1:JSR cha
r:ps2 inc temp:BNE ps:INC t
emp+1:BNE ps:ps1 LDA temp+1
:PHA:LDA temp:PHA:RTS

```

```

980 .string PLA:STA temp:P
LA:STA temp+1:LDY#0:BEQ ps5:
.ps3 LDA(temp):Y:BEQ ps4:JSR
&FEE:ps5 inc temp:BNE ps3:
INC temp+1:BNE ps3:ps4 LDA
temp+1:PHA:LDA temp:PHA:RTS
990 .start LDA#28:JSR&FEE
:LDA#0:JSR&FEE:LDA#12:JSR&F
FEE:LDA#39:JSR&FEE:LDA#0:JS
R&FEE:LDA#12:JSR&FEE:LDA#2
6:JSR&FEE
1000 LDY#7:LDA#0:stp1 STA#

```

```

LDY#0:JSR vdu31:JSR str:EQU
S JMP :BRK:JMP vdu28
1140 .ptr JSR vdu26:LDX#35
:LDY#0:JSR vdu31:JSR str:EQU
S PTR :BRK:JMP vdu28
1150 .prn JSR vdu26:LDX#12
:LDY#0:JSR vdu31:JSR str:EQU
S RAM :BRK:JMP vdu28
1160 .prn JSR vdu26:LDX#12
:LDY#0:JSR vdu31:JSR str:EQU
S ROM :BRK:JMP vdu28
1170 .pos JSR vdu26:LDX#12

```

```

1290 LDX#16:LDY#0:LDY#0:JSR
SR spc
1300 LDX#18:LDY#0:LDY#16:JSR
SR spc
1310 JMP vdu28
1320 .follow
1330 LDA jmp#2:BEQ f2:JSR fj
mp
1340 .f2 LDA jsr#1:BEQ f3:JSR
R f3
1350 .f3 RTS
1360 .fjmp LDA op:CMP#&C:B
NE fjmp2:JSR prompt:BCS fjmp
4:RTS:fjmp4 JSR ffw:LDY#1:J
SR read:PHA:INV:JSR read:STA
addr+1:PLA:STA addr:LDA#0:S
TA inc:RTS
1370 .fjmp2 CMP#&C:BEQ fjm
p5:RTS:fjmp5 JSR prompt:BCS
fjmp3:RTS
1380 .fjmp3 JSR ffw:LDY#1:J
SR read:PHA:INV:JSR read:STA
addr+1:PLA:STA addr:LDA#0:J
SR read:PHA:INV:JSR read:STA
addr+1:PLA:STA addr:LDA#0:S
TA inc:RTS
1390 .fjsr LDA op:CMP#&B:BN
NE fjsr3:JSR prompt:BCS fjsr
2:RTS:fjsr2 JSR ffw:LDY poi
nter
1400 LDA addr:STA stack,Y:1
NY:LDA addr+1:STA stack,Y:1N
Y:STY pointer:LDY#1:JSR read
:PHA:INV:JSR read:STA addr+1
:PLA:STA addr:LDA#0:STA inc:
RTS
1410 .fjsr3 CMP#&B:BNF fjsr
r5:LDA pointer:BEQ fjsr5:JSR
ptr.on:JSR string:EQU" --
Return --:BRK:JSR&FEE:JSR
ptr.off

```

```

1420 LDY pointer:DEY:LDA sta
ck,Y:STA addr+1:DEY:LDA sta
ck,Y:STA addr:STY pointer:LD
A#3:STA inc
1430 .fjsr5 RTS
1440 .fjsr5 ptr.on:JSR str
ring:EQU" -- follow --:BRK
:JSR&FEE:JMP ptr.off
1450 .togjsr LDA jsr#1:EOR#8
FF:STA jsr#1:AND#1:STA stat:L
DA jsr#1:AND pointer:STA poin
ter:JMP pjsr
1460 .togjsr LDA jsr#1:EOR#8
FF:STA jsr#1:AND#1:STA stat:J
MP pjsr
1470 .togptr LDA ptr#1:EOR#8
FF:STA ptr#1:AND#1:STA stat:J
MP ptr

```

```

1480 .ptr.on LDA ptr#1:BEQ e
noptr:LDA#2:JSR&FEE:enptr
RTS:ptr.off:LDY ptr#1:BEQ e
noptr:LDA#3:JMP&FEE
1490 .input JSR vdu16:LDX#1
1:LDY#0:JSR vdu31:JSR str:
EQU:Continue at 8:BRK:L
DX#table3 MOD256:LDY#table3
0IV256:LDA#4:STA#table3#2:LDA
op#1:JSR&FF1
1500 .move LDA table#4:CMP
#&B:inp2:LDA table#4:#3:ST
A table#4:#3:LDA table#4:#2:ST
A table#4:#3:LDA table#4:#1:ST
A table#4:#2:LDA table#4:table
4+1:LDA#4:STA table#4:JMP mov
e
1510 .inp2

```



```

CFB,Y:DEY:BPL stp1:LDA#255:S
TABCFB
1010 LDA#40:LDX#0:LDY#1:JSR
chr:LDA#40:LDX#0:LDY#0:LDY#1:
JSR chr
1020 LDA flag:BNE miss:LDA#6
410:STA addr+1:LDA#411:STA addr
+1:LDA#0:STA jsr#1:STA jmp#X:
STA ptr:l:miss
1030 LDA#0:STA stat:JSR pjs
r:JSR pjsm:JSR pptr
1040 LDA#&FF:STA loc:STA fl
ag
1050 LDA#1:STA stat:LDA jsr
#1:BEQ st2:JSR pjsr:st2 LDA
jdx#1:BEQ st3:JSR pjsm:st3 L
DA ptr#1:BEQ st4:JSR pptr
1060 .st4
1070 LDA#40:STA addr:LDA#4
11:STA addr+1
1080 LDA#0:STA jsr#1:STA y:JSR
vdu28
1090 JMP main:loop
1100 .vdu28 LDA#28:JSR&FEE
:LDA#0:JSR&FEE:LDA#28-2:JSR
R&FEE:LDA#39:JSR&FEE:LDA#2
6:JSR&FEE:LDX x:lby y:JSR v
du31:JMP ptr.on
1110 .vdu28 LDA#134:JSR&FF
4:STX x:STY y:JSR ptr.off:LD
A#26:JMP&FEE
1120 .pjsr JSR vdu26:LDX#0:
LDY#0:JSR vdu31:JSR str:EQU
S JSR :BRK:JMP vdu28
1130 .pjsr JSR vdu26:LDX#6:

```

```

:LDY#0:JSR vdu31:JSR str:EQU
S MOS :BRK:JMP vdu28
1180 .what PHA:TXA:PHA:TYA:
PHA:LDA#1:STA stat
1190 LDA addr+1:CMP#&B:BNL
what2:LDA loc:BEQ endwhat:L
DA#0:STA loc:JSR prn:JMP en
dwhat
1200 .what2 CMP#&B:BNL wha
t3:LDA loc:CMP#1:BEQ endwhat
:LDA#1:STA loc:JSR prn:JMP
getrom:JMP endwhat
1210 .what3 LDA loc:CMP#2:B
EQ endwhat:LDA#2:STA loc:JSR
pwas
1220 .endwhat LDA#0:STA sta
t:PLA:TAY:PLA:TXA:PLA:RTS
1230 .getrom JSR vdu26:LDY#
0:STY stat:LDX#18:JSR vdu31:
JSR str:EQU:ENTER ROM NUMBE
R:BRK
1240 LDY#16:LDY#0:JSR vdu
31:JSR str:EQU:ROM ROM :B
RK
1250 LDA#0:LDX#table3 MOD25
6:LDY#table3 DIV256:JSR&FF1
1260 LDY#0:g1 LDA table#4,y
:CMP#13:BEQ g2:SEC:SBC#48:ST
A table#4,y:INT:JMP g1
1270 .g2 CPY#0:BNF g3:LDA#0
:STA table#4:STA table#4+1:JMP
g6:g3 CPY#1:BNF g6:LDA tab
le#4:STA table#4+1:LDA#0:STA t
able4
1280 .g6 JSR dec:STA rom

```

```

1520 LDA#2:STA table3+2:LDA
#20:LDA#1:LDF#BOT:JSR spc:J
SR vdu28
1530 JSR string:EQUS -- Ne
w Address --:BRK:LDX#table4
MOD256:LDY#table4 DIV256:ST
X&F2:STY&F3
1540 JSR&FFFE7
1550 LDY#0:JSR num:STA addr
+1:INY:JSR num:STA addr:LDA#
0:STA inc:clr LDY#4:lo STA
table4,Y:DEY:BPL lo:STA inc
:RTS
1560 .spc PHA:JSR vdu31:PLA
:TAT:lo .sp LDA#32:JSR&FFFE:DE
Y:BNE sp:RTS
1570 .chr PHA:JSR vdu31:PLA
:TAT:lo .sp LDA#255:JSR&FFFE:DE
Y:BNE sp:RTS
1580 .num LDA(&F2),Y:JSR in
str:CLC:ASLA:ASLA:ASLA:ASLA:
STA temp2:INY:LDA(&F2),Y:JSR
instr:CLC:ADC temp2:RTS
1590 .instr STY y:STA temp
LDY#0:loop LDA Idata,Y:CMP
temp:BEG endins:INY:CPY#16:B
NE loop:LDY#0:endins TYA:LD
Y y:RTS
1600 .Idata EQUS#123456789
ABCDEF
1610 .table3 EQUB table4 MO
9256:EQUB table4 DIV256: EQU
B2:EQUB 32:EQUB 127
1620 .table4 EQUS#0000#
1630 .dec LDA#0:STA temp2:L
DA table4:BEG dec2:LDB table
4:dlp LDA temp2:CLC:ADC#10:
STA temp2:DEY:BNE dlp
1640 .dec2 CLC:LDA table4+1
:ADC temp2:RTS
1650 .prompt JSR vdu26:LDX#
13:LDY#BOT:JSR vdu31:JSR str
ing:EQUSFollow? (Y/N):BRK
1660 .pr1 JSR&FFFE:CMPSASC
Y:BNE pr2:SEC:JMP pr3
1670 .pr2 CMPSASC:N:BNE pr
1:CLC:JMP pr3
1680 .pr4 CMP#27:BNE pr1:JM
P stop
1690 .pr3 PHP:LDA#13:LDY#bo
t:LDA#14:JSR spc
1700 JSR vdu28:PLP:RTS
1710 .stack EQUS STRINGS12
8,CHRSD
1720 .table1
1730 J
1740 RESTORE 1750:FOR I=1
TO 152:READA,b,c:PP#EVAL('
&+A&):PX?1=b:PX?2=c:PI#PX+3
:NEXT
1750 DATA 69,1,1,65,1,2,75,
1,3,60,1,4,79,1,5,70,1,6,61,
1,7,71,8,29,2,1,25,2,2,35,
2,3,20,2,4,30,2,6,39,2,5,21,
2,7,31,2,8
1760 DATA A,3,0,6,3,2,16,3,
3,E,3,4,1E,3,6,90,4,9,80,5,9
,F0,6,9,24,7,2,2C,7,4,30,8,9
,80,9,9,10,10,9,0,11,10,50,1
2,9,70,13,9
1770 DATA 18,14,10,08,15,10
,58,16,10,88,17,10,89,18,1,C
5,18,2,05,18,3,03,10,4,00,18
,6,09,18,5,C1,18,7,01,18,8,E
0,19,1,4,E,19,2,EC,19,4
1780 DATA C0,20,1,C4,20,2,C
2,20,4,C6,21,2,06,21,3,CE,21
,4,DE,21,6,CA,22,18,88,23,10
,E8,24,10,18,25,10,E8,27,2,F
6,27,3,EE,27,4,FE,27,6
1790 DATA 49,26,1,45,26,2,5
5,26,3,40,26,4,30,26,6,59,26
,5,41,26,7,51,26,8,4c,28,4,6
C,28,11,20,29,4,49,30,1,45,3
0,2,85,30,4,30,30,4
1800 DATA 80,30,6,89,30,5,A
1,30,7,81,30,8,42,31,1,46,31
,2,86,31,3,4E,31,4,8E,31,5,A
0,32,1,4,4,32,2,84,32,5,AC,32
,4,BC,32,6
1810 DATA 4A,33,0,46,33,2,5
6,33,3,4E,33,4,5E,33,6,EA,34
,10,48,35,10,8,36,10,68,37,1
0,28,38,10,40,39,10,60,40,10
,38,41,10,18,42,10
1820 DATA 78,42,10,AA,44,10
,A8,45,10,98,46,10,8A,47,10,
8A,48,10,9A,49,10,9,50,1,5,5
0,2,15,50,3,0,50,4,19,50,5,1
0,50,6,1,50,7,11,50,8
1830 DATA 2A,51,0,26,51,2,3
6,51,3,2E,51,4,36,51,6,6A,52
,0,66,52,2,4,66,52,5,6E,52,4,7
E,52,6,6E,53,1,EE,53,2,FE,53
,3,ED,53,4,70,53,6
1840 DATA F9,53,5,E1,53,7,F
1,53,8,85,54,2,95,54,3,80,54
,4,90,54,6,98,54,5,01,54,7,9
1,54,8,86,55,2,96,55,3,8E,55
,4,84,56,2,94,56,3,8C,56,4
1850 DATA 0,0,0
1860 OPT L1:table2
1870 FROM I=1 TO 5:READAS:1
PI#ASCLEFTS(AS,1):PI?1#ASCMI
D(AS,2,1):PI?2#ASCRTIGS(AS
,1)
1890 PI#PI#4:NEXT
1900 DATA ADC,AND,ASL,BCC,B
CS,BEQ,BIT,BMI,BNE,BPL,BRK,B
VC,BVS,CLC,CLD,CLI,CLV,CMPC,C
PX,CPY,DEC,DEK,DEY,INX,INY,E
OR,INC,IMP,JSR,LDA,LDX,LDY,L
SR,NOP,PHA,PHP,PLA,PLP,RTL,R
TS,SEC,SEI,SET,TAX,TAY,TYA,T
SX,TXA,TXS,ORA,ROL,ROR,SBC,S
TA,STX,STY
1920 OSCLI'SAVE TRACKER 72C
0 *STR#PX

```

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Jafa Systems	54
Kosmos Software	54
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Voltmac	12

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