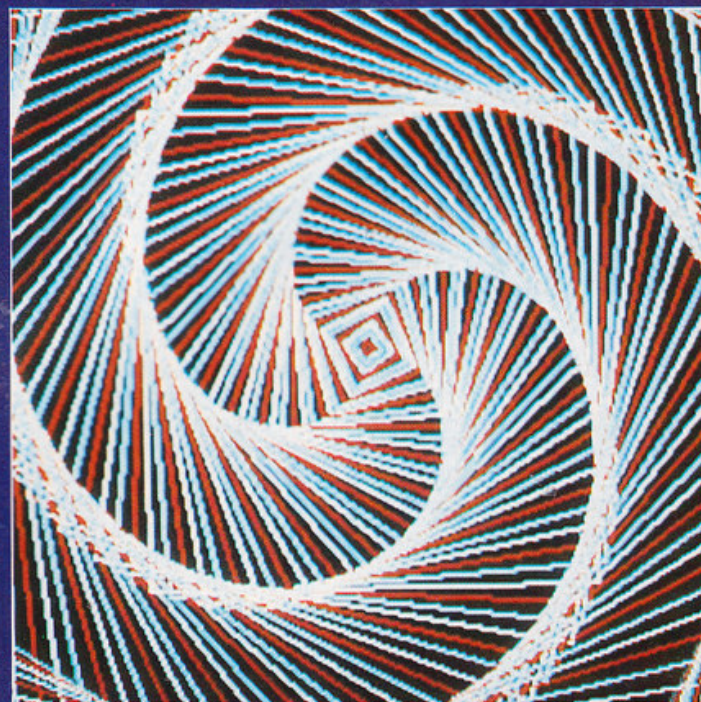
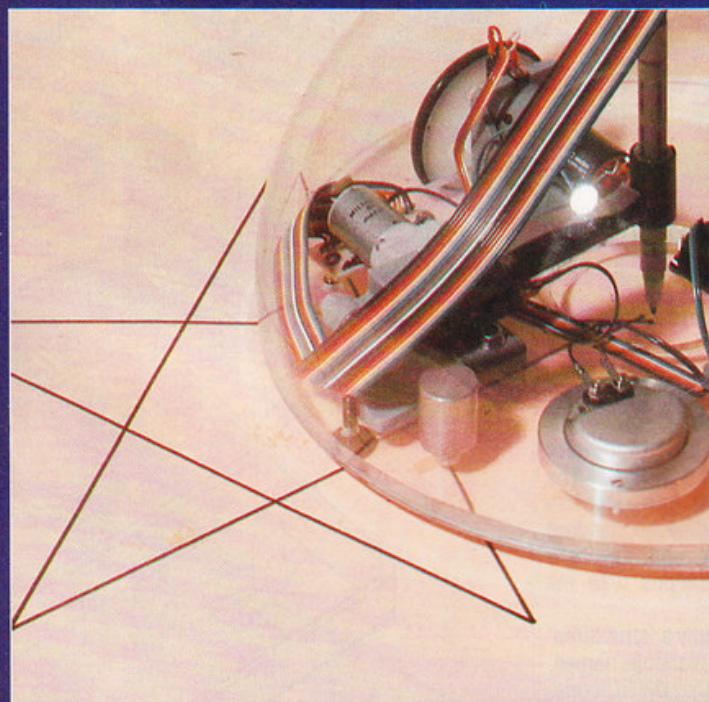
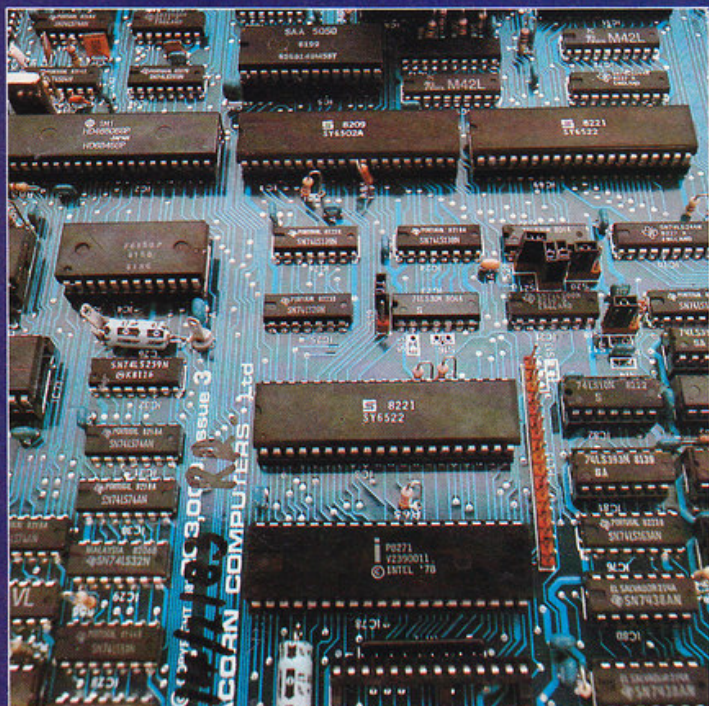


**PCN**  
micropaedia

EIGHT-PAGE  
SUPPLEMENT  
PULL OUT AND KEEP

# ANATOMY OF THE **BBC MICRO**

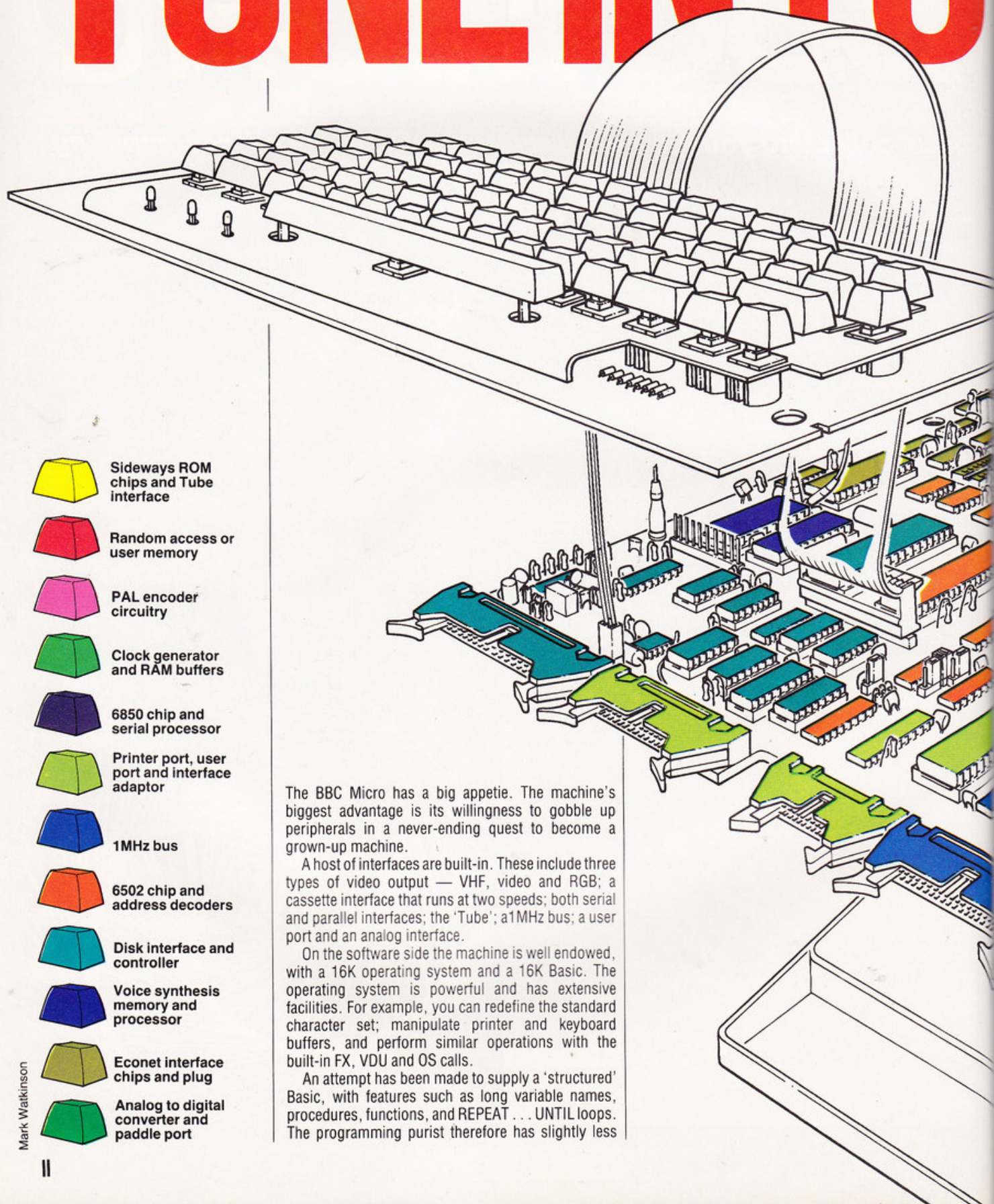
*Start collecting your complete reference library of microcomputing.*



**Part 1, Volume 1**



# TUNE INTO



Sideways ROM  
chips and Tube  
interface

Random access or  
user memory

PAL encoder  
circuitry

Clock generator  
and RAM buffers

6850 chip and  
serial processor

Printer port, user  
port and interface  
adaptor

1MHz bus

6502 chip and  
address decoders

Disk interface and  
controller

Voice synthesis  
memory and  
processor

Econet interface  
chips and plug

Analog to digital  
converter and  
paddle port

The BBC Micro has a big appetite. The machine's biggest advantage is its willingness to gobble up peripherals in a never-ending quest to become a grown-up machine.

A host of interfaces are built-in. These include three types of video output — VHF, video and RGB; a cassette interface that runs at two speeds; both serial and parallel interfaces; the 'Tube'; a 1MHz bus; a user port and an analog interface.

On the software side the machine is well endowed, with a 16K operating system and a 16K Basic. The operating system is powerful and has extensive facilities. For example, you can redefine the standard character set; manipulate printer and keyboard buffers, and perform similar operations with the built-in FX, VDU and OS calls.

An attempt has been made to supply a 'structured' Basic, with features such as long variable names, procedures, functions, and REPEAT . . . UNTIL loops. The programming purist therefore has slightly less



# THE BBC

justification for condemning Basic as used on the BBC machine. An assembler built into Basic also allows you to perform routines quickly without leaving Basic.

Educational software is also becoming available now that most local authorities are recommending the BBC Micro for schools and colleges.

Word processing is offered in a unique form on the BBC Micro. In addition to the traditional cassette and disk-based word processing, chip-based systems can be operated.

The sound generator can make four sounds at once, and each can have its 'envelope' altered. The sounds are 'interrupt driven', so that complex sequences of sounds can be generated without loss of execution speed.

The 'user keys' also prove their worth once you're familiar with the machine. These ten keys can be pre-programmed with commands, and can also be used to generate 30 extra characters.

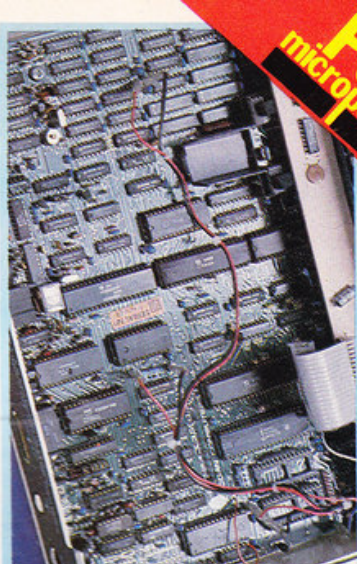
Eight graphic modes are available. The maximum resolution is 640 x 256, and a maximum of eight 'colours' can be used in some modes. Plotting co-ordinates remain the same, whatever the mode in use.

Although the BBC machine has great potential as a cassette machine it can also use disks.

The machine needs a disk interface fitted, which is possible with the 1.2 operating system. Once operating as a disk system the machine takes on a new role, with considerable potential as a business system.

The BBC machine can also be fitted with a networking system called Econet. This enables up to 256 machines to talk to one another on a single circuit, each terminal sharing the use of a single printer or disk system.

Econet is ideal for education as it allows one machine to inspect and even take over the output at each terminal.



## Tube Map

The 'Tube' is a fast means of communication through which a Model B is able to be linked with a second microprocessor system.

In such a configuration the Model B acts as an input/output device for the second processor. It handles keyboard, disks, printer, screen, clock and so on, while the second processor does the rest — executing the central processing function of running the program proper, and interpreting the commands issued in whatever high-level language is in use (for example, Basic or Pascal).

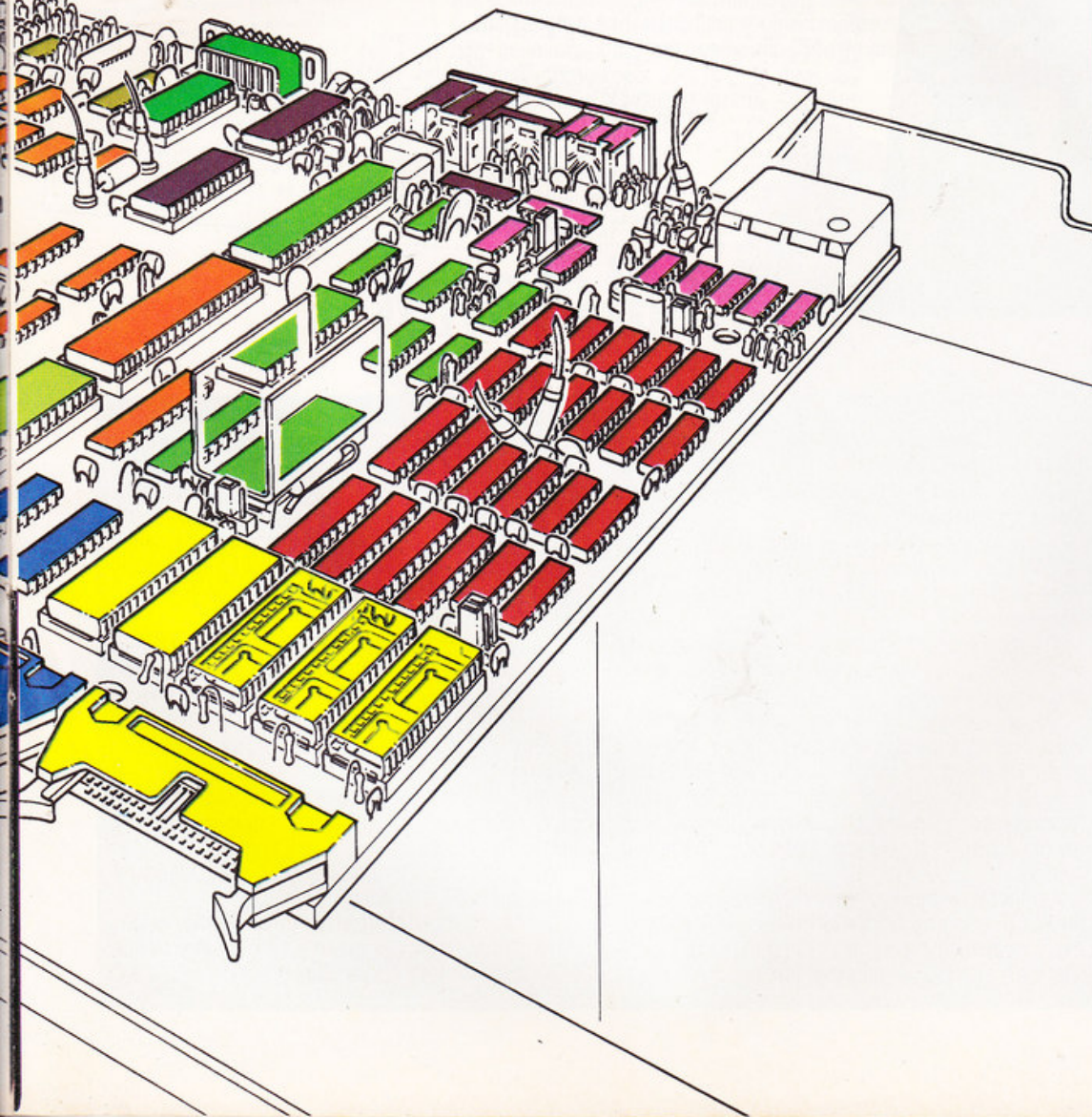
The advantages of such a system are that much of the second processor's full addressable memory (64K or more) is available for your programs.

Considerable gains in speed result, partly because you have two processors carrying out different tasks at the same time, and partly because the second processors envisaged run at a higher speed than the Beeb itself.

A further advantage is that there will be a choice of second processor. There is a fast 6502A-based processor board, a Z80 unit which can run CP/M, and a 16-bit National Semiconductor 16032-based machine which can directly address up to 16 megabytes of memory. The 6502A unit will cost around £200.

To run in Basic or any other language, the second processor must have access to an interpreter. Interpreters are currently being written for the Z80 and the 16032. The 6502A second processor unit is able to initiate a copying-over routine when first switched on, which makes a copy in its own RAM of the model B's 16K Basic ROM.

Transfer is fast and takes only about one second, though at first sight it seems wasteful to have to keep two copies of the same 16K of code. But this is a small price to pay for a technique which makes the BBC machine so expandable. Comparable machines allow only add-ons.



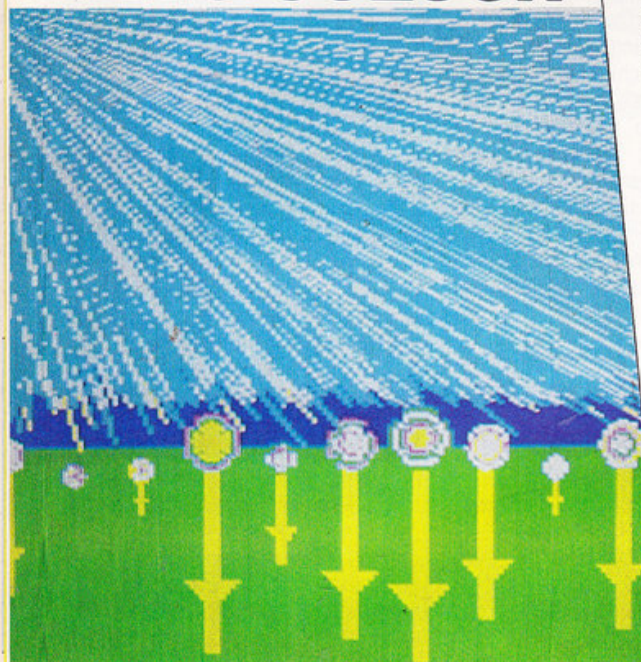


# BLOSSOMING INTO COLOUR

```

>LIST
10 MODE 2: VDU 5: VDU 19,2,0:0:19,4,0:0:
20 GCOL 0,4: MOVE 1279,1023: MOVE 0,1023: PLOT 85,1279,340: PLOT 85,0,340
30 GCOL 0,2: MOVE 0,0: PLOT 85,1279,340: PLOT 85,1279,0
40 FCX = 10: DIM PP(FCX,1), SZ(FCX), CO(FCX): SG = FALSE: RCX = 3
50 PROCPLANT_POTS: RYX = 682: SHX = 30
60 VDU 19,8,5:0:19,9,4:0:19,10,3:0:19,11,7:0:19,12,1:0:19,4,4:0:19,2,2:0:
70 REPEAT
80 PROC SUN_BURST: PROCSTALK
90 UNTIL SG = TRUE
100 RCX = 7
110 FOR CTX = 5 TO 1 STEP -1
120 LX = 9
130 FOR WX = 0 TO 9
140 LZ = LX + CTX
150 PROC SUN_BURST: PROC PETALS
160 NEXT WX
170 FOR CX = 0 TO FCX: CO(CX) = 7 + RND(5): NEXT CX
180 NEXT CTX
190 REPEAT
200 ETX = 200
210 REPEAT: UNTIL TIME >= ETX
220 PROC SUN_BURST: VDU 19,7 + RND(5),RND(7):0:
230 UNTIL FALSE
240 DEF PROCPLANT_POTS
250 FOR CX = 0 TO FCX
260 PP(CX,0) = 100 + CX * 109: PP(CX,1) = RND(299)
270 SZ(CX) = 3 - PP(CX,1)/100: CO(CX) = 7 + RND(5)
280 NEXT CX
290 ENDPROC
300 DEF PROC SUN_BURST
310 FOR CX = 0 TO 4
320 GCOL 0,RCX: PROC CRAY
330 GCOL 0,6: PROC CRAY: PROC CRAY
340 NEXT CX
350 ENDPROC
360 DEF PROC CRAY
370 X% = RND(1279): Y% = RND(RYX)
380 MOVE 0,1023: DRAW X%,Y% + 1023 - RYX
390 ENDPROC
400 DEF PROCSTALK
410 FOR CX = 0 TO FCX
420 GCOL 0,3: X% = PP(CX,0): PROC LINE
430 IF SZ(CX) > 1 THEN X% = PP(CX,0) - 4: PROC LINE: X% = PP(CX,0) + 4: PROC L
440 IF SZ(CX) > 2 THEN X% = PP(CX,0) - 8: PROC LINE: X% = PP(CX,0) + 8: PROC L
450 IF SHX = 20 THEN PROC LEAF
460 PP(CX,1) = PP(CX,1) + 4 * SZ(CX)
470 IF 1023 - PP(CX,1) < RYX THEN RYX = 1023 - PP(CX,1)
480 NEXT CX
490 SHX = SHX - 1: IF SHX = 0 THEN SG = TRUE
500 ENDPROC
510 DEF PROC LINE
520 MOVE X%,PP(CX,1): DRAW X%,PP(CX,1) + 4 * SZ(CX)
530 ENDPROC
540 DEF PROC PETALS
550 FOR CX = 0 TO FCX
560 GCOL 0,CO(CX): X% = PP(CX,0): Y% = PP(CX,1)
570 R = LX / (4 - SZ(CX))
580 FOR TH = 0 TO PI/5 STEP 4/R
590 DX% = R * SIN(TH): DY% = R * COS(TH)
600 MOVE X% + DX%,Y% + DY%: DRAW X% - DX%,Y% + DY%
610 MOVE X% + DX%,Y% - DY%: DRAW X% - DX%,Y% - DY%
620 MOVE X% + DY%,Y% + DX%: DRAW X% - DY%,Y% + DX%
630 MOVE X% + DY%,Y% - DX%: DRAW X% - DY%,Y% - DX%
640 NEXT TH
650 IF 1023 - Y% - R < RYX THEN RYX = 1023 - Y% - R
660 NEXT CX
670 ENDPROC
680 DEF PROC LEAF
690 GCOL 0,3: MOVE PP(CX,0) + 16 * SZ(CX),PP(CX,1)
700 MOVE PP(CX,0),PP(CX,1): PLOT 85,PP(CX,0),PP(CX,1) - 16 * SZ(CX)
710 PLOT 85,PP(CX,0) - 16 * SZ(CX),PP(CX,1)
720 ENDPROC

```



# SECOND OPINION

I started with the book.

My first impression of the BBC Model B micro-computer User Guide was that it was well-written and clearly presented. But I quickly discovered it was best suited for reference purposes.

It contains descriptions of the capabilities of the machine, its operating system and language, but has none of the kind of spoon-feeding you expect in a training manual.

The references to sound and graphics suggested wide-ranging capabilities which were borne out when I began programming.

Sound was particularly impressive, with a four-voice synthesiser which allows definition of a plethora of effects using the simple SOUND and ENVELOPE functions. The graphics facility gave me various formats (according to 'mode' selected) depending on my requirements of pixel size, text size and number of colours.

Another attraction for me was that characters within the ASCII set can be defined by the user. In BBC Basic, the implementation of 'PROCEDURE' and 'REPEAT...UNTIL' made programming much easier

and allowed better structuring of programs.

When I ran a series of test programs, the speed of operation was impressively fast. Even when I added modules to programs simply by tacking them onto the end, operating speeds did not seem to fall. After I'd written my program and added lines to it, the dynamic RENUMBER function was very rapid in re-aligning the documentation, while the LISTO function facilitated well-laid-out listings.

I spotted a slight drawback to the system in BBC's screen display. The machine used only one screen display area, while the Apple II, for example, can give up to two text screens and two high-resolution graphic screens (admittedly at a cost to available user memory).

However, the BBC compensates for this by combining user-selectable text and graphic windows with mixed-screen use.

With the speed of the machine, animation and sound can easily be added.

Overall, I felt a lot of effort had gone into the design, making even this small micro a very capable device with good facilities for expansion.

NC



# COUNTING ON THE BEEB

Four short programs to demonstrate in a rudimentary way the mathematical capabilities of the BBC Model B. One calculates fuel consumption on any car, in either imperial or metric fuel measurement (gallons or litres) and by the mile or kilometre. Another converts Centigrade temperatures to Fahrenheit, the third will add VAT to any price you are quoted, and the final program will give you percentages. They are short but are easy to expand and develop to handle more complex tasks. They also demonstrate the power of the 'INPUT' request which asks for more information to complete the program.

```
10 PRINT "INPUT THE DISTANCE TRAVELLED"
20 PRINT "FOLLOWED BY A COMMA AND THE PETROL USED"
30 INPUT M,P
35 PRINT "HERE IS YOUR CONSUMPTION"
40 PRINT M/P
```

```
3 REM A PROGRAM TO CONVERT CENTIGRADE
5 PRINT "INPUT THE CENTIGRADE VALUE"
10 INPUT C
15 PRINT "HERE IS THE FAHRENHEIT"
20 PRINT 9/5*C + 32
```

```
5 PRINT "INPUT THE PRICE WITHOUT V.A.T."
10 INPUT V
15 PRINT "HERE IS THE PRICE WITH V.A.T."
20 PRINT 1.15*V
```

```
3 REM "PERCENTAGES PROGRAM"
5 PRINT "INPUT THE PERCENTAGE YOU WANT"
10 PRINT "THEN A COMMA AND THEN THE"
20 PRINT "THE NUMBER YOU WANT THE PERCENTAGE OF"
30 INPUT P,N
40 PRINT "HERE IS THE ANSWER"
50 PRINT N*P/100
```

If the micro is the biggest thing to hit science labs since the test tube, then the BBC machine is the Pyrex of computers.

The BBC micro's 80 per cent penetration rate into schools is probably the best testament to that view.

In the schools, where most scientific and maths software is developed, high resolution graphics, animation and colour have until recently been missing from programs.

The marketplace demands that this BBC 'software gap' be filled — with the emphasis on quantity, not quality. This will happen as existing maths and science programs are translated to run on BBC machines.

Some of the best new software is being produced by the ILEA (Inner London Education Authority) SMILE centre (Secondary Mathematics Individualised Learning Experiment). SMILE programs are not written to prescribed formulas, or to fit existing mathematical structures. They are based on the ideas of teachers who have worked with children on micros.

A program called Snooker helps students judge angles and understand the geometric principles behind them, while in the Lines program talk between the two players is encouraged as they work together to defeat the computer.

One important maths capability of the BBC micro is its implementation of the Logo educational language. It is claimed that children can more easily understand spatial concepts and relationships, object representation, geometry, arithmetic, computing and problem-solving by using Logo.

Less software is available for the scientific uses of the BBC than for the mathematical, and much of it is of highly specific use in the classroom.

Dave Holland of the University of London Institute of Education offers a BBC-based Mass of Magnesium program that allows real-time interaction.

Another ideal scientific use for the BBC machine centres on the user port (a device made possible by the micro's 6502 base and 6522 VIA chip). This port makes it possible, for example, for a BBC Model A to use a joystick.

The user port can also be used for inter-machine communications and control of machinery — which would allow two BBCs to play against one another.

In addition to the user port, the BBC Model B has a digital to analog converter which makes short work of data collection in school science experiments. Unlike single-channel digital to analog converters available for other computers, the BBC multiplexes four inputs into one converter.

The conversion speed makes it too slow for speech conversion and recognition, or for recording a sine wave more than 1Hz, but the sampling speed matches the resolution of the screen. This useful compromise allows the machine to become a digital oscilloscope and record any experiment that inputs analog information at a slow enough speed.

The BBC's EVAL command is also a valuable feature in science work. You can type an equation into the computer while a program is running and allow the computer to evaluate the equation. This makes it comparatively easy to write programs that allow you to input an equation and have the computer plot a graph.

Graphics or text can be mixed on the BBC, and this makes the machine useful in labelling graphs. Text can be moved around easily, so MgO need not appear as Mg2O. Finally, the dual processor capability of the BBC makes a parallel computation possible.

## Keys to the Store

The BBC Micro's 10 red function keys may look bland, but once you get used to them they are among the machine's most versatile features.

One marathon session of loading cassette programs by endlessly typing in CHAIN" and/or LIST, LOAD and RUN should convince you.

Take the CHAIN" function. By simply typing \*KEY 1 CHAIN" and hitting Return, function key 1 will automatically respond with CHAIN" when pressed. Number that instruction 10 \*KEY 1 CHAIN" and you have the beginnings of a program to load all your most common instructions onto the function keys.

If you then go on to load all the function keys with useful commands (don't forget function key 0) and save

the program, you will have an easily accessed group of key utilities that can be downloaded every time you turn on your machine.

You can then go on to make up a chart that will tell you what you have programmed each key to do. This can be slipped under the clear plastic ruler above the function keys. If you have more than one program using the function keys, you can devise interchangeable charts — although if you use the VIEW word-processing system, your chart space will be occupied by the VIEW command ruler.

Once loaded, the functions will stay on the specified keys until you do a 'hard' reset (hit CONTROL and BREAK keys together), turn the machine off or reprogram the keys. This means that you can load and exit as many programs as you wish without losing the special functions.





# Learning by Logo

The BBC is multi-lingual and will converse in several computer languages. Among the most interesting is Logo, a language developed to help children learn to talk to computers.

The Turtle is to Logo what the hand is to drawing. It can be either a cybernetic robot such as the Edinburgh Floor Turtle, consisting of a clear plastic dome on wheels with a retractable pen at the centre of its base, or it can be a triangular image on a VDU screen that creates a pattern by tracing a line as it moves.

There are many BBC Logo dialects, but even the most primitive can accommodate the same simple commands as the most powerful.

For instance, an equilateral triangle can be drawn in any Logo in this way, programming in 'direct mode':

```
FORWARD 100
RIGHT 120
FORWARD 100
RIGHT 120
FORWARD 100
```

Units for forward and backward movement are arbitrary, but angle movement left or right is in degrees. Usually, Logos allow single or two-letter entry for commands — FO or FD, LE, RI, etc.

Most Logos also incorporate a REPEAT command so the triangle can be drawn more easily, typing a single line command.

This loop procedure can then be defined as TRIANGLE and saved for later use as a command.

Computer Concept's Logo II is the most powerful Logo available for the BBC Micro. To make a series of ever-growing triangles involves a recursive use of variables:—

```
TO SERIES
  MAKE SIZE = 50
  REPEAT 10, TRIANGLE: MAKE
    SIZE = SIZE + 10
END
```

All Logos have a PENUP and PENDOWN command so that lines need not appear connected, but even BBC Logo II lacks an ERASE command, which could allow animation and the removal of accidental lines.

Although these graphics may seem to be a product of BBC Basic language, they are, in fact, a product of the operating system, as is the machine's sound capabilities.

# BASIC FACTS

Basic is often condemned as harmful to the development and understanding of programming principles. But one of the most vociferous of its critics, Roy Atherton, has said that BBC Basic 'represents a major advance in educational and practical terms'.

There are four areas where BBC Basic really scores over other popular versions.

## 1 Long variable names

Compare:—

```
FOR I=0 TO N STEP S
```

with:—

```
FOR total=0 TO GRANDTOTAL STEP GROSS
SUBTOTAL
```

The second statement is clearly much more comprehensible than the first. Its great merit is that it is effectively self-documenting, and this makes subsequent debugging and alteration much easier.

Many Basics seem to allow the use of long variable names but actually recognise only the first two letters: this means that they will not differentiate between GRANDTOTAL and GROSS\_\_SUBTOTAL.

Moreover, embedded keywords, such as the TO in GRANDTOTAL or SUBTOTAL, can cause problems in many versions of Basic.

But in BBC Basic all letters of a variable name are recognised, and embedded keywords are allowed.

A variable cannot begin with a keyword, which is why we write 'total' and not 'TOTAL'. In BBC Basic, all keywords use upper case letters only, which gives you complete freedom to use lower case characters when naming variables.

## 2 Procedures, multi-line functions and local variables

Compare:—

```
X=T1:Y=T2:R=T3:GOSUB 2000
```

with:—

```
PROCCIRCLE (XCENTRE,YCENTRE,DIAMETER/2)
```

or:—

```
N=N1:S=S1:U=U1:GOSUB 1000:A=A1
```

with:—

```
ANSWER=FNNET_PROFIT (NUMBER, SIZE,
UNIT_COST)
```

In both cases, the self-documenting benefit is obvious. The parameters in both the procedure and the function are passed to local variables in the procedure definition.

So if the definition for PROCCIRCLE begins DEF PROCCIRCLE(XCOORD,YCOORD,RADIUS) then any value taken by XCOORD,YCOORD and RADIUS within the procedure are purely local to it and will not affect their values if they are also used in the rest of the program.

Moreover, if the procedure also uses the variables STORAGE and PLACE it can ensure that these are local too by writing LOCAL STORAGE,PLACE before the first use of STORAGE and PLACE within the procedure.

In this way, one can safely build up and use a library of procedures (and functions) without fear of contamination from variables used in the library routine. And one can safely utilise recursive definitions of procedures (and functions) while retaining initial condition values.

In BBC Basic, functions can be exceptionally complex constructions of many lines. The function is terminated by the equals sign, followed by the required return value of the function.

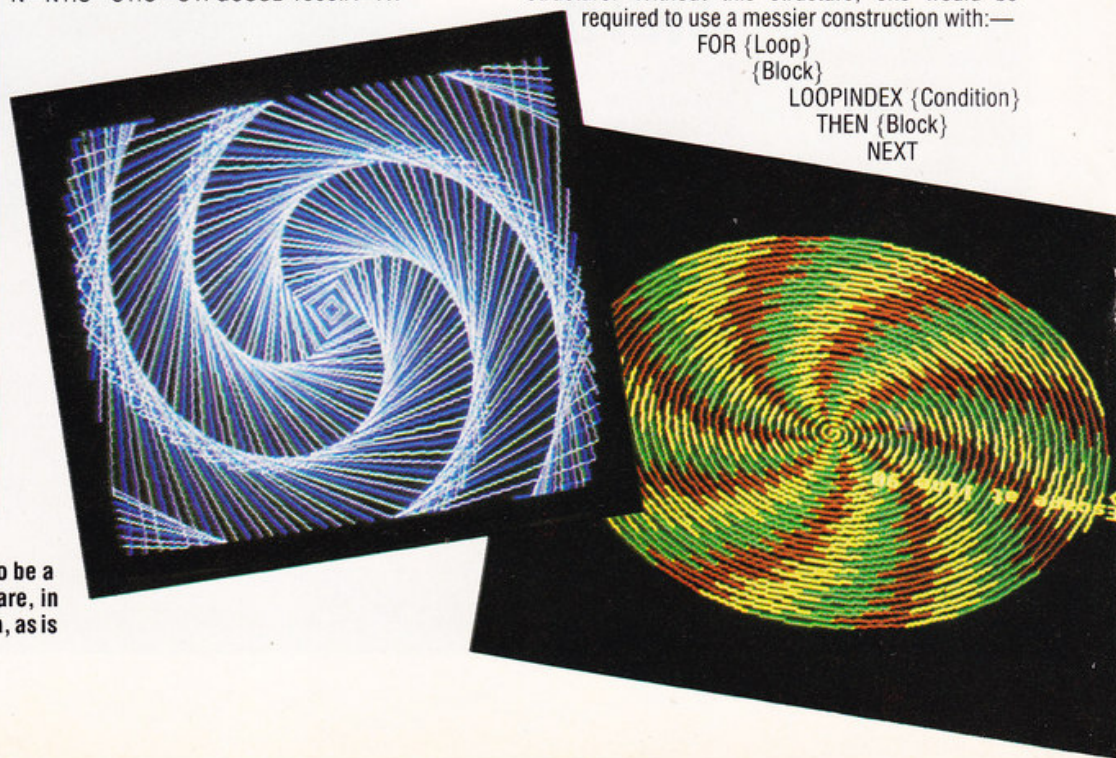
Many versions of Basic allow only one-line functions. And few utilise local variables, despite all the benefits they confer. Still fewer of them implement procedures at all.

## 3 Some extended structure

All Basic dialects allow the IF... THEN construction. Some extend this to IF... THEN... ELSE. BBC Basic is one of these, but only on a single-line basis. However, this is not as great a disadvantage as it might seem since a line in BBC Basic can be up to 238 characters long.

Few Basics implement the REPEAT... UNTIL structure. Without this structure, one would be required to use a messier construction with:—

```
FOR {Loop}
  {Block}
LOOPINDEX {Condition}
THEN {Block}
NEXT
```





at the test condition point.

Unfortunately, the other vital structure REPEAT-  
WHILE...ENDWHILE is missing from BBC Basic (as it  
is from virtually all Basics), and this means that if you  
want to implement a loop structure which allows exit  
before the loop is performed, you must fabricate one  
using:—

```
IF {Condition}
THEN {Block}
ELSE GOTO ...
```

It is important that, when listing, the structure  
inherent in a well-written program can be displayed by  
use of indentation at the entry and exit points of loops.  
BBC Basic goes some way to providing this with its  
LISTO command.

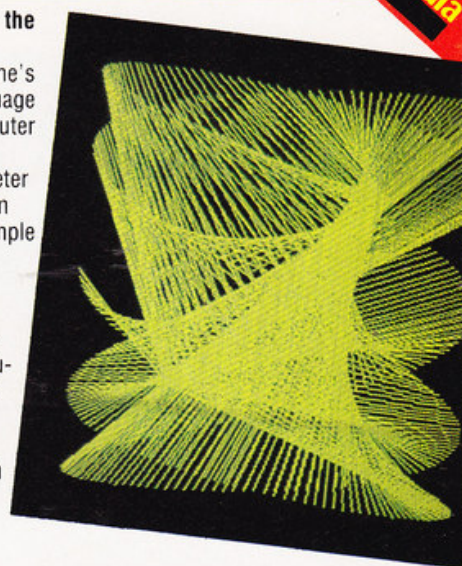
Almost all Basics implement an ON...  
GOTO/GOSUB structure, and it would have been  
helpful if BBC Basic had extended this to ON...PROC;  
but unfortunately it does not.

#### 4 A built-in assembler with easy access to the resident operating system.

The BBC's built-in assembler is one of the machine's  
most valuable assets. Working in assembly language  
allows a valuable insight into the way the computer  
functions, as well as providing increased speed.

Also unusual in the BBC dialect is an interpreter  
that contains an assembler entered directly from  
Basic. This allows convenient editing and the simple  
mixing of Basic and assembler, which in turn  
allows other facilities.

All the main operating system functions are  
available to the assembler (and some are avail-  
able in BBC Basic also) and these are well docu-  
mented in the user guide. Acorn has done this  
because of the importance of writing software  
in a way which is compatible with the Tube, a  
high-speed interface which allows the connection  
of other processors.



# SPECIAL WORDS

<b>ADVAL (OS)</b>	Reads the appropriate analog port.	<b>INKEY</b>	limit. Can also be used to sense if one or more keys pressed.	<b>SOUND (OS)</b>	Sound generation command — there are three channels plus a white noise channel, any of which may be combined.
<b>AUTO</b>	Generates Basic line numbers.	<b>INSTR</b>	Returns position of substring in a string.	<b>STRINGS</b>	Outputs copies of a specified string.
<b>CALL</b>	Allows Basic variables to be passed to a machine-code program.	<b>LINE</b>	Used with INPUT to allow unrestricted input.	<b>TAB (OS)</b>	Two-dimensional tabulation, text and graphics.
<b>CLG (OS)</b>	Clears graphics area (leaves text windows alone).	<b>LISTO</b>	Produces structured output with LIST.	<b>TRACE</b>	Fairly simple program trace.
<b>CLS (OS)</b>	Clears text area (leaves graphics windows alone).	<b>LOCAL</b>	Sets local variables within procedures and functions.	<b>UNTIL</b>	See REPEAT.
<b>COLOUR (OS)</b>	Changes text colours.	<b>LOMEM</b>	Sets bottom of usable memory above Basic program.	<b>USR</b>	Allows access to the 6502's registers on return from a machine-code program.
<b>COUNT</b>	Counts characters output to any output channel for current line.	<b>MOD</b>	Remainder on integer division.	<b>VDU (OS)</b>	General-purpose entry to OS screen-handling functions like windows, user-defined characters and colour palette changes.
<b>DELETE</b>	Deletes a contiguous group of Basic lines.	<b>MODE (OS)</b>	Selects screen mode. There are eight possibilities ranging from 640 × 256 pixel two-colour display, through 160 × 256 pixel 16-colour display to standard teletext.	<b>VPOS (OS)</b>	Vertical text cursor position.
<b>DIV</b>	Integer division (ie result with no remainder).	<b>MOVE (OS)</b>	Move to specified point on graphics screen.	<b>WIDTH</b>	Sets a limit to computer 'page' width.
<b>DRAW (OS)</b>	Draws a continuous straight line.	<b>OLD</b>	Allows recovery from NEW.	<b>★FX (OS)</b>	Allows access to many general-purpose OS functions such as disabling cursor keys, disabling ESCAPE, turning on the printer and acting on various input/output buffers.
<b>ELSE</b>	Used in IF... THEN... ELSE etc.	<b>OPT</b>	Specifies assembler output (assembler is entered with [ and exited with]).	<b>★OPT (OS)</b>	Allows filing error messages and actions to be altered.
<b>ENDPROC</b>	Terminates a procedure definition (which begins DEF PROC).	<b>PAGE</b>	Allows multiple programs in memory.	<b>★KEY (OS)</b>	Allows programming of the user-defined keys.
<b>ENVELOPE (OS)</b>	Defines a frequency and amplitude envelope.	<b>PLOT (OS)</b>	The main graphics command — allows plotting, drawing and filling.	<b>★LOAD/★SAVE (OS)</b>	Allows filing control over any section of memory.
<b>ERL</b>	The line number at which the last 'error' (including ESCAPE) occurred.	<b>POINT (OS)</b>	Allows pixels to be read.	<b>★TAPE/★DISC/★ROM/★NET/★EXEC/★SPOOL</b>	Easy interchange between filing systems. Allows loading & saving of ASCII files.
<b>ERR</b>	The error number of the last 'error'.	<b>POS (OS)</b>	Horizontal position of text cursor.		
<b>ERROR</b>	Used in ON ERROR to provide error trapping.	<b>PROC</b>	Accesses a specified procedure.		
<b>EVAL</b>	Applies Basic's evaluation routines to user input. Very powerful.	<b>RENUMBER</b>	Very fast renumbering of a Basic program.		
<b>GCOL (OS)</b>	Changes graphics colours.	<b>REPEAT</b>	Part of REPEAT...UNTIL structure.		
<b>HIMEM</b>	Sets the top of usable memory below screen.	<b>REPORT</b>	Gives text of last 'error'.		
<b>INKEY (OS)</b>	Reads input with time				



# USER GUIDE EXTRA

You may have been told the User Guide is the bible of the BBC, but you'll soon find all you need isn't there. Even guide author John Coll believes that it probably needs a supplement.

Here are some of the things that are missing from the user guide or are very difficult to find.

One of the first problems you're likely to have is screen flutter caused by the BBC's interlaced PAL video signal. To fix this jitter, use the operating system command \*TVO, 1 and then hit Return.

The change may not be apparent immediately, as it doesn't take effect until you next change modes. Now try Mode 3 and Return — you should achieve a stable picture.

The \*HELP and the \*FXO commands are actually missing from the user guide. Either will give details of the operating system, and tell you what extra ROMs are installed in the machine and what programs are on those ROMs.

The \*FXO operating system command is one of a number of \*FX commands not mentioned in the guide. The \*FX 16,0 turns off the analog-to-digital converter on the Model B (theoretically allowing programs to run faster).

The \*FX 4,2 command (on the 0.1 operating system) enables cursor keys to be read with INKEY or GET. But on the 1.0 operating system those commands would be \*FX4, 1 to enable the cursor keys to read INKEY or GET and \*FX4,0 to return them to normal.

Some cassette-loading fixes on the 0.1 operating system are also omitted (see part 2 of this Micropaedia), as well as detailed commands for use with the Disk Operating System, Econet and the Teletext adapter.

Instructions and operating details for each of these add-ons will, however, be included when you buy them.

BBC boards being assembled and tested by Acorn at Race Electronics in Mid-Glamorgan, South Wales. Here a chip is being checked.

## Likely Languages

Three popular languages besides Logo are advertised for the BBC micro.

All are available from Acornsoft, the software wing of Acorn Computers. Forth and Lisp are put on to the BBC using cassette tapes and books, and the BCPL heavy systems language will be available on a 16K ROM chip from Acorn.

Acornsoft's Forth is claimed to be a complete implementation to the 1979 standard specification, and will run on the Model B significantly increasing program execution speed.

Acorn claims up to five times the speed of Basic, although you will have to get used to the idiosyncratic Reverse Polish Notation employed by the language.

The Forth package costs £7.50 and includes a Forth dictionary, compiler, tape interface or screen editor, macro-assembler and high-resolution graphics demonstration.

The company also offers a version of Lisp, the language used in artificial intelligence research, which includes a 5.5K machine code interpreter, and 3K of initialised Lisp workspace with constants and utilities. This package also costs £7.50.



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## Next Week

Part 2 of Anatomy of the BBC Micro looks at peripherals, word-processing on a chip and games for the Beeb.

And in two weeks' time, the third and final part of our first Micropaedia series highlights the Acorn Econet system, the mysterious plastic turtle and a guide to servicing your BBC.