AN ARGUS SPECIALIST PUBLICATION

computing today

JANUARY 1985
90p

GAMES-MANSHIP
The rights and wrongs of software writing

BBC COMMODITIES
Stocks and shares and bulls and bears

MUD, MUD, GLORIOUS MUD:
Monsters down the modem

Is there Life on the MTX?
Conway's game revisited

Big business: Fujitsu reviewed

HAVE AN ADVENTURE THIS CHRISTMAS WITH LEVEL 9

"The appearance of a new program from Level 9 is a flag-day for all aspiring adventures and, in my household, a signal for the cat to hide under the bed for the duration against the inevitable moment when I go rampaging through the flat, a wild look in my eyes muttering ferociously about bricklaying birds nudist beaches and the like. Since *Return to Eden*, the sequel to *Snowball* is out, the cat may be in hiding until Christmas.

You don't need to have played *Snowball* to get into the sequel as ever, there is ample documentation with the tape which in my Commodore 64 version (it is also on the Spectrum, Amstrad and BBC), is turbo-loaded. It starts with you, agent Kim Kimberly, having been framed for sabotaging the colonyship Snowball, in a crashed stratoglider on the planet Eden. For the moment your mission is to survive the misplaced retribution by your own people, but life gets very much more complicated than that. Solving these puzzles has nothing to do with luck: you either figure your way out of trouble on Eden or die there.

One major difference between this and former Level 9 efforts is that the Spectrum and C64 versions have graphics of a very high quality and can be switched off if required. The scope of the vocabulary appears unscathed by this addition.

Even experienced adventurers will probably get fried a few times by the avenging engines of the Snowball, before discovering how to take shelter. But, once that hurdle is passed, the real adventure begins, and it's a lulu.

From the radioactive desert caused by the engine blast, you progress through a variety of hazards through some highly unlikely locations.

I haven't got to that point yet, and so far superhuman willpower has stopped me using the clue sheet provided, but I can't hold out very much longer since I am having what could be lethal communication problems with some robots. Terrific fun, but should carry a mental health warning."

Popular Computing Weekly 7 Nov 84

DISTRIBUTORS

If your local dealer doesn't stock Level 9 adventures yet, use the coupon to buy them from us, or ask him to contact: Centresoft, Microdealer UK, Lightning, R&R, Leisuresoft, PCS(SW), MCD, TBD etc.

	Cassette £9.95	Disk £11.95 BBC or CBM64
COLOSSAL ADVENTURE: The classic mainframe game, with 70 bonus rooms.	☐	☐
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SNOWBALL: Immense Science Fiction game with over 7000 locations.	☐	☐
RETURN TO EDEN: Vegetarian adventure. (Amstrad, CBM 64 and Spectrum versions have 240 pictures).	☐	☐
LORDS OF TIME: Imaginative romp through World History.	☐	☐
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AMSTRAD BBC CBM64 SPECTRUM MEMOTECH NASCOM ATARI

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VOL 6 NO 11 JANUARY 1985

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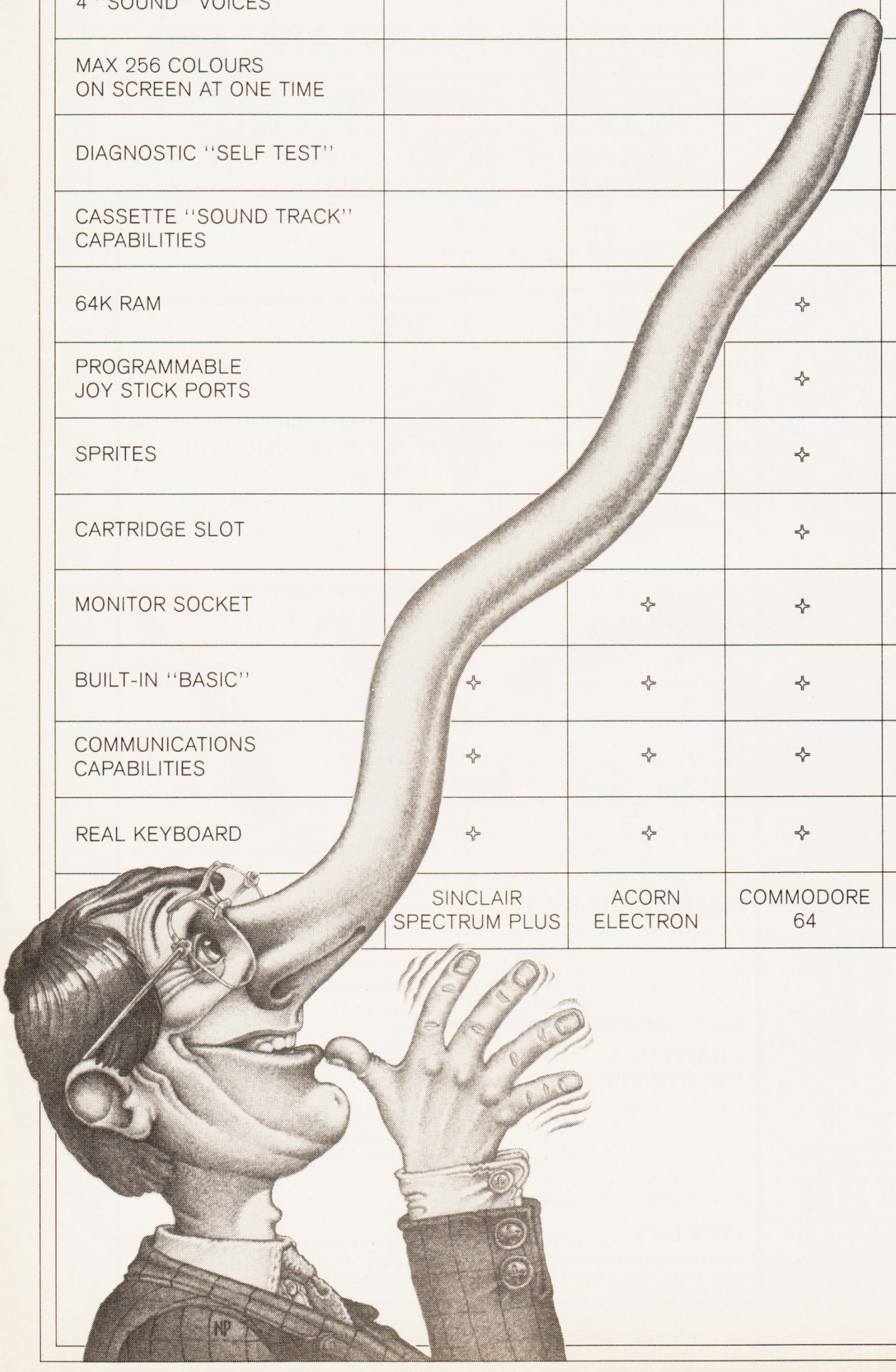
Computing Today is constantly on the look-out for well written articles and programs. If you think that your efforts meet our standards, please feel free to submit your work to us for consideration.

Potential contributors are asked to take note of the points raised in our Program Submissions page, which can be found on page 10 of this issue.

We regret that Part 2 of the Amstrad drawing program will not now appear until next month.

FEATURES				
4 "SOUND" VOICES				✧
MAX 256 COLOURS ON SCREEN AT ONE TIME				✧
DIAGNOSTIC "SELF TEST"				✧
CASSETTE "SOUND TRACK" CAPABILITIES				✧
64K RAM			✧	✧
PROGRAMMABLE JOY STICK PORTS			✧	✧
SPRITES			✧	✧
CARTRIDGE SLOT			✧	✧
MONITOR SOCKET		✧	✧	✧
BUILT-IN "BASIC"	✧	✧	✧	✧
COMMUNICATIONS CAPABILITIES	✧	✧	✧	✧
REAL KEYBOARD	✧	✧	✧	✧
	SINCLAIR SPECTRUM PLUS	ACORN ELECTRON	COMMODORE 64	ATARI 800XL



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NEWS

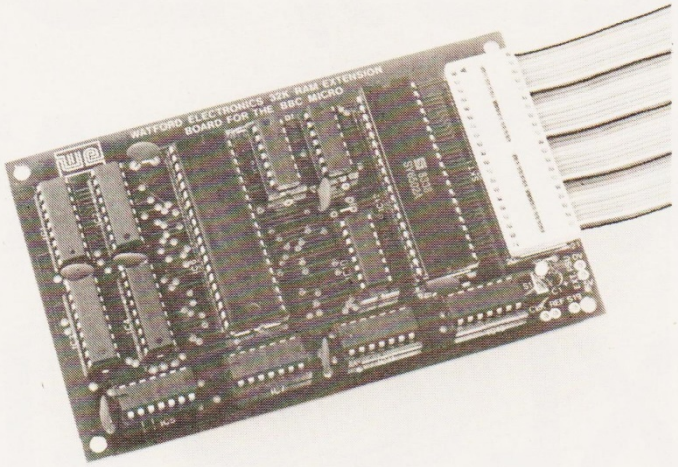
BEEB BITS

Watford Electronics have added two new products to their range of hardware for the BBC Micro. The first, illustrated here, is a ZIF socket (zero insertion force) on a small circuit board which fits into the keyboard breakout panel and connects to one of the internal ROM sockets. No soldering is needed. Now you can swap sideways ROMs in and out without opening up the Beeb: price is £16 plus VAT.

If more RAM is your problem, Watford have an answer to that too. They have a 32K RAM expansion card which fits inside the computer. The extra RAM can be used as screen memory, freeing something like 28K for use as program space in modes 0-2; as an I/O buffer; and as a printer buffer for word processing systems. For £69 plus VAT you get the RAM card, a manual and the firmware. Watford Electronics are at 33/35 Cardiff Road, Watford, Herts WD1 8ED (phone 0923 40588).

AUDIOGENIC OMISSION

In last month's review of the KoalaPad graphics tablet, we forgot to include the name of the UK distributor. Audiogenic are the people to contact, and they can be found at 39 Suttons Industrial Park, London Road, Reading, Berkshire RG6 1AZ (phone 44-734-664646).



FOSTERING AI

An artificial intelligence system that has been developed in secret by a Western Australian firm is expected to earn it tens of millions of dollars — and is regarded as a quantum leap forward in silicon circuitry. The project, named Hi-Q, is an entirely new approach to artificial intelligence and was designed wholly in Western Australia.

The veil was partially lifted on the system on 7 September 1984 by the Deputy Premier and Minister for Technology, Mr Bryce, at a press conference to announce that one of the keys to the security of the system — a large scale integrated (LSI) custom chip — had been commissioned from US manufacturer.

The breakthrough has been achieved by Formulab Technology (Australia) Pty Limited, of Subiaco, Western Australia. Nearly three years ago its research team 'stubbed its toe' on a particular effect. It was studied for four months before the effect was fully understood. When its potential became obvious, the team decided to do further development work in secret to diminish the risk of pirating by other companies. The research premises remained un-named and were guarded by a number of security devices.

The State Government became interested in August 1983. "We were able to provide additional protection to the company and to introduce it to top government consultants in Western Australia and other States," Mr Bryce said.

In September last year, a graphics recorder using the intelligence system astonished visitors to an international electronics exhibition in Sydney. Interest in it was expressed from many parts of the world. Formulab has continued its development so that the final product would perform to its optimum.

Mr Richter, MD and Chairman of Formulab, said: "Our secret is that we are able to produce the system and its ancillary devices in an extremely compact form and at only a fraction of the cost — perhaps only 5 per cent — of equipment that might perform similar functions. And we believe that, as a generic technology, it has more potential than anything else known to us in the world." Mr Richter expected the first recorder and other products to go on sale in the United States in January

ROLLING YOUR OWN

DIY computer persons can now make use of two small computer boards from J.P. Designs, the Communicator 65 and the Control 68. The former is a 6502 computer which can perform many complex processing tasks. It is supplied fully cased and opperates from a mains supply. The unit which conforms to International safety requirements is ideally suited for serial protocol manipulation applications.

The Communicator 65 provides two separate RS232C serial asynchronous channels, operating at 50 to 19200 baud, and will support commonly used handshake protocols. The board also contains 2K of static RAM, 2 to 32K of EPROM decoding, and a 6522 VIA which provides 16 I/O lines with handshake signals and two powerful interval timers. A mains-derived non-maskable interrupt can be used for real time applications.

The hardware can be configured to operate in many different modes by setting on-board links. The unit is supplied with clear user notes and circuit diagram and a 4K monitor EPROM, but particular application software can be made available.

Communicator 65 is supplied at a basic price of £229.95 plus VAT.

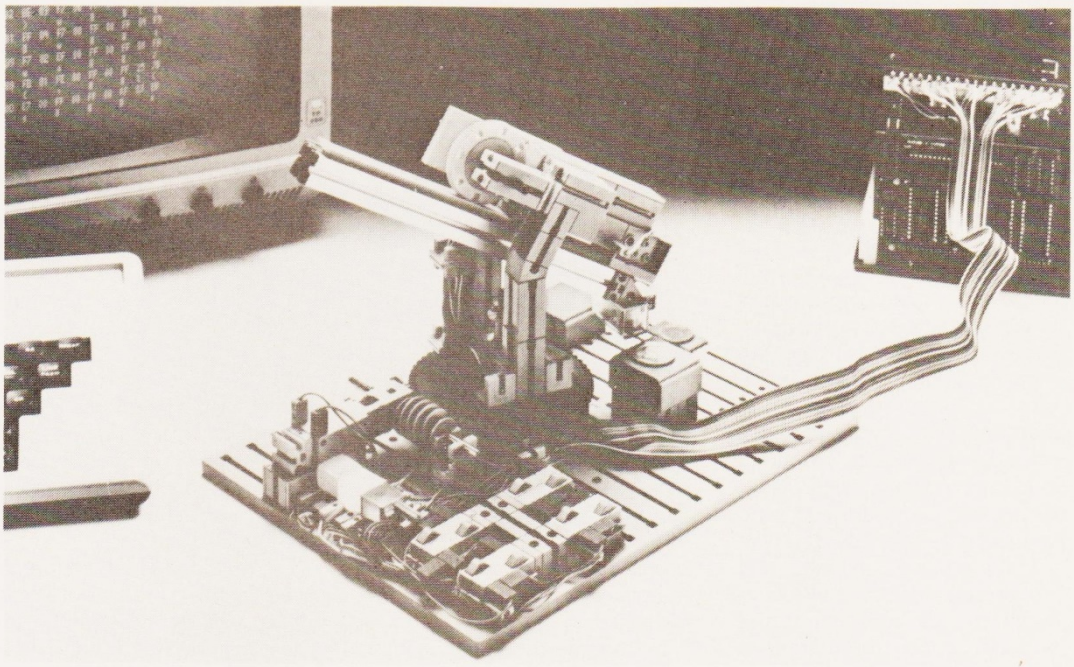
Control 68 was designed to give small 'stand alone' terminals, intelligence and flexibility. This compact 75 mm by 100 mm PCB needs only a +5 V supply and features the 6802 microprocessor running at 4 MHz, 2K of user RAM, up to 8K of EPROM decoding and 16 TTL compatible Input/Output lines. Onboard links allow 2716 or 2732 EPROM-type devices to be used. PIOinterrupts are serviced for quick I/O response times.

The card is supplied with full user notes and circuit diagram at a cost effective price of £54.95 plus VAT. You can contact J.P. Designs at 37 Oyster Row, Cambridge CB5 8LJ (phone 0223 322234).

I, ROBOT

Home robotics on the cheap is offered by Fischertechnik's new 'Computing' package. For £64.95, the kit provides all the components needed to build six different robot forms. These include a robot arm, a graphics board, a sorting machine, a lifting and sorting robot to solve the Tower of Hanoi puzzle, a plotter and a solar tracker. Most domestic micros can control the robots with a suitable interface.

Parts included in the kit include potentiometers, microswitches and motors as well as all the building parts. Interested parties should contact Artur Fischer (UK) Ltd, Fischer House, 25 Newtown Road, Marlow, Bucks SL7 1JY (phone Marlow 72882/6).



next year.

Mr Richter described the recorder as a computer-like structure incorporating non-volatile solid state cartridges — and advanced enough to be analagous to the human brain. "The recorder makes possible the high-speed storage of more data than ever before in an extremely compact area," he said. "One solid-state memory brick alone has the capacity of eight standard microcomputers — and the recorder's capacity can be easily trebled."

The recorder has many skills. The most basic is the clever and simple production of graphics for promotional and teaching purposes. Another capability is the recording of complete books in its silicon circuits. These can be played back, cassette-style, on the recorder and read on the screen — the world's first silicon book.

The versatile recorder can also be used for the electro-mechanical control of machine tools. At the touch of a switch it becomes a security system. Not only can it detect an intruder and warn the appropriate authority, it can tell the difference between a cat and a cat burglar.

The intelligence system is also the heart of a non-volatile portable memory pack that makes possible low-voltage recording data in almost any area.

For further information contact, Terry Lewis, Information Officer, Government of Western Australia, 115 Strand, London SW2R 0AJ (phone 01-240 2881).

FREEZE FRAME

Once in a while we get wind of something really unusual and innovative in the computing field. This month it's a device called the Slomo. This odd little gadget is designed to make your computer run slower. Yep, that's what we said. Available for the Spectrum, BBC, Electron and Commodore 64 at present, the Slomo plugs into the user port or Tube and takes control of the bus to inhibit the operation of the CPU. It can do this at regular, adjustable intervals or permanently, thus allowing you to slow the operating speed of the micro down to, and including, a full stop in smooth stages.

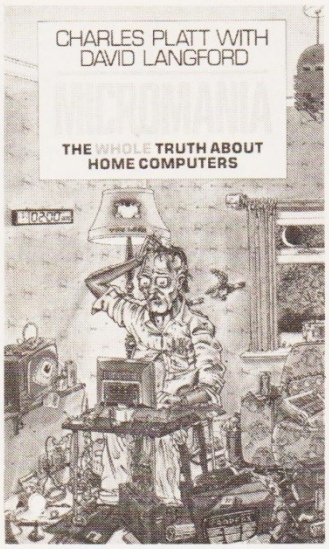
At first glance this seems a bit pointless. Then you start to realise the possibilities. For example, it means you can slow down any game to the point where you can reach high scores easily. Only a blaggard would claim these as true high scores, but it does mean you can practise on the harder levels and gradually increase the speed to maximum as you improve. Educational software can be made to run at a speed suitable for any particular student at the turn of a switch. Most important of all, for magazines, is that any screen can be frozen indefinitely for photography. Listing speed can be reduced, any game can be paused, and debugging of programs made easier by seeing exactly what's happening. Why didn't someone think of it sooner?

The Slomo costs £14.95 including VAT and postage and is available from Cambridge Computing Research Ltd, 61 Ditton Walk, Cambridge, CB5 8QD.

MANIC WRITER

A slim little paperback book dropped through the letterbox from Sphere Books recently and has caused a great deal of mirth around the office. Titled **Micromania,** it's by a pair of loonies called Charles Platt and David Langford and its object is to take the mickey out of the entire computer industry: home, business, magazines, users, no-one is spared. Sample humour; Platt's Sixth Law of Computers: "Computer memory and male genitals have one thing in common: everyone says size isn't necessarily important but no one quite believes it".

Unfortunately, since the whole object of the book is to make fun of computing, the authors stoop to ridiculous lengths to be Devil's advocates. For example, they suggest that word processors are a bad thing because Honore de Balzac was able to write over 100 novels in 18 years using only a quill pen. You can drive a bus through the holes in this argument: Balzac might have written twice as many novels with access to a word processor, and people



can't match his output because he was a very gifted and talented writer.

No matter: so long as you take it with a pinch of salt and are simply looking for a bellylaugh, buy the book. Or slip it into your favourite hacker's Christmas stocking and watch him turn purple.

Computing Today isn't mentioned in the chapter on magazines: considering what is said about some of the others, I feel rather relieved.

SHAKEN, NOT STIRRED: ACORNSOFT MIX IT

Readers with long memories will recall my sarcasm concerning the launch of the Electron last year. This wasn't just the sheer tackiness of the occasion but the belief of the organisers that the ability to list cocktail recipes was an earth-shattering piece of application software. Apparently my comments were wasted as Acornsoft have just released the 'Complete Cocktail Maker' on cassette for the BBC Micro for £9.95, with a disc version to follow.

To anyone daft enough to consider this a pretty neat idea, let me point out the following. The program is based on Geoffrey Hindley's book of the same name, published by Ebury Press. Now by the time you've switched on the computer, found your tape, loaded the program, run it, sorted out the right ingredients and mixed the cocktail, you could have looked up the entry in the book and drunk yourself into a stupor. Good grief. . .

QL LINGUISTICS

Metacomco, the company who produced the QL Assembler Development Kit, have launched two new languages for the machine: LISP and BCPL. Both kits cost £59.95 each and are available now by mail order or from retailers.

LISP is an important language in the field of artificial intelligence, and has now started to make an appearance on home machines. QL LISP is compatible with Acornsoft's LISP for the BBC Micro and supports all the QL's operating features as well as providing turtle graphics. BCPL is a compiling language which is widely used in systems programming, being used for utilities, games and applications software. If you're already using the QL Assembler kit, you'll be glad to know that both languages use the same screen editor. Metacomco can be contacted on Bristol (0272) 428781.

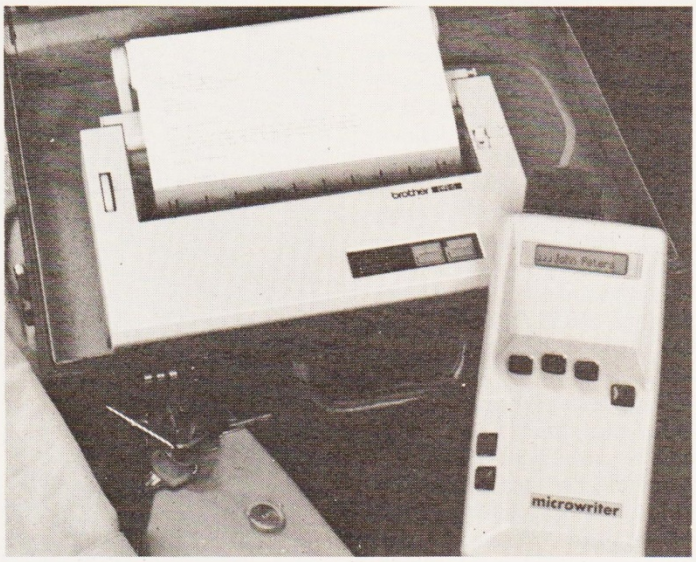
CHART TOPPER?

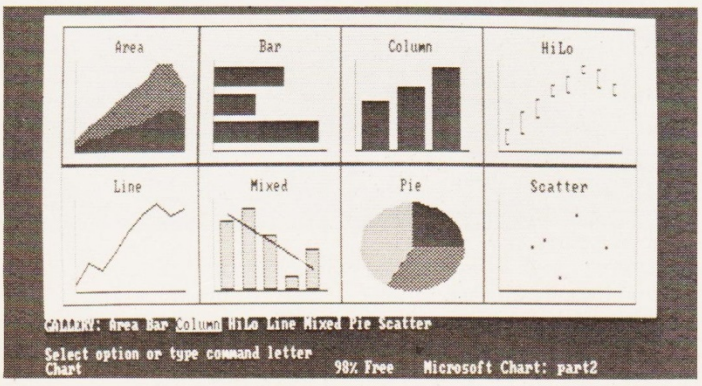
Microsoft Ltd have become the latest company to release a business graphics package. Chart is intended primarily for existing users of Multiplan, Microsoft's spreadsheet, and it allows users to graph the data directly. The program runs on the IBM PC and its compatibles.

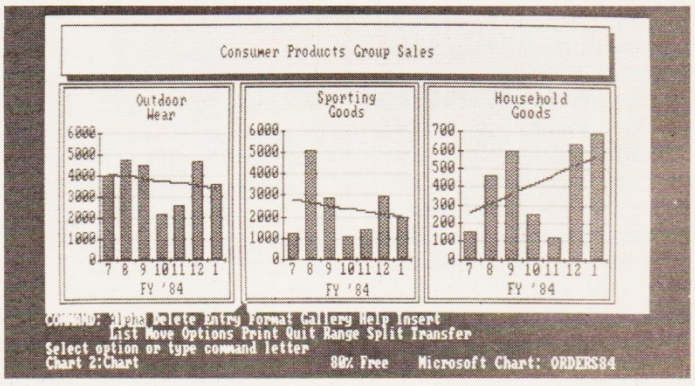
As with all these types of software, Chart offers a range of pictorial representations, including bar graphs, histograms, line graphs, pie charts and scatter diagrams. Fonts, shading, scale of axes and so on can be altered to suit, and a range of statistical functions are included in the software. Costing £235 plus VAT, Chart requires at least 128K of RAM and a high-res screen. For further information contact Microsoft Ltd, Piper House, Hatch Lane, Windsor, Berkshire (phone 07535 59951).

OH BROTHER

MicroWriter and Brother have joined forces to produce a budget personal word processing package for £399. The system consists of MicroWriter's hand-held six-key word processor, featured before in these pages, and the Brother HR-5 thermal printer which we have also reviewed in CT. Both components are battery operated and fit easily into a briefcase, making the word processing system truly portable. The system can be purchased through MicroWriter Ltd, 31 Southampton Row, London WC1 (note that the price is VAT-exclusive).







START UP EPSTART

Now in stock at P & P Micro Distributors is a very handy little package called Epstart, published by Softstyle of Hawaii. Epstart is application software which allows your Macintosh computer to print on an Epson FX80, FX100 or JX80 printer. The standard Macintosh printer drivers support only the Imagewriter printer or compatibles; unfortunately, they do not support many of the popular Epson printers. Epstart will quickly modify the printer drivers to support them, and will also reverse the process.

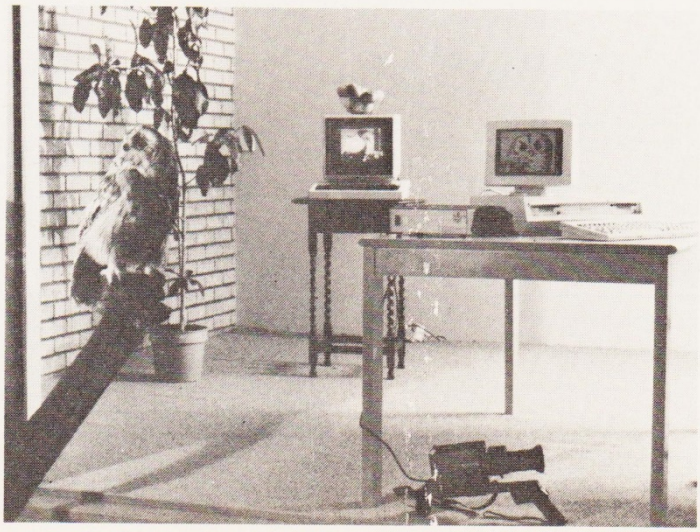
All you do is copy Epstart onto your startup or application disk. Then use the mouse to open the Epstart application, point to the appropriate printer type, click the mouse and the printer drivers are changed (with typical Macintosh simplicity). Once you use Epstart on a Macintosh startup disk or application disk, the disk never needs to be changed again. From then on your Macintosh applications using the disk will be able to print on an Epson FX or JX printer.

Epstart is compatible with all Macintosh application software using standard Macintosh printing conventions. That means MacPaint, MacWrite, Multiplan, Microsoft BASIC, and more. Epstart requires a Macintosh with a standard Macintosh printer cable. Plug the printer cable into the ordinary serial interface of the Epson printer. The serial interface inside your printer should be an Epson 8145, 8148 or equivalent. Epstart has a retail price of £39.95 plus VAT. Further information from P & P Micro Distributors Ltd, Todd Hall Road, Carrs Industrial Estate, Haslingden, Rossendale, Lancashire. (phone 0706 217744).

APRICOT VISION

Remember the Digithurst MicroSight system we reviewed back in the June issue of CT? This image analysis system is now available for the ACT Apricot. Digithurst have taken this step in the hope of attracting artists and graphics designers who may want to use the computer's graphics capabilities on images derived from a video source. MicroSight uses an interface to convert a video image into a 256 by 256 pixel matrix with 256 grey levels.

Several MicroScale packages are also available, from £495 plus VAT each, for applications such as object counting and area measurement. MicroSight itself costs £900 plus VAT and further details can be obtained from the company at Leaden Hill, Orwell, Royston, Herts SG8 5QH (phone 0223 208926).



THE QUEST FOR QL

Most reviewers of the QL have identified the Microdrives, non-standard operating system and lack of user memory as major drawbacks of a machine aimed at the serious user. Now Quest have produced a stylish range of products to cure these problems. The operating system offered is CP/M-68K, supplied on 5¼" floppy disc for £49.50 and on Microdrive cartridges at £79.50. Floppy disc drives range from single 200K units at £249 to dual 800K drives for £599, while the Firefly Winchester disc drive provides 7.5 Megabytes of storage for £995. Memory expansion boards start at £99 for 64K, and range upwards in the usual multiples to 512K, which costs £499. An expansion module has been designed to house the QL and the expansion cards.

Finally Quest are selling their Tally accounting software for £50 and £99: these products are not only compatible with each other but with the four Psion packages supplied with the QL. As a single package running under CP/M-68K the five Tally modules are available for £149.

Quest are at School Lane, Chandler's Ford, Hampshire, SO5 3YY (phone 04215 66312).

BUGS STRIKE AGAIN

We've got a couple of small but silly ones this month. First, those of you who are paying attention, as the librarian at the University of Helsinki is, will have noticed a glitch in the numbering of the magazine lately. We've had two Volume 6 No. 5s and two Volume 6 No. 6s. This isn't some strange new bookkeeping system foisted on us by the Common Market: we simply made a boob. So November should have been Number 9, December was number 10, and this issue you'll see we're back to Volume 6 No. 11. Sigh. . .

Second, you may have got the impression from the review of the Amstrad CPC464 in the October issue that the machine is rather large. It would have to be if the Enter key were 30 cm square, as we suggested — this is 900 square cm, somewhat bigger than this page! It is, of course 30 mm square.

HAVE YOU EVER THOUGHT YOU COULD DO BETTER THAN THIS?

Then why haven't you? Why not put our money where your mouth is? *Computing Today* is always on the lookout for new and interesting programs and articles for publication in the magazine. All submissions will be acknoweldged and the copyright in such works, which will pass to Argus Specialist Publications Ltd, will be paid for.

If you're interested in making your hobby pay its way and you've written a program that you think suits the magazine's content, why not send it to us today with the form below (or a photocopy of it). The address is Computing Today, No. 1 Golden Square, London W1R 3AB: and please mark your envelope clearly 'PROGRAM SUBMISSION' so that it doesn't get confused with all the other mail we receive.

We will need a copy of your program on cassette (or disc, for some systems, if you prefer) together with clear documentation on what it does and how it does it, including a list of the major variables, and if possible some indication of how a conversion to other micros might be attempted. We would appreciate a listing of the program and any screen dumps that you feel might be useful, but not on ZX Printer paper (it doesn't reproduce very well in the magazine). Remember that CT is a general computing magazine and accepts articles for any popular computer including Commodore, Acorn, Atari, Sharp, Amstrad, Sinclair, Oric, Tandy and Genie models.

If you would prefer to make a tentative approach to see if we are interested in your program *before* you put a lot of effort into it (or to check whether we have discs for your particular machine), then that's fine too, provided it is understood that a full write-up will be required before we can publish.

Subject matter can be as broad as you like, bearing in mind that the more readers it will interest, the more likely we are to accept it. A brilliant business program that requires the simultaneous use of four disk drives probably won't be accepted! Also we tend to steer clear of simple arcade games unless, like our Frogger, they demonstrate how to use a particular machine's capabilities to the full.

PLEASE COMPLETE IN BLOCK CAPITALS

Your name: .....

Your address: .....

.....

.....

Telephone number: .....

Program name: .....

Computer/memory size it runs on: .....

Amount of memory program occupies: .....

Any special peripherals required? (joystick, discs, printer (etc): .....

Have you sent your submission to another magazine? .....

Is it original or a variation on a theme? .....

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B. ATARI 800 48K
B. ATARI 800 XL 64K
B. ENTERPRISE 64
B. MITSUBISHI – MSX ML – 8000
B. SANYO – MSX WAVY 10
B. SONY – MSX HB – 75
B. TOSHIBA – MSX – 64K
B. SHARP – MZ – 700
C. COMMODORE 64
C. COMMODORE – C – 16
C. VIC 20
C. ORIC ATMOS
C. ACORN ELECTRON
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computing today

FEBRUARY ISSUE ON SALE JANUARY 11th

Pride of place on the February cover goes to the Sakata SCP-800 colour plotter/printer. This new peripheral from the Japanese giants retails for under £200 and can handle A4 paper as well as the usual paper roll option. Compatible with all major home micros, the Sakata may not be out-of-this-world but it makes a nice job of drawing it. We put it through its paces next month.

On the programming front, we will be presenting a machine code monitor program for BBC owners, an error handler for the Spectrum, and a feature on 6809 interrupts that Dragon owners will find interesting. On the Amstrad, we'll be reviewing the Tasword word processor.

Finally, on a more general note we have the start of a new series on BASIC principles, an explanation of just how to use benchmarks to assess computer performance, and a cassette volume meter to build. Don't miss the February issue of Computing Today.

Articles described here are in an advanced state of preparation but circumstances may dictate changes to the final contents.

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ELITE - BBC 3D

Simon Rockman

When programmers look at a game and say "No, you can't do that !" you know it's something special. This new game from Acornsoft has absolutely stunning graphics.

Once upon a time, when computers were black and white and the only sound they ever produced was Control G, there was a game for the TRS-80 called Star Trader. In this text-only game, you played the part of a merchant who had to pilot a spaceship from planet to planet buying and selling commodities. Later, as graphics improved and colour was introduced to the home computer, no game was worth its salt unless you could kill something. (Admittedly, adventures are a law unto themselves, having the appeal of the crossword puzzle; you either love them or hate them but they are not mass sellers.)

The king of the shoot-em-up games was Atari, who produced the game-of-the-film Star Wars for the amusement arcades, an impressive colour vector graphic game where the golden rule is: if it moves, shoot it, if it doesn't move, shoot it anyway. This game requires an incredible amount of processing and could not be attempted on the home computer.

Then came Elite, and programmers' ideas of what could not be done on a home computer were shattered.

AN ELITE PROGRAM

Elite is incredible. You don't play it, you experience it. Elite combines the finance and commodity trading of Star Trader with the dexterity and alien-zapping skill of Star Wars. You start life as a humble trader and have to work up ranks until you make 'Elite'. You will never achieve this by trading — to increase your rating you have to become a formidable space-warrior.

However, even the best warrior needs weapons and the nasties you will encounter are far too fearsome to be tackled with the puny pulse laser that comes as a standard fitment. To build up your armoury it is necessary to trade. This takes you from planet to planet and gives you the first chance to admire the graphics in the game.

Each planet is orbited by a rotating space-station. In order to trade it is necessary to dock with the space-station. Since the door is facing the planet, docking is a very difficult manoeuvre which takes a great deal of practice. You have to fly your Cobra Mk III spaceship towards the planet surface: an altimeter will tell you if you get too close. When the space-station appears in the rear screen it is time to spin the craft around and head for the door. It is of the utmost importance that the space station is in the centre of your forward vision: Failure to ensure this will cause the door to rotate eccentrically and make docking very difficult.

The rotation of your ship has to match that of the target portal. The amount of maths the Beeb must be doing to cope with the rotation of a 3D shape relative to your own ship which is capable of pitching and yawing is fantastic.

An added bonus is the hidden line removal. In most vector graphic games all the objects appear to be made of wire frames — in Elite everything looks solid, although some shapes can be seen through others. The space stations certainly look solid as you approach them, and they sound very solid should you brush your ship against the doors during docking.

Once you have become a wealthy trader it is possible to buy a docking computer which will take the risk out of docking. However, the docking computers are not perfect: when presented with a space station from the wrong side they may try to fly through the obstacle to reach the door, the result being instant death. (The docking computers seem to cheat, flying through solid bits of space stations).

Once docked it is possible to start trading. The price and type of commodities available depends on the nature of the planet. A broad generalisation is that it is best to take liquor and radioactives from agricultural planets to industrials and computers and machinery on the return

trips. The nature of the planets in the current galaxy can be looked up by moving a cursor across a chart to any one of the 1,000 stars in the current galaxy (there are eight in all). However prices can only be determined by visiting the planet.

Generally speaking the less hospitable the planet, politically, the better the prices. A domocracy may be safe but trading will not be nearly as lucrative as a visit to a planet in a state of anarchy. The penalty for trading with barbaric planets is the shroud of pirates which surround the planet. Such trading is not for the inexperienced — however, once you are well-armed such a mission is the ideal way to increase your rating, particularly if you are carrying a forbidden commodity, such as narcotics or slaves. Destroying any ship enhances your rating, even if it is a police Viper craft.

Only when you are a proven pilot will you be offered a mission. One mission may be to seek out and destroy a particular ship. Just finding it among 8,000 stars is not easy and will require a lot of patience. Space can be a cruel place; there is rumoured to be a spaceship which eats other ships.

TACTICS AND BUGS

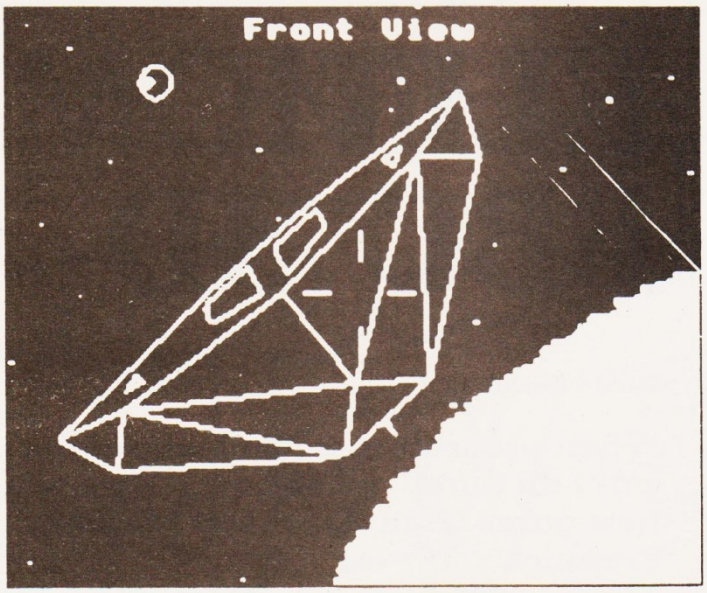
Games software used to be tested and bug-free. However, with the advent of games like The Hobbit and Atic Atak it is not possible to test them fully. With the Beeb it is very difficult to know what set-up the end user is likely to have: with three operating systems, two Basics, two ULAs, a multitude of disk operating systems and a huge range of third party ROMs there are bound to be eventualities which cannot be catered for.

One such problem is the possibility of a ROM corrupting the data file which allows you to save off your character. The ROM manager from Watford Electronics is supposed to give you the facility to switch other ROMs on and off: it has the side effect of causing any saved commander to become Elite! This is fine for impressing your friends but it will not fool Acornsoft, as there is a number generated which has to be sent in on a special card if you want to be eligible for a prize on reaching a high rating. This number tells the judges of the competition how many ships you have shot down. Anyone who has reached "Elite" with only a few victories is a cheat and will be excluded.

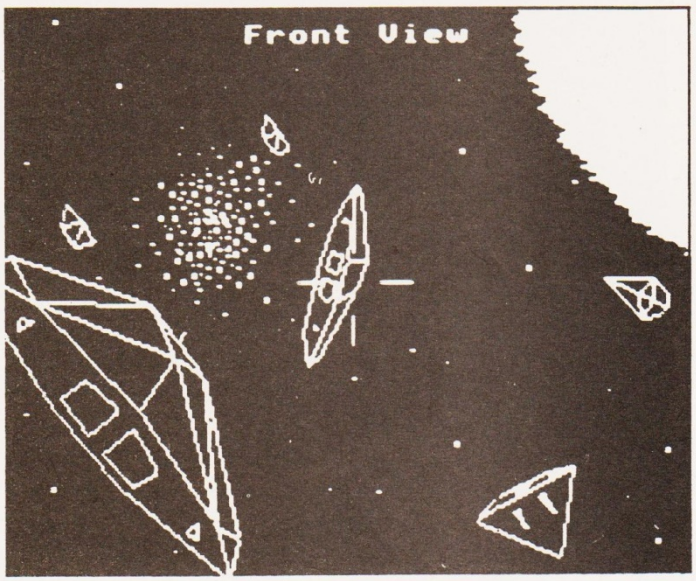
There are some bugs which can be used, legally. Later versions of the game may have all or some of these corrected so try to find a shop with stock dating back to the launch. The most useful bug is that of the mining laser. This is only avalaible on the disk version. When you buy a mining laser you are not debited for it, meaning that you can buy one even if you cannot afford it. If you then try to buy a second mining laser and fit it to the same mounting as the first you will get the error message "Laser Present". However, your account will be credited with around 4000 cr. This makes it very easy to build up a fortune before you go off to zap pirates!

Once you have obtained all the weaponry you want it is time to do something about your rating. The easiest way to do this is to fit a large laser to the rear of your ship, target the hyperspace on a nearby system and launch into space. As you leave, slow down and switch to a rear view. The door of the space station should be in the centre of the rear sights. Open fire. This is a dreadful crime and the police ships will spill out in an attempt to destroy you. As they appear in the centre of your gun sights there is just enough time to blast them before they can attack. Should a ship slip past you it is easier to hyperspace to another planet and repeat the procedure than to fight it out. Getting to the distant planet may be difficult when you leave hyperspace because, being an offender, you will have made yourself a target. There seems to be a bug in the control of your legal status which causes you to drop from fugitive to offender when you leave the scene of a crime.

Because there is a lot of calculation to be done, the game slows down when you are looking out at space; to speed things up it is best to display a sheet of information or a map of the local planets. On the cassette version this is dangerous because you are likely to collide with an asteroid. Due to a bug in the disk version there are no asteroids, which makes flying blind safer but the game less exciting. With the aid of these bugs you should be able to make "Elite" in no time. But is that right?



A Cobra Mark III trading/combat craft, the spaceship that you will pilot in Elite. Ships are drawn as wireframe shapes in 3D with hidden line removal.



Things are starting to get crowded — and dangerous! This is where your piloting and combat skills are required, but Elite will also test your entrepreneurial abilities.

IN THE FUTURE

Before Elite the two authors were almost unknown. Ian Bell had written Starship Command "on an off day". The two authors have completed an Electron version of the game, which they said took a lot of work. They refused to say what is next but with Final exams looming at Cambridge it may take a while. One option is to write a Commodore 64 version, and this certainly being considered. A version has been written for the Second Processor, however Acorn are sitting on it and denying that it exists. Since Elite uses graphics routines which have to run on the Beeb side of the Tube, a second processor would not add a vast amount to the graphics. Elite is destined to become a standard in the same way as The Hobbit and Manic Miner, and is a game that any Beeb owner should buy.

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COMMODITIES

P.J. Kenworthy

If you haven't got enough money stashed away to buy any shares in British Telecom, don't despair: you can still play the stockmarket by typing in this listing. Written in BBC BASIC, it should be possible to convert it to other machines.

This program has been written for 32K BBC Model B Microcomputer with a 1.2 Operating System, though it should work on a 32K Model A. The program runs in just over 10K and uses Mode 4 most of the time, to provide the medium resolution text display of 40 by 32 characters. For the program to work on a 16K Model A, it would have to be rewritten so it ran entirely in Mode 7.

IN USE

When the program is first run, after offering the user instructions, the computer will then ask for the size of loan which the user would like to start off with. It is recommended that a loan of around £20,000 should be taken. This will allow the burden of interest which has to be paid on the loan to be raised more easily.

The computer then requests a choice of interest rate (there are five to choose from).

If, after 15 days, the player can successfully pay back the loan, plus the interest due on it, a bonus (which is dependent on the rate of interest chosen) is awarded.

After the relevant interest rate has been chosen, the main game display is generated. This shows the 11 commodities, their current prices, whether they are on an upward or downward trend and the number of units of each commodity held by the player. The total value of stock which the player possesses, together with the amount of cash on hand, are also displayed.

At the foot of this table, a menu of options is shown. These are Sell, Buy, See Graph, and Transactions over. The first two of these are fairly obvious. Sell allows you to sell stock whcih you possess while Buy allows you to Buy. The obvious checks are carried out by the computer to make sure that you are not trying to sell stock which you do not own, or attempting to buy stock worth more than the cash in hand.

The current market price of the commodities is partly dependent on the amount of trading carried out each day in them. If excessive buying/selling is carried out each day in one particular commodity, together with the presence of certain market conditions, then that commodity may be suspended from the market. The length of the suspension varies and while it is in force no stock may either be bought or sold in the commodity. If a commodity has been suspenced, a "*" is shown next to it on the master display.

If you elect to use the menu option "see graph", the main game display is cleared from the screen, to be replaced with a graph of the FT-Index values of the previous 50 days. This option is particularly useful in determining when a current market trend is about to change. For example, if, over the past fortnight, the market has been buoyant, you should be able to tell from the graph when a change is about to take place. Hence, if care is taken, you should be able to sell your stock short to avoid taking a loss on it.

The final option "transaction over" should only be used when the days dealings have been concluded, or if you don't wish to do anything that day. This option takes the market through to the next day, updating the prices of the commodities and hence the overall value of the player's holding.

Every so often, an economic/natural event will happen, which will affect on particular commodity. This is displayed on the screen and according to the nature of the event, the price of the commodity will either rise or fall. A player holding this commodity will either stand to make an instant profit or loss!

The final point to note as to buying and selling when playing Commoditites is to do with the price of gold. The gold price is a barometer of the market. If the market is on an upward trend then the price of gold will be decreasing. The opposite will happen if the market is on the decline. The price of gold will also rise if a lot of selling has happened in the previous day. The opposite applies to buying. (This is an accurate analogy of real markets around the world, where people invest in gold if the rest of the market is showing signs of insecurity).

After 15 days has elapsed since the beginning of the game, a check will be carried out to see if you can pay back the loan together with the interest owing on it. If this cannot be done, the game is over.

Once the loan and interest has been repaid you will probably be left with quite a low sum to start investing with again. This results in the game becoming harder to play, since (so to speak), you will have to sink all your eggs in one basket. If this can be overcome, you will be on the way to being a millionaire!

CONVERSIONS

Commoditites should work on any other microcomputer which offers approximately the same resolution of graphics (320 by 256), on-screen format (40 by 32) and a similar sized memory.

The procedures used throughout the program (such as PROCGRAPH and PROCSELL), can be replaced by GOSUB/RETURN statements. The only reasons that I used these commands are that PROCedures run faster on the BBC than ordinary subroutines and make the listing of a program easier to understand.

The VDU 23 command at line 40 defines the only user-defined character used in the program. This is merely a horizontal line one character wide (probably found as a standard graphics character on other micros), and is accessed throughout the program by CHR$(224).

*FX15,1 (line 180) clears the input buffer each time the loop is effected.

VDU 28,0,31,39,19 (line 290) defines a text window, in this case between the extreme left and right sides of the screen (0,39), and between the horizontal lines of 19 and 31. This text window is disabled by the command VDU 26 (lines 420,1520).

STRING$ (line 1490) instructs the computer to print a certain item X number of times. In this case it is the user-defined character and it is to be printed 39 times (thus drawing a horizontal line across the screen).

TAB(X,Y) (eg lines 1530-1550) prints at a position X characters across the screen and Y lines down.

VDU 5 (line 1600) commands the computer to print text at the graphics (not text), cursor. VDU 4 counteracts this command.

MOVE x,y (eg line 1630) moves the graphics cursor x pixels across the screen and y pixels up.

DRAW x,y (eg line 1680) draws a line between the point last visited and the present position of the graphics cursor.

RND (X), where X>1, produces a random integer bet-

Listing 1. BBC BASIC version of Commodities.

```
    5 ON ERROR VDU 26:CLS:GOTO 190
   10 CLEAR
   20 DIM C$(11),P(11),H(11),L(11),U(11),FT(400),V
(11),V$(11)
   30 DIM FD%(11,2),SP%(11,2),S$(11),E$(30)
   40 VDU 23,224,0,0,0,255,0,0,0,0
   50 MODE 7
   60 FOR N=1 TO 2:PRINT TAB(10);CHR$(131);CHR$(14
1);"COMMODITIES":NEXT
   70 PRINT TAB(6,10);CHR$(136);CHR$(130);"COMPILI
NG STOCK DATA"
   80 TURN=51:PROCINITIAL
   90 PRINT TAB(2,20);"Do you require instructions
? (Y/N)"
  100 A$=GET$:IF A$<>"N" AND A$<>"Y" THEN 100
  110 IF A$="Y" THEN PROCINSTRUCTIONS
  120 PROCLOAN
  130 MODE 4
  140 PROCCHECK
  150 FOR N=1 TO 11
  160 FD%(N,1)=0:FD%(N,2)=0
  170 NEXT N
  180 *FX 15,1
  190 SOUND 1,-9,10,7:PRINT TAB(3);"COMMODITY";TAB
(21);"`/UNIT";TAB(29);"UNITS HELD"
  200 PROCHORIZ
  210 PRINT
  220 FOR N=1 TO 11
  230 PRINT TAB(0);S$(N);TAB(2);N;")";TAB(6);C$(N)
;TAB(16);V$(N);TAB(22);P(N);TAB(33);H(N)
  240 NEXT
  250 PROCHORIZ
  260 PRINT TAB(13);"Value of stock ` ";T
  270 PROCHORIZ
  280 PRINT'"Cash in hand ` ";AA;TAB(33);"DAY ";TU
RN-50
  290 VDU 28,0,31,39,19
  300 PRINT"Here are your options :-"
  310 PRINT'"1) Sell"
  320 PRINT"2) Buy"
  330 PRINT"3) See FT graph"
  340 PRINT"4) Transactions over"
  345 PRINT"5) End Program"
  350 PRINT'"Enter choice (1 - 5)"
  360 A$=GET$:A=VAL(A$)
  370 IF A<1 OR A>5 THEN 360 ELSE SOUND 1,-9,45,5

  375 IF A=5 THEN MODE 7:END
  380 IF A=1 AND T<=0 THEN CLS:PRINT "No stock to
sell":PRINT:GOTO 300
  390 IF A=2 AND AA<=0 THEN PRINT "No cash to buy"
:PRINT:GOTO 300
  400 IF A=1 THEN PROCSELL:CLS:GOTO 300
  410 IF A=2 THEN PROCBUY:CLS:GOTO 300
  420 IF A=3 THEN VDU 26:CLS:PROCGRAPH:CLS:GOTO 19
0
  430 PROCEVENT
  440 FOR N=1 TO 11
  450 IF FD%(N,1)>0 THEN PROCBUYADJUST
  460 IF FD%(N,2)>0 THEN PROCSELLADJUST
  470 IF FD%(N,1)>(100*RND(8)) THEN J=30:V(N)=2:V$
(N)="-":PROCSUSPEND
  480 IF P(N)>=U(N) OR P(N)<=L(N) THEN PROCSUSPEND

  490 NEXT
  500 FOR N=2 TO 11
  510 U=INT(P(N)/10):IF U=1 OR U=0 THEN U=2
  520 IF SP%(N,2)=2 THEN V(N)=2:V$(N)="-":GOTO 550

  530 IF SP%(N,2)=1 THEN V(N)=1:V$(N)="+"
  540 IF V(N)=1 THEN P(N)=P(N)+RND(U):GOTO 580
  550 IF V(N)=2 THEN P(N)=P(N)-RND(U):GOTO 580
  560 J=RND(2)
  570 IF J=1 THEN P(N)=P(N)+RND(U) ELSE P(N)=P(N)-
RND(U)
  580 IF P(N)>=U(N) OR P(N)<=L(N) THEN PROCSUSPEND
  590 NEXT N
  600 PROCGOLD
  610 TURN=TURN+1
  620 IF TURN=66 THEN PROCCHECKLOAN
  630 IF TURN=LO% THEN VDU 26:CLS:PRINT"GAME OVER"
:PRINT'''"YOUR TOTAL ASSETS = `";AA+T:END
  640 PROCSTOCK
  650 GOTO 130
  660 DEFPROCBUY
  670 CLS
  680 INPUT'"What do you wish to buy",S$:S=VAL(S$)
  690 IF S<1 OR S>11 THEN 680
  700 IF S$(S)="*" THEN CLS:PRINT"COMMODITY SUSPEN
DED - CANNOT BUY":GOTO 680
  710 CLS:PRINT C$(S);TAB(13);"Units held already:
 ";H(S)
  720 INPUT'"How many units to be bought",A
  730 IF AA-(A*P(S))<=0 THEN CLS:PRINT"Not enough
cash to buy ";A;" units":GOTO 680
  740 H(S)=H(S)+A:T=T+(A*P(S)):AA=AA-(A*P(S))
  750 FD%(S,1)=FD%(S,1)+A
  760 PROCCHANGE
  770 PRINT "Do you wish to buy anything else ":A$
=GET$
  780 IF A$="N" THEN ENDPROC ELSE 670
  790 DEFPROCSELL
  800 CLS
  810 IF T=0 THEN CLS:PRINT"NO STOCK LEFT TO SELL
.PRESS ANY KEY TO CONTINUE":A$=GET$:ENDPROC
  820 INPUT'"What commodity do you wish to sell",S
$:S=VAL(S$)
  830 IF S<1 OR S>11 THEN 800
  840 IF S$(S)="*" THEN CLS:PRINT"COMMODITY SUSPEN
DED - CANNOT SELL":GOTO 820
  850 IF H(S)=0 THEN CLS:PRINT"No stock in that co
mmodity":PRINT:GOTO 820
  860 CLS:PRINT C$(S);TAB(13);"Units held already:
 ";H(S)
  870 INPUT'"How many units to be sold",A
  880 IF A>H(S) THEN CLS:PRINT"You do not hold tha
t much":PRINT:GOTO 870
  890 H(S)=H(S)-A:AA=AA+(A*P(S)):T=T-(A*P(S))
  900 FD%(S,2)=FD%(S,2)+A
  910 PROCCHANGE
  920 PRINT'"Do you wish to sell anything else ?";
:A$=GET$
  930 IF A$="N" THEN ENDPROC ELSE 800
  940 DEFPROCINITIAL
  950 RESTORE 1370
  960 FOR N=1 TO 11
  970 READ C$(N),P(N),L(N),U(N)
  980 P(N)=P(N)+RND(30):P(N)=P(N)-RND(10)
  990 H(N)=0
 1000 NEXT:SOUND 1,-6,5,90
 1010 REM FT VALUES
 1020 LO%=1
 1030 ST%=630+RND(20)
 1040 REPEAT
 1050 DIR%=RND(2)
 1060 DUR%=RND(21)
 1070 FOR X%=1 TO DUR%
 1080 IF DIR%=1 THEN ST%=ST%+RND(11) ELSE ST%=ST%-
RND(11)
 1090 FT(LO%)=ST%
 1100 IF ST%>730 AND DIR%=1 THEN DIR%=2
 1110 IF ST%<630 AND DIR%=2 THEN DIR%=1
 1120 LO%=LO%+1
 1130 NEXT X%
 1140 UNTIL LO%>370
 1150 SOUND 1,-7,50,20:PROCSTOCK
 1160 RESTORE 1200
 1170 FOR A=1 TO 16
 1180 READ E$(A)
 1190 NEXT
 1200 DATA Prices bound to
 1210 DATA fall
 1220 DATA rise
 1230 DATA Oil exporters in Middle East place
 export restrictions
 1240 DATA Massive harvest of
 1250 DATA Overseas consortium has placed large
 amounts of
 1260 DATA on the Market
 1270 DATA Tornadoes have decimated the plantation
s of
 1280 DATA Rumours circulating that large deposits
 of
 1290 DATA have been found
 1300 DATA Low harvests of
 1310 DATA due to
 1320 DATA high rainfall
 1330 DATA disputes in workforce
 1340 DATA are being withheld from the market
 1350 DATA The government has placed import
 restrictions on
 1360 ENDPROC
 1370 DATA GOLD,220,0,10000
 1380 DATA SILVER,20,9,130
 1390 DATA PLATINUM,300,100,2000
 1400 DATA COFFEE,1700,800,4000
 1410 DATA COCOA,1400,400,3000
```

ween 1 and X.

PROGRAM STRUCTURE

Lines 10 - 130 All arrays dimensioned, user-defined character created, titles displayed and loan routine executed.

Lines 140 - 350 Main game loop commences. Routine for checking whether a commodity is suspended from the market carried out at line 140. Game display shown on screen comprising all 11 variables (C$(N)), together with their current market status (+/−) and prices, the player's Stock and Cash totals. After this data is shown, the text window is set up (line 290), and the main menu is shown.

Line 360 - 420 Player enters choice from main menu (360), and the appropriate routines are executed as a result.

Lines 430 - 650 These lines are only used if the player has chosen option 4. (Transactions over for the day). The event routine is executed, as are those for the adjustment of stock prices due to the daily trading in each commodity (lines 450 and 460). Checks are made in the following two lines to make sure that neither excess trading in, nor the maximum/minimum price has been exceeded, for any commodity. If either of these have occurred, the commodity is suspended from the market. Between 520 and 570, the price per unit of a commodity is adjusted, the direction of the change being dependent on the current market status of the commodity. Line 600 executes the routine which sets the price of gold for the day. The day counter (TURN) is incremented by one and checks carried out to decide whether the time has arrived for the loan to be repaid, or for the game to end. Finally, line 640 sends the computer to the procedure which adjusts the market status of each commodity for the next day.

Lines 660 - 930 These lines are the routines by which the player can buy or sell units of commoditities. Whenever a commodity is bought or sold the master display is automatically updated (lines 760 and 910). In addition, checks are carried out to make sure that the player does not inadvertently attempt to buy or sell stock which he either cannot afford, or does not possess. In both routines, it is the variable H(N) which plays the major role, since this contains the information about how many units of each commodity the player holds at any one time.

Lines 940 - 1470 These lines are used at the beginning of the program, to set up all of the arrays used later on. Between 950 and 1000, all the arrays for the screen display are made up. This is done by accessing data and held at 1370 onwards, containing such information as the price, and the upper/lower limit in price, of each commodity.

Between 1020 and 1140, the FT-Index values for the coming year are prepared. The variables DIR% and DUR% give, respectively, the direction of the current market trend and the duration for which that trend will last for. The overall market pattern for the year is made up of lots of these separate trends put together. The actual FT values are computed at line 1080 and checks are carried out at lines 1100 and 1110 to make sure that the values do not exceed sensible parameters. Every time a new FT value is calculated, the loop counter LO% is incremented by one and the array FT(LO%) made equal to the new calculated FT value.

Lines 1160 and 1190 read data (held at line 1200 onwards), into the string array E$(N), which is the 'event holder'. There are 16 different sentences to do with natural/economic events, held in the array, which are combined together in various ways later on in the program, to form a whole event which will then be displayed on the screen.

Lines 1200 to 1470 holds the data for the routines mentioned above.

Lines 1590 - 1790 Lines 1600 to 1660 are used to print the FT-Range up the vertical axis. In order to provide the accurate positions of the values, the VDU 5 command is used (line 1600), thus allowing them to be positioned at the graphics cursor. Text is printed at the text cursor again, once the VDU 4 command is effected (line 1660). The axes for the graph are completed between 1670 and 1700.

The value (FT(N)) are plotted at line 1750, with 1760 re-positioning the graphics cursor after each line has been drawn, ready for the next.

Lines 1800 - 2130 These lines contain what is probably the most important routine in the whole program. They compute and then update daily the market status of the 10 commoditites (gold being the exception). Lines 1820 to 1860 look back over the previous 10 days' FT-Values in order to determine whether a trend is present. If one is detected, the variable C or D is incremented (C being for a downward trend and vice-versa for D), to provide a figure for the length of time which the current rend has existed for.

If the game is past the first day, lines 1880 to 1980 are ignored. These lines are only used to set up the market status of some of the commoditities on the first day of trading. A number between one and the number of days which the current trend has existed for (C or D), is chosen at random (line 1890). This number J is the total number of commoditires which will have a sign (+/−) attached to them indicating their market condition. The actual commoditities themselves are chosen between 1950 and 1960. It is the string V$ which is shown next to the commodity on the master display.

Lines 1980 and 2020 are used to introduce some 'rogue' commodities on to the market, ie some which are going against the current downward/upward trend. After the initial market conditions have been worked out, the number of commodities currently on a downward/upward trend will be constantly changing. For example, if the market was in decline when the game began, most of the commodities would probably be on a decline as well. However, if after five days the market starts to pick up, so should the value of some of the commodities. Lines 2040 and 2100 attempt to realistically reproduce these circumstances. If the market has just changed direction (ie C or D low in value), whatever sign was beside a commodity before, will be removed over the course of a day or so, being replaced with the opposite sign the next day. The former routine is carried out at 2060 and 2070, while the latter is done in the two lines immediately afterwards. These changes will alter the daily fluctuation in price of a commodity.

Lines 2140 - 2210 These lines are used on a daily basis to adjust the price of each com-

VARIABLES USED

C$(N)	Commodity (Gold/Silver etc).
P(N)	Price of each commodity.
U(N)	Upper limit of price of each commodity.
L(UN)	Lower limit of price of each commodity.
FT(N)	FT-Index value for day N.
H(N)	Number of units of each commodity held by the player.
V(N)	Variable containing data as to the market position of each variable.
V$(N)	String used for display purposes containing data about the market position of each variable.
FD%(X,Y)	Integer containing data as to how many units of each commodity has been bought or sold each day.
SP%(X,Y)	Integer containing data relating to the suspension of commoditites from the market.
S$(N)	String used for display purposes for showing the suspension of commodities.
E$(N)	String array containing various economic/natural events.
T	Total value of stock held by player at any one time.
AA	Cash in hand of player at any one time.
AAA	Value of loan taken by player.
IT%	Interest rate chosen by player on the loan.
COUNTERS	TURN, LO%
GENERAL STRINGS	A$
GENERAL VARIABLES	A, U, J, S, ST%, DIR%, DUR%, F, K, KK; HH, H, S1, S2, T1, X, T%, ASSET, EV, C, D.

```
 1420 DATA RUBBER,73,24,230
 1430 DATA OIL,15,3,70
 1440 DATA SUGAR,170,76,400
 1450 DATA TIN,37,10,140
 1460 DATA LEAD,75,23,230
 1470 DATA ZINC,112,34,328
 1480 DEFPROCHORIZ
 1490 PRINT STRING$(39,CHR$(224));
 1500 ENDPROC
 1510 DEFPROCCHANGE
 1520 VDU 26
 1530 PRINT TAB(33,S+1);"      ":PRINT TAB(33,S+1);
H(S)
 1540 PRINT TAB(30,14);"        ":PRINT TAB(30,14);
T
 1550 PRINT TAB(15,16);"          ":PRINT TAB(15,16
);AA
 1560 VDU 28,0,31,39,19
 1570 CLS
 1580 ENDPROC
 1590 DEFPROCGRAPH
 1600 VDU 5
 1610 FOR N=(620-600)*7 TO (760-600)*7 STEP 200
 1620 F=INT((N/7)+600)
 1630 MOVE -225,N
 1640 PRINT F
 1650 NEXT
 1660 VDU 4
 1670 MOVE 100,0
 1680 DRAW 100,1000
 1690 MOVE 0,100
 1700 DRAW 1279,100
 1710 PRINT TAB(0,0)"FT"
 1720 PRINT TAB(4,30);"50              DAYS AGO
    1";
 1730 MOVE 100,FT(1)
 1740 FOR N=TURN-50 TO TURN
 1750 DRAW ((N-(TURN-50))*22)+100,(FT(N)-600)*7
 1760 MOVE ((N-(TURN-50))*22)+100,(FT(N)-600)*7
 1770 NEXT
 1780 PRINT TAB(7,0);"PRESS ANY KEY TO CONTINUE":A
$=GET$
 1790 ENDPROC
 1800 DEFPROCSTOCK
 1810 K=TURN
 1820 C=0:D=0
 1830 FOR L=TURN-1 TO TURN-10 STEP -1
 1840 IF C>0 AND FT(L)<FT(L+1) OR D>0 AND FT(L)>FT
(L+1) THEN L=TURN-10:GOTO 1860
 1850 IF FT(L)>FT(K) THEN C=C+1 ELSE D=D+1
 1860 NEXT L
 1870 IF K>51 THEN 2040
 1880 HH=0
 1890 IF C=0 THEN J=RND(D) ELSE J=RND(C)
 1900 IF J<1 THEN J=1
 1910 FOR F=1 TO J
 1920 KK=RND(11):IF KK=1 THEN 1920
 1930 IF HH=10 THEN 1970
 1940 IF V(KK)>0 THEN HH=HH+1:GOTO 1920
 1950 IF C>0 THEN V(KK)=2 ELSE V(KK)=1
 1960 IF V(KK)=1 THEN V$(KK)="+" ELSE V$(KK)="-"
 1970 NEXT F
 1980 FOR N=1 TO RND(3)
 1990 H=RND(11):IF H=1 THEN 1990
 2000 IF C>0 THEN V(H)=1:V$(H)="+"
 2010 IF D>0 THEN V(H)=2:V$(H)="-"
 2020 NEXT N
 2030 GOTO 2120
 2040 FOR N=2 TO 11
 2050 IF V$(N)=" " AND C<3 AND D<3 THEN 2100
 2060 IF C>2 AND V$(N)="+" AND RND(5)<5 THEN V(N)=
0:V$(N)=" ":GOTO 2100
 2070 IF D>2 AND V$(N)="-" AND RND(5)<5 THEN V(N)=
0:V$(N)=" ":GOTO 2100
 2080 IF C>2 AND V$(N)=" " AND RND(4)<3 THEN V$(N)
="-":V(N)=2:GOTO 2100
 2090 IF D>2 AND V$(N)=" " AND RND(4)<3 THEN V$(N)
="+":V(N)=1:GOTO 2100
 2100 NEXT N
 2110 GOTO 1980
 2120 PROCPLAYER
 2130 ENDPROC
 2140 DEFPROCBUYADJUST
 2150 P(N)=P(N)+((FD%(N,1)*(P(N)/U(N)))/P(N))
 2160 P(N)=INT(P(N))
 2170 ENDPROC
 2180 DEFPROCSELLADJUST
 2190 P(N)=P(N)-((FD%(N,2)*(P(N)/U(N)))/P(N))
 2200 P(N)=INT(P(N))
 2210 ENDPROC
 2220 DEFPROCPLAYER
 2230 T=0
 2240 FOR N=1 TO 11
 2250 T=T+(H(N)*P(N))
 2260 NEXT N
 2270 ENDPROC
 2280 DEFPROCGOLD
 2290 S1=0:S2=0:T1=0
 2300 FOR N=2 TO 11
 2310 S1=S1+FD%(N,1):S2=S2+FD%(N,2):T1=T1+FD%(N,2)
*P(N)
 2320 NEXT N
 2330 P(1)=P(1)-((S1/(T+1))*20)+((S2/(T1+1))*20)
 2340 A=0:H=0
 2350 FOR N=2 TO 11
 2360 IF V$(N)="+" THEN A=A+1
 2370 IF V$(N)="-" THEN H=H+1
 2380 NEXT
 2390 P(1)=P(1)+(H*3)
 2400 P(1)=P(1)-(A*3)
 2410 IF P(1)<0 THEN P(1)=100+RND(40)
 2420 P(1)=INT(P(1))
 2430 ENDPROC
 2440 DEFPROCSUSPEND
 2450 X=RND(11):IF X<6 THEN 2450
 2460 SP%(N,1)=X:S$(N)="*"
 2470 IF P(N)>=U(N) THEN SP%(N,2)=2 ELSE SP%(N,2)=
1
 2480 IF J=30 THEN SP%(N,2)=2
 2490 IF P(N)>U(N) THEN P(N)=U(N)-1
 2500 IF P(N)<L(N) THEN P(N)=L(N)+1
 2510 ENDPROC
 2520 DEFPROCCHECK
 2530 FOR N=1 TO 11
 2540 IF SP%(N,1)=0 THEN 2590
 2550 SP%(N,1)=SP%(N,1)-1:IF SP%(N,1)>0 THEN 2590
 2560 IF SP%(N,2)=2 THEN V$(N)="-":V(N)=2:GOTO 258
0
 2570 V$(N)="+":V(N)=1
 2580 S$(N)=" ":SP%(N,2)=0
 2590 NEXT
 2600 ENDPROC
 2610 DEFPROCLOAN
 2620 CLS:FOR N=1 TO 2:PRINT TAB(12); CHR$(141);CH
R$(131);"LOAN FIXING":NEXT
 2630 INPUT''''"How much is your loan going to be.
",AAA
 2640 IF AAA<1000 THEN PRINT'"Small Fry!"
 2650 IF AAA>80000 THEN PRINT'"High-flyer!"
 2660 AA=AAA
 2670 PRINT'"          You now have to choose a rate
 of interest. Remember, the higher the rate the hi
gher the bonus after 15 days! You may choose betwe
en the following rates"
 2680 PRINT''CHR$(130);"1) 5%  2) 10%  3) 15%  4)
20%  5) 25%"
 2690 PRINT'TAB(7);CHR$(131);"ENTER THE NUMBER ONL
Y"
 2700 A$=GET$:IT%=VAL(A$):IF IT%<1 OR IT%>5 THEN 2
700
 2710 IT%=IT%*5
 2720 ENDPROC
 2730 DEFPROCCHECKLOAN
 2740 VDU26:CLS:PRINT"Fifteen days have elapsed si
nce you tookout the loan."
 2750 PRINT'"A check now has to be carried out to
seewhether you can repay the loan together with th
e agreed amount of interest"
 2760 PRINT''"LOAN";TAB(29);"`";AAA
 2770 T%=INT(AAA*(IT%/100))
 2780 PRINT'"INTEREST @ ";IT%;"%";TAB(29);"`";T%
 2790 ASSET=(AA+T)-(T%+AAA)
 2800 PRINT'"NET ASSETS NOW";TAB(29);"`";ASSET
 2810 IF ASSET<0 THEN PRINT'"Unfortunately you wer
e unable to  repay your debt, therefore the game i
s over":END
 2820 AA=ASSET-T
 2830 PRINT'"CASH IN HAND NOW"TAB(29);"`";AA
 2840 IF AA<0 THEN PRINT'"Although your stock and
cash together   were sufficient to repay your debt
, yourcash in hand is now overdrawn. Stock    must
 be sold to remedy this"
 2850 T%=(IT%/10)*1000
 2860 PRINT''"Due to the size of interest rate you
    chose, you have earned a cash bonus of    `";T%
 2870 AA=AA+T%
 2880 PRINT'"NEW CASH TOTAL";TAB(29);"`";AA
 2890 PRINT''TAB(8);"PRESS ANY KEY TO CONTINUE";:A
$=GET$
 2900 ENDPROC
```

```
2910 DEFPROCEVENT
2920 IF RND(4)<3 THEN 3170
2930 EV=RND(11):IF EV=1 THEN 2930
2940 CLS
2950 IF EV=7 THEN 3130
2960 IF EV=2 OR EV=3 OR EV>8 THEN 3050
2970 IF EV=8 OR EV=6 THEN 3090
2980 ON RND(6) GOTO 2990,3000,3010,3020,3030,3040
2990 PRINT E$(6);" ";C$(EV);" ";E$(7);".";E$(1);"
";E$(2):GOSUB 3140:GOTO 3160
3000 PRINT E$(5);" ";C$(EV);" ";E$(1);" ";E$(2):G
OSUB 3140:GOTO 3160
3010 PRINT E$(11);" ";C$(EV);" ";E$(12);" ";E$(13
);E$(1);E$(3):GOSUB 3150:GOTO 3160
3020 PRINT E$(11);" ";C$(EV);" ";E$(12);" ";E$(14
);" ";E$(1);E$(3):GOSUB 3150:GOTO 3160
3030 PRINT E$(9);" ";C$(EV);" ";E$(15);" ";E$(1);
" ";E$(2):GOSUB 3140:GOTO 3160
3040 PRINT E$(16);" ";C$(EV);" ";E$(1);E$(3):GOSU
B 3150:GOTO 3160
3050 ON RND(3) GOTO 3060,3070,3080
3060  GOTO 2990
3070 GOTO 3030
3080 PRINT E$(9);" ";C$(EV);" ";E$(10);" ";E$(1);
" ";E$(3):GOSUB 3150:GOTO 3160
3090 ON RND(3) GOTO 3100,3110,3120
3100 PRINT E$(8);" ";C$(EV);" ";E$(1);E$(3):GOSUB
3150:GOTO 3160
3110 PRINT E$(16);" ";C$(EV);" ";E$(1);E$(6):GOSU
B 3150:GOTO 3160
3120 PRINT E$(11);" ";C$(EV);" ";E$(12);" ";E$(14
);E$(1);E$(3):GOSUB 3150:GOTO 3160
3130 PRINT E$(4);" ";E$(1);E$(3):GOSUB 3150:GOTO
3160
3140 P(EV)=INT(P(EV)-(P(EV)/7)):RETURN
3150 P(EV)=INT(P(EV)+(P(EV)/7)):RETURN
3160 PRINT''TAB(7);"PRESS ANY KEY TO CONTINUE":A$
=GET$
3170 ENDPROC
3180 DEFPROCINSTRUCTIONS
3190 CLS:FOR N=1 TO 2:PRINT TAB(3);CHR$(134);CHR$
(141);"INSTRUCTIONS FOR COMMODITIES":NEXT
3200 PRINT'"   The game revolves around the fall
andrise in price of the following eleven  commodi
ties"
3210 PRINT:FOR N=1 TO 11:PRINT TAB(16);CHR$(130);
C$(N):NEXT
3220 PRINT'"   The fall and rise of prices depend
s  firstly on the state of the Market and  secondl
y on the amount of buying and  selling of each c
ommodity"
3230 PRINT'TAB(6);CHR$(136);"PRESS ANY KEY TO CON
TINUE";:A$=GET$
3240 CLS:PRINT"   You are firstly asked to enter
the  size of loan you want. This will be yourstar
ting capital. you are then asked forthe rate of in
terest you would like on  the loan"
3250 PRINT'"  The loan, together with the interes
t  owed on it, must be paid back in full  fifteen
 days later. If this cannot be  done, the game is
 over. Providing you  succeed in paying it off a
bonus is paidto you,";
3260 PRINT" which is dependent on the size  of in
terest rate you chose"
3270 PRINT'"   In order to help you to predict  t
he future price of commodities, a graph  showing
 the FT-Index of the last fifty  days is available
. This is updated every day. In addition, the curr
ent market  position (plus/minus) is";
3280 PRINT" shown by each  commodity"
3290 PRINT''TAB(6);CHR$(136);"PRESS ANY KEY TO CO
NTINUE":A$=GET$
3300 CLS:PRINT"   To make the game that much more
     realistic, certain natural/economic  even
ts happen from time to time. These  may cause the
price of various commod-  ities  to rise and fall
dramatically."
3310 PRINT'"   Lastly, the price of gold is a bar
om-eter of the market, if the market is on a downw
ard trend the price will increaseand vice-versa fo
r an upward trend"
3320 PRINT''"Good luck!"
3330 PRINT''''TAB(6);CHR$(136);"PRESS ANY KEY TO
CONTINUE";:A$=GET$
3340 ENDPROC
>
```

modity in relation to the amount of buying and selling which has been carried out in it during the day. The variable FD%(N,1) represents the number of units in commodity N which have been bought that day, while FD%(N,2) represents the number which have been sold. The actual amount by which the price may rise or fall is strictly dictated by the current market price P(N) and the upper limit U(N), which that price may reach.

Lines 2220 - 2270 At the end of each day, the 'Value of stock' total is adjusted. This is done by adding up successively the total of units held (H(N)) multiplied by market price P(N) of each commodity.

Lines 2280 - 2430 As I have mentioned previously, the price of gold is a barometer of the market. Therefore a separate routine is needed to work out the price of gold each day. The first calculation performed is that due to the total amount of trading carried out in that day. Lines 2290 to 2330 add up, by means of a FOR/NEXT loop, the totals for buying and selling. S1 is the total of buying carried out and S2 that of selling. T1 is the amoung of money taken out of the market by the selling of stock. Line 2330 calculates the new price of gold using the above figures.

Obviously if no stock was sold, using the above calculation the price of gold would remain unchanged. Therefore a second calculation is necessary in order to provide a reasonably accurate analogy of real life. This calculation is based on the overall condition of the market. For this, the program takes into account all of the commodities which are on an upwards trend (ie V$(N)="+"), and all of those on a downward trend. This produces two totals. In the program (lines 2360 and 2370), they are called A and H respectively. The price of gold is then adjusted accordingly, the amount of rise/fall being dependant on the size of the difference between A and H.

Lines 2440 - 2600 These lines contain the two routines which are relevant to the suspension of a commodity from the market. If it has been decided (see previous notes), that a commodity should be suspended then PROCSUSPEND is used. Line 2450 decides how long the suspension should last for. This is decided by random number and can last for anything between 6 and 11 days. The array SP%(X,Y) contains all the relevant data for any suspension. SP%(X,1) contains the random number mentioned above for commodity X. SP%(X,2) contains the information about what direction the price of the commodity should go while it is suspended. The final two lines fo the procedure (2490 and 2500), reset the price of a commodity if it has fallen below or exceeded the lower/upper limit.

The second routine (PROCCHECK) is used every day when a commodity has been suspended. The variable SP%(N,1) is decremented by one (ie reducing the number of days which the suspension still has to run for). If this turns out to be zero, then SP%(N,2) is reset at zero. In addition, the string S$(N) (which has "*" in it when the commodity is suspended), becomes a null string.

Lines 2610 - 2720 At the beginning of the game the player has to enter into the computer the size of loan that he wishes to start with. This is done in this routine, together with the allocation by the player of a suitable rate of interest to accompany the loan. These figures are represented by the variables AAA for the loan and IT% for the rate of interest.

Lines 2730 - 2900 When 15 days have elapsed since the beginning of the game, these lines carry out a survey of the player's financial position and if the player can afford it re-possess the loan together with the interest due on it (2790 and 2820). If the player's total assets are less than the loan plus interest, the game is over. Otherwise, the loan etc. are taken away from the 'cash in hand' figure of the player, normally leaving an overdraft. This can be settled by the player selling some stock the next day (2840). A bonus is awarded at the end of the routine (2850 to 2870), the size of which is totally dependent on the size of the rate of interest chosen at the beginning of the

game.

Lines 2910 - 3170 As I have mentioned in a previous section, at various stages in a game certain natural/economic events occur affecting different commodities. It is the routine held in these lines which selects and then displays these events. Line 2930 selects which commodity is going to be affected. All the data for 'events', is held in the string array E$(N), which was set up from data statements at the beginning of the game. Only certain events can happen with some commoditites. For example one of the events is to do with tornadoes destroying plantations of various commodities (coffee, rubber and so on). This event could not be used if the commodity selected was a metal. Lines 2950 and 2970 resolves this problem, by weeding out the commoditites into groups. Therefore, when the commodity is chosen (EV), these lines send the program to the correct routine for the commodity. There are 13 different events, affecting all of the commoditities except gold. Repetition, therefore, is not a problem.

Lines 3180 - End These lines contain all of the instructions for the game, which can be displayed, if the player wishes, at the beginning of the program.

PROCEDURES USED

PROCINITIAL Sets up all string arrays used in the program. All values for the FT-Index are worked out, together with the current market state of all the commoditites used in the game.

PROCINSTRUCTIONS Displays instructions for the game on the screen.

PROCLOAN The player chooses the size of loan he would like to start the game with, together with the rate of interest on that loan.

PROCCHECK This routine is only used if a commodity has been suspended from the market. Each day, it decrements the number of days the suspension has got to last for by one. If the suspension has no days left to run (ie is over), the appropriate variables are reset and the commodity is allowed back onto the market.

PROCHORIZ Draws a horizontal line across the screen.

PROCSELL Routine used when the player wishes to sell some units of a commodity.

PROCBUY Routine used when the player wishes to buy some units of a commodity.

PROCGRAPH Displays graph of FT-Index values over the previous 50 days.

PROCEVENT Routine used to generate an economic/natural event affecting a particular commodity. The price of the commodity is then raised or lowered accordingly.

PROCBUYADJUST At the end of each day, this routine raises the price of each commodity in proportion to the amount of that commodity which has been bought.

PROCESELLADJUST The equivalent for selling of PROCSELLADJUST.

PROCSUSPEND If a commodity has been suspended, this routine decides now long the suspension will last for.

PROCGOLD At the end of each day, this routine decides on the rise or fall of the price of gold. In order to do this, it takes into account the total amount of buying and selling which has taken place that day, together with the current state of the market as a whole.

PROCCHECKLOAN After 15 days has elapsed since the beginning of the game, a check is made as to whether the player can pay back the loan, together with the interest due on it, which he chose on the first day. If he can, the scores are adjusted accordingly and a bonus (dependant on the size of interest rate chosen) awarded. If the loan cannot be paid back, the game is over.

PROCSTOCK This routine is used to decide which commodities are on an upward/downward trend. Before this is done, an analysis of the market (done by using the FT-Index values) is carried out.

PROCCHANGE After the player has bought or sold some stock, this routine wipes clear the relevant parts of the display, ready for the new data to be shown.

PROCPLAYER If the player has just bought or sold some stock, this routine is used to adjust the total value figure for all the stock he holds.

HACKERS AND HORSES

Dick Constable

The hacking of large computer installations is quite topical, and the TV dramatists have latched on to it with a vengeance. What exactly are they talking about?

The BBC TV thriller Bird of Prey brought a specialised from of computer language into our living rooms and it was one which didn't have a lot to do with BASIC! The 'language' concerned was the jargon of computer crime, and apart from Henry's 'Trojan Horse' (which preserved his life in the first series), there were one or two other words like 'Bandits', 'Data diddling' and 'Trap doors' which were thrown about by the characters like so much confetti. But what did it all mean? Computing Today puts you in the picture with a short glossary of the seedy side of life at the console keyboard.

PROGRAM TAMPERING

This covers a variety of techniques which manipulate a computer program in a manner never intended by the commissioning party. The culprit(s) can operate from various levels within the institution concerned — it might be the system designer, a member of the coding team, or a member of the installation team who has the means and the motive to tamper with the system.

The illicit program may be short and simple. It may have been easy to write. What is not so easy to achieve is its long-term camouflage. Find the hidden code, then find out what it does, and you will usually be directed to the guilty party. Let's look at some hidden-code techniques.

THE LOGIC BOMB

A logic bomb is an unauthorised segment of programming which deliberately crashes the current program, and as such is really quite a simple piece of programming. It is usually practiced by the employee who has reason to suppose his future prospects with the company are nil. Being vindictive by nature, said employee inserts the logic bomb code into the system and waits for his predicted dismissal. About a month after he has left, the hidden code registers that his number is no longer on the company payroll, and the logic-bomb is triggered. What damage the bomb does depends on the programmer's knowledge and skill (and meanness). Logically, a mass erasure or system crash would be the obvious choice and one which might not lead to any suspicion of foul play.

SALAMI TECHNIQUES

The principle behind this fraud is to steal such a very small amount of money that nobody notices — or if they do, they don't bother to complain (a thin slice of salami seems not to shorten the length of the sausage!). The crafty programmer, though stealing ha'pennies, is stealing them from so many different sources that the total amounts to a sizeable gain.

To avoid detection the programmer will not run the program to any set pattern. He will extract small, but different, amounts of money and he will never steal from the same account twice as that might alert suspicion. The money taken is electronically transferred to a holding account until the amount is worth drawing out. On completion of a successful withdrawal, the holding account will be electronically closed. Sensible criminals do not push their luck.

DATA DIDDLING

This computer crime requires no knowledge of program writing and no access to the program within the computer is needed. A classic example was perpetrated by a clerk in America. He noticed that on all the forms used to put data into the computer an employee's name and payroll number was used, but that the computer only recognised the number when processing the monthly paycheques. Conversely, the staff never identified employees by their number. The clerk made a mental note of the workers who often did overtime. On days when a particular person did no overtime, the clerk would fill out an overtime data sheet for that employee, but would use his own payroll number. Neither the senior staff, nor the computer recognised any discrepancy and the clerk enjoyed the fruits of his fraud until the tax officials questioned why a payroll clerk should earn so high a salary.

Other examples include the physical tampering with discs, including the exchange of one disc for another, the incorrect setting of time and date controls and the actual forging of computer stationary and documents.

SUPERZAPPING

This fraud takes its name from a legitimate program or Superzap which is used to crash into a program that has gone slightly wrong. The Superzap is a useful utility — it's just a bigger version of 'disc doctor' programs which help rescue data on damaged discs — but because it is a master-key which opens up a program for inspection and correction, it is a powerful tool for the unscrupulous. A computer criminal who has a Superzap can bypass all the protection devices that are normally coded into a system to prevent unauthorised operations. Money or actual goods can be transferred by forcing the computer to generate suitable messages and authorisation codes, and any record of the transaction can be removed without trace. Such a crime would be extremely difficult to detect.

TRAP DOORS

Programmers commonly put breaks, called 'trap doors' into their programs to assist in the de-bugging process and to cater for any temporary or permanent code which might have to be patched into the system to allow it to run to specification. Some trap doors will be left unused, and, tidying-up processes being somewhat rare in the programmer's scheme of things, they will remain in situ at all times.

The danger of fraud comes from two directions. Either the original programmer will deliberately leave some trap doors at criminally-attractive places in the program flow so that he can make use of them at a later date, or else other programmers, browsing through the complete program will find tempting trap doors left behind. The trap door is very attractive because, in simple terms, it allows the criminal to insert a simple JUMP or CALL in the main program which then causes the normal system flow to branch to the illegal routine. The appearance of the main program is for all intents and purposes unchanged, while the illegal routine may, quite literally, be hundreds of miles away.

TROJAN HORSE

And so to Trojan Horse . . . the program within a program, sitting there, waiting to be called up. The dramatic licence of a TV play allows for

a Trojan Horse of some 32K (?) to be inserted, by telephone, into the Civil Service mainframe computer. Well done, Henry!! However, these equine programs do exist, and they are usually very devious. A typical example comes from the States, and involved a computer program which mailed out monthly cheques. The Trojan Horse was responsible for filtering incoming notifications of client's deaths. The death was converted to a notification of change-of-address and this status was held for three months. Three pay-cheques later the original death notice, freshly dated, was passed to the main program, and the record of the change of address was erased. Needless to say, the false address was the temporary accommodation for the criminal, who was ghoulishly keeping clients alive beyond their allotted time to receive their income.

TIMESHARING FRAUDS

Timesharing brings about its own particular problems. Under such systems one company might find itself at risk, not so much from its own staff, but from the dishonest staff of other companies who share the same mainframe. Sometimes the fraud is masterminded at the highest level, and a ploy known as 'Scavenging' can be used with great success. One case history tells how a company insisted that a 'scratch-tape' (a used tape) be installed on the mainframe before they ran their programs. The use of this second-hand tape, being less expensive than a brand new reel, gave the company concerned a name for penny-pinching. In fact the company was reading the scratch tape before writing new data onto it and the only pinching being done was that of getting confidential information about a competitor's business!

HACKING

Hacking, if you don't already know, is the process of using a small micro to break the code and thus gain entry into the large micros of industry, commerce and Government. The attempt is made by modem link over the standard telephone network and costs the hacker the price of a somewhat lengthy telephone call but nothing else, since it is not yet a criminal offence to attempt to find the password code of a mainframe computer. However, and this is a non-governmental health warning, although hacking may be regarded by some as harmless enough (like a quick puff on a cigarette behind the bike sheds), it can lead to criminal activity.

On the other hand it must be said, lest there be too many red-faces amongst the young readership, that if it wasn't for the teenagers beavering away with their Spectrums at the silly three-digit codes of certain large organisations, said organisations may never have realised how insecure their computer systems were. I doubt there are many short-entry codes around in 1984. To the company on the receiving end, these hackers are merely 'bandits' making a nuisance of themselves and tying up 'phone lines.

COMPUTER PROTECTION

Computers are, in fact, very good at protecting themselves. Most of the fraud taking place does so because the operating systems are (or at least, were) badly designed — the system designers simply failed to appreciate that protection was necessary. Today, firms are generally more security conscious.

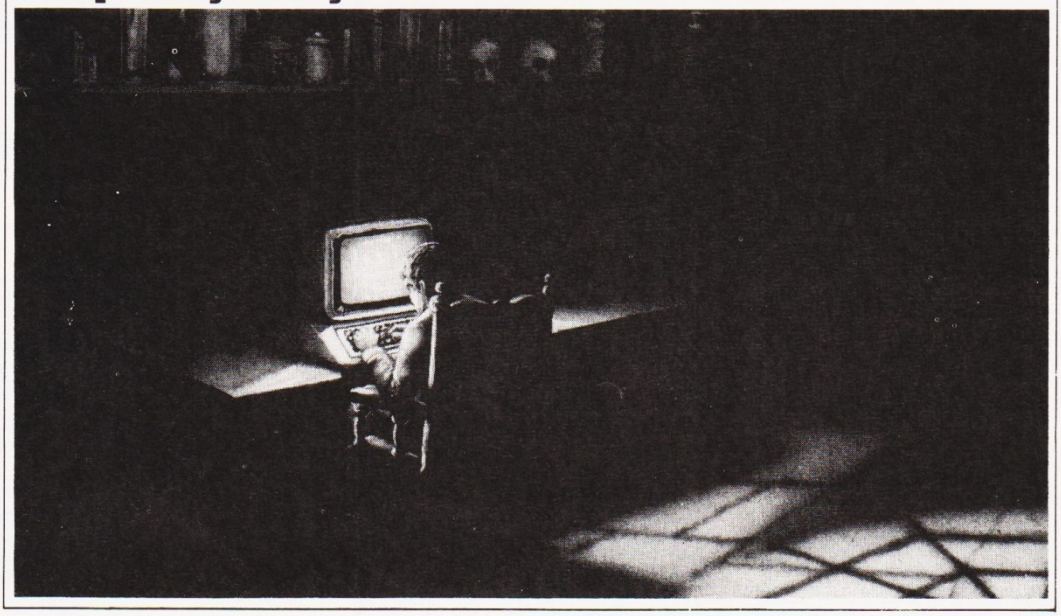
Terminals and computer rooms tend to be physically protected in much the same way as cash registers and money vaults. Personal codes and identity cards are frequently used and access to the system is more restricted. The system may even monitor the length of time a user is at a terminal — and report suspicious activity. When data is moved, by telephone or satellite link, it is encoded to prevent electronic eavesdropping.

There will always be computer criminals who attempt to break the system, but whether the facts of the matter will ever approach the scenario presented by the film maker — well, we'll just have to see, won't we?

FUN WITH MUD

B.W. Smith

It's so cheap to kill your friends, after 12 and at weekends. Multi-User Dungeons, played remotely at the end of a telephone line, could herald the future of computer gaming.



Every adventure game written for computers has its roots in the original role-playing fantasy games, where a Dungeon-master created a whole fantasy world on a table top, and the players had to explore it while acting out their chosen personas. The whole concept can be curiously compulsive, and hardened role-players have been known to comment that what happens in the game is real life: the fantasy world is the one that you and I inhabit. This type of game is also part acting, and a lot of pleasure comes from interacting with the other members of your team, all of whole have their own make-believe characters.

Transferring this sort of game to a home computer presents problems. A role-playing game can be as big as the Dungeon-master cares to make it, while micros are limited to relatively small databases. On top of that is the problem of hooking up all the players simultaneously; networking is still relatively rare in the home market. Consequently the direction taken by adventure games has been the single-user puzzle-solving programs which we all know and love.

GLORIOUS MUD

For some time now, however, a true multi-user role-playing computer game has been available to those with the right equipment. The game is called Multi-User Dungeons (not surprisingly!), or MUD for short, and it runs on a DEC System 10 minicomputer in Essex University. If you aren't actually on site to play in person, then you can play remotely using your home computer and a modem as a terminal.

This explains why MUD is a nocturnal or weekend activity: the telephone charges are cheaper then. Also, the DEC is required for rather more mundane tasks during working hours! Unfortunately some restraint is still called for: nighttime play didn't prevent one player from racking up a massive £3000 phone bill, which not surprisingly brought participation to a sudden end.

It may seem odd that a serious institution would devote so much equipment, time and programming effort into such an apparently frivolous pursuit. But MUD has hidden depths. From a computer science viewpoint MUD provides a testbed for artificial intelligence routines (for example, the parser which interprets the English sentences input by the players), and for communications (MUD has probably one of the most advanced user-to-user communication channels in public service: better than Micronet, for example). Co-author of MUD Richard Bartle belives that MUD has put Essex in the forefront of this field.

PLAY TIME

MUD is a real-time game, and he who hesitates will probably find that another player has beaten him to the treasure. Any player who is on-line can manipulate the database, so if you drop an object somewhere and go back to collect it later, it's quite likely that someone else will have found it and taken a fancy to it.

You can talk directly to any or all of the other players by using the person's name or the command Shout. You can fight them as well if you wish, but novices are warned that this could be a quick way to die early. Cooperation is also possible, and you can ask another, more powerful player to perform some action that is beyond you: he, of course, may or may not oblige. Or he might demand payment of a treasure.

Just like the 'real' role-playing game, your character develops with experience. Players start off as novices and can work their way up through the ranks to the heady heights of Wizard. Players at this level have quite extraordinary powers, and can spy on lesser players, move them around and generally be the sort of nuisance that wizards are supposed to be.

The human players are not the only participants in MUD's adventures: the game has its own characters called mobiles, which are creatures, usually hostile, which are controlled by the program. They can be quite nasty, and a group of players may need to combine their strengths in order to vanquish one.

GETTING IN

MUD is free to play, but you require a modem and a computer configured as a terminal. You will also need an account with the PSS (Packet Switching System) of British Telecom, which doesn't come cheap. (Compunet users will be getting their own version of MUD). You're probably looking at a start-up cost of £150 if you only have a computer at present. On the other hand, the fascination that MUD has on its players may be worth this outlay. I know one Wizard, Thor by name, who gets a lot of useful information through his MUD contacts: sometimes even paying for real-world data with fantasy-world treasure!

He also points out that MUD has a disturbing tendency to reinforce character traits in certain players, which is reflected in their daytime behaviour. So if you do get the MUD bug, try to keep a grip on reality: whatever that is . . .

REMEMBER

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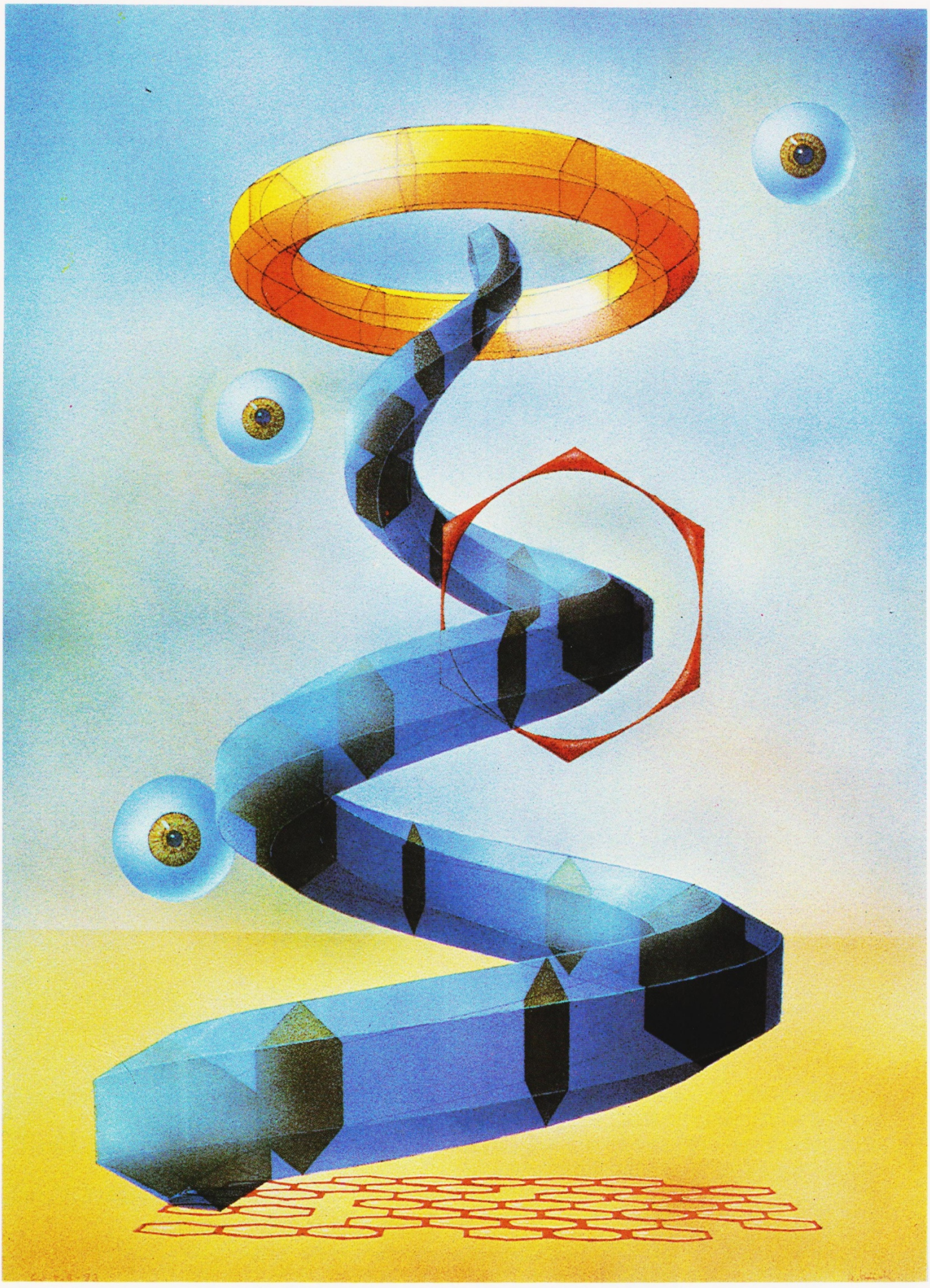
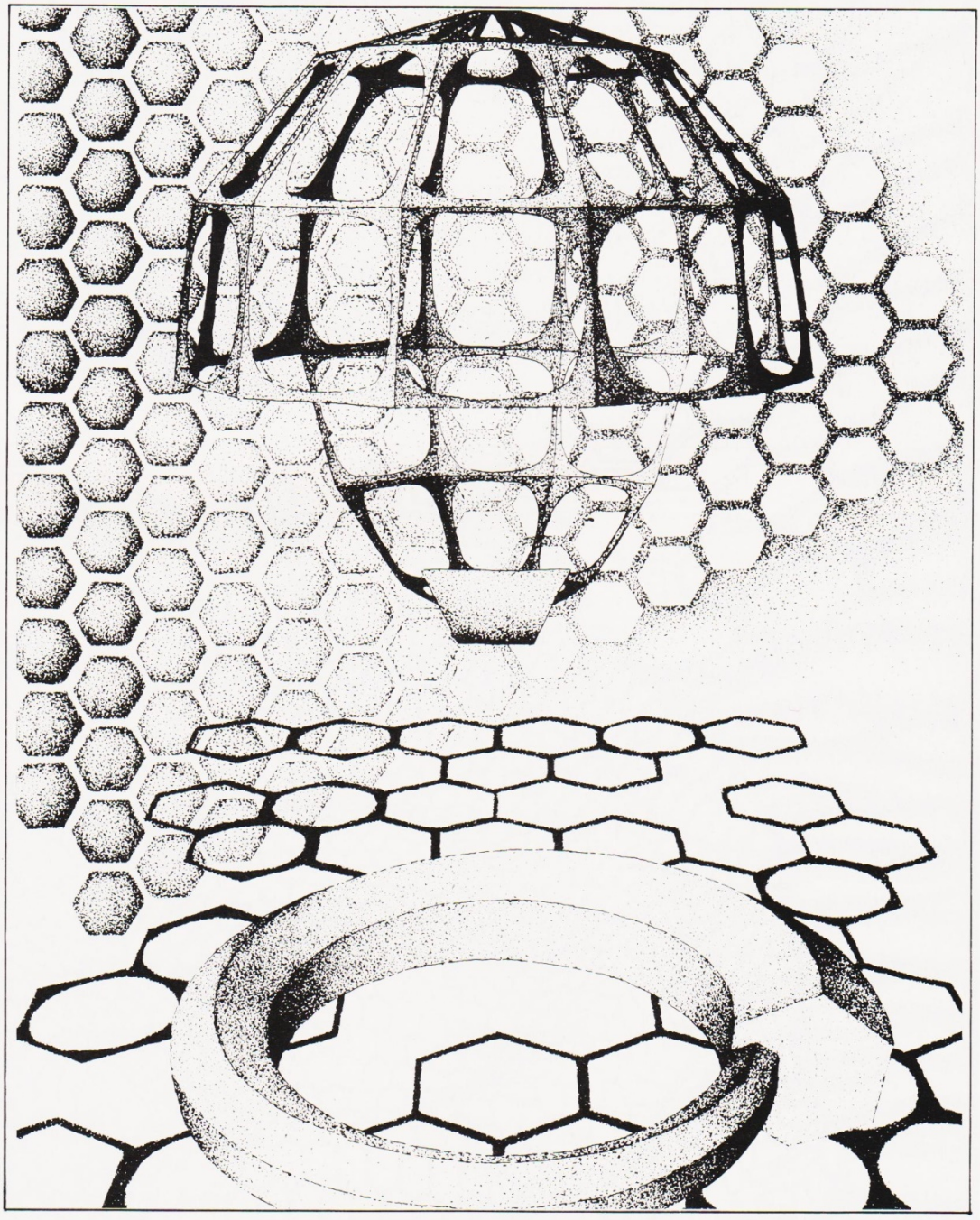


GRAPHIC DELIGHTS

Peter Green

A new book has just been published which deals with graphics on home micros. It's really rather nice.



Generally speaking, graphics produced on the average home microcomputer are fairly flat and two-dimensional. Equally generally, this is a failure of technique rather than technology: coloured pixels are the same whether they are produced by a ZX Spectrum or a large minicomputer.

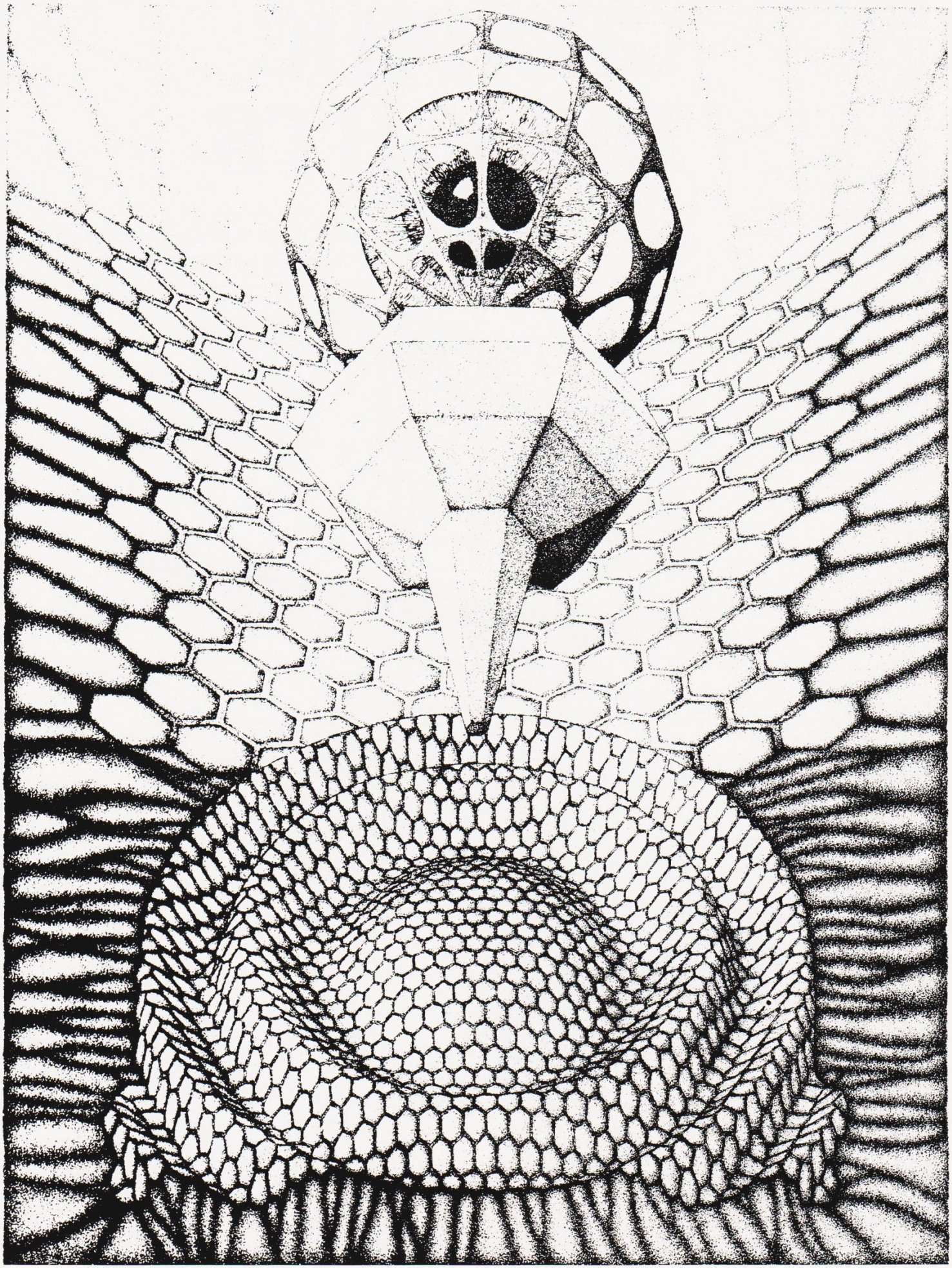
Three-dimensional graphics requires a fairly hefty dollop of applied geometry and working things out from first principles may not be too easy for those of us with only a passing acquaintance with Euclid. Fortunately a new book called **Computer Art and Graphics** from publisher Paul Petzold Ltd contains, not only the geometry required, but a series of program modules which can be slotted together to generate quite stunning pictures. All of the illustrations reproduced are taken from the book and indicate the sort of thing which can be achieved using the modules.

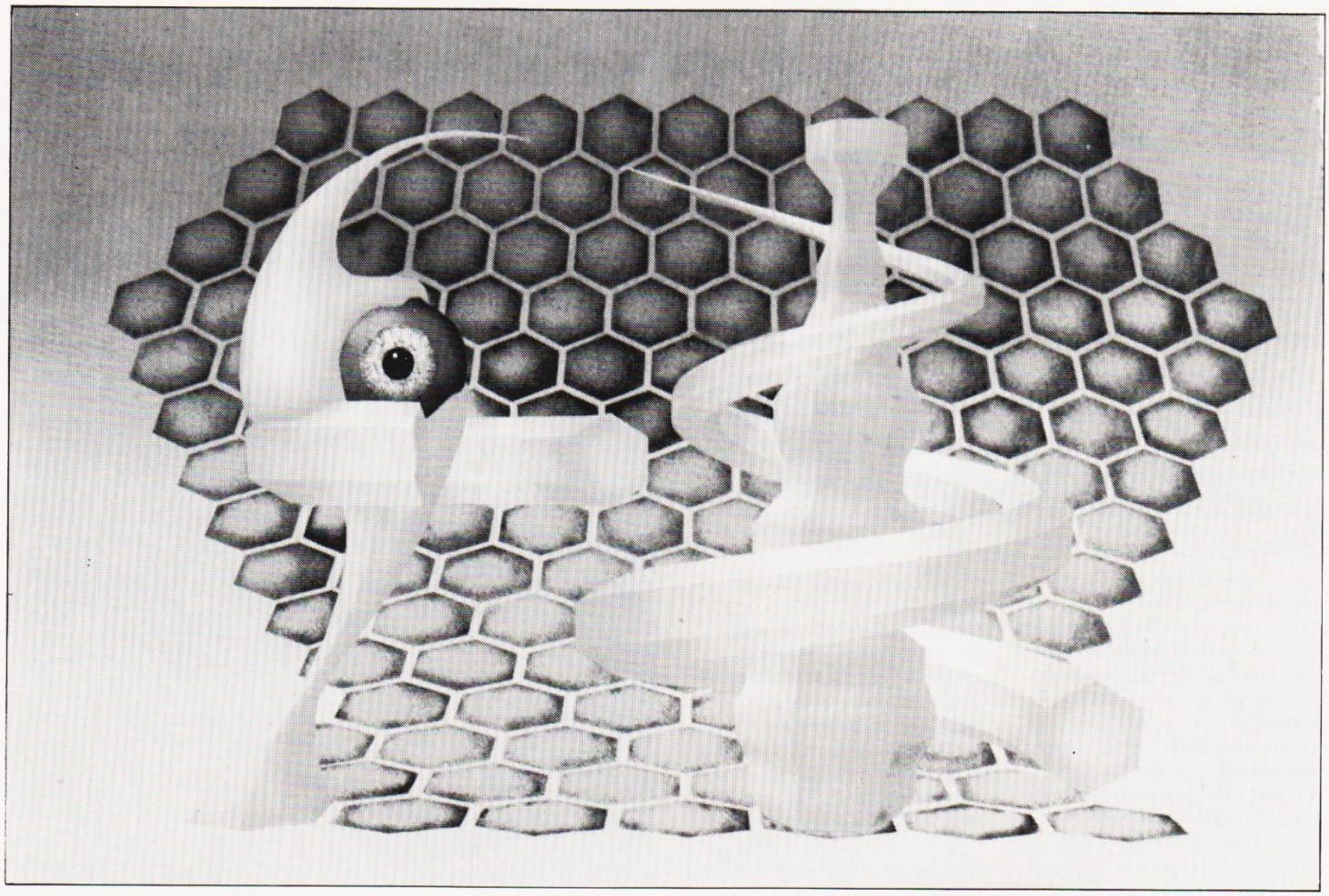
You might think that complicated programming is required for this sort of work, but the routines are written in very simple BASIC using ordinary variables and arrays and keywords that should work on most popular computers. A conversion table is given at the back of the book in case any syntax difficulties are encountered. General algorithms have been used in the modules rather than specific routines using DATA statements that have to be changed for each application, so the system is very versatile.

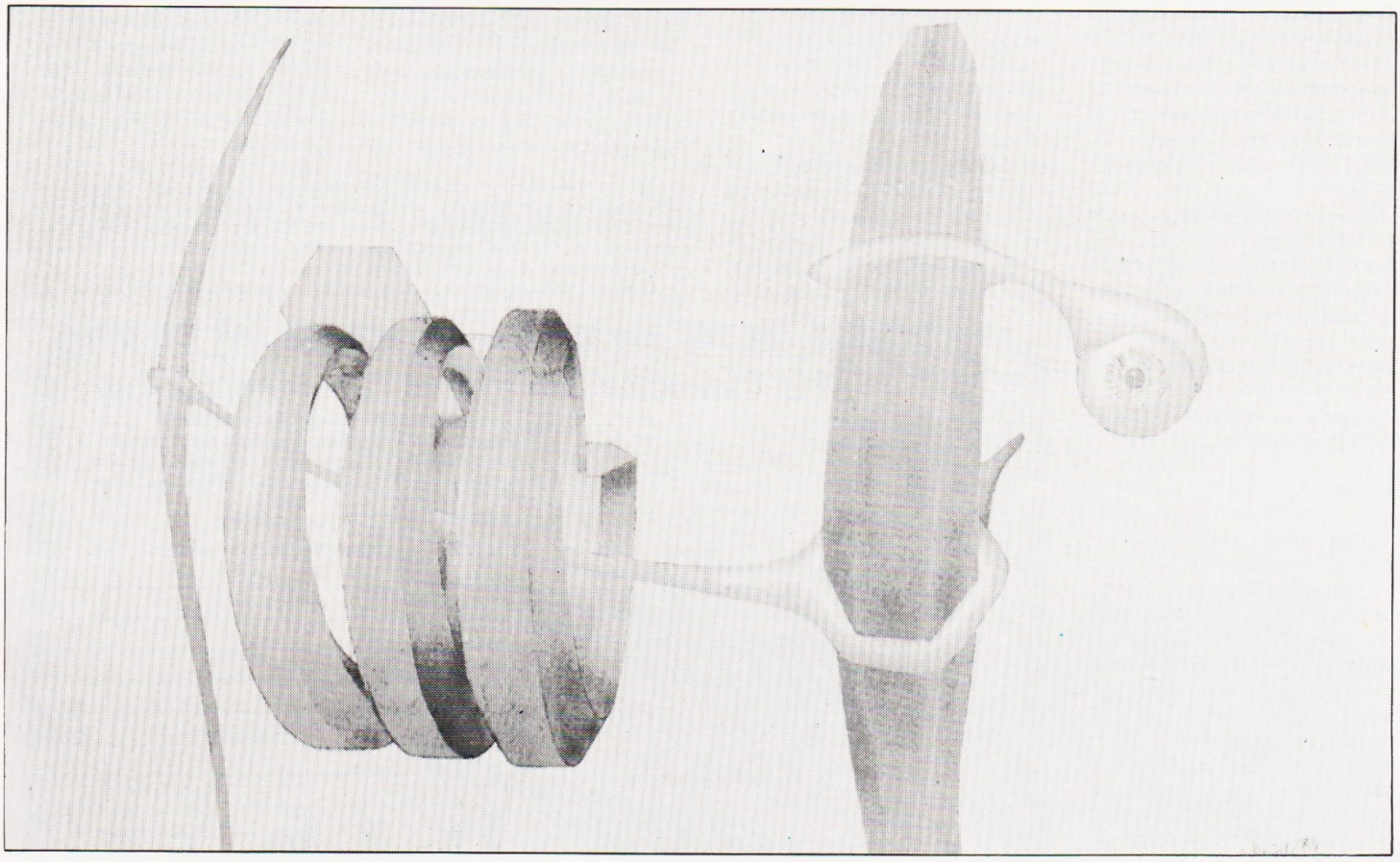
The book starts with a discussion of the output devices: a plotter is the usual choice, but the screen may also be used with a simple program change. Then the technique for drawing a straight line is given, building up into simple shapes, rotation and translation, circles, polygons, solids and perspective. The text is liberally illustrated with figures and there are 12 full colour and numerous other black-and-white examples.

The author, Axel Bruck, is a German artist, so he doesn't just cover the technical details. An appendix covers the practical side of computer art, including choice of paper, methods of colouring, hand stippling, airbrushing and working with gouache and acrylic. Boldly, he also gives his home address so that readers can write with queries.

IBM PC owners are spared the necessity of typing in the programs as Transam Microsystems, 59/61 Theobald's Road, London WC1X 8SF (phone 01-404 4554) can supply the graphics software, plus a teaching program on perspective, on disc for £75. **Computer Art and Graphics** costs £14.95 and in case of difficulty you can contact Paul Petzold Ltd at 4A Alexandra Mansions, West End Lane, London NW6 1LU (phone 01-794 8609).







'THE USUAL PROBLEMS OF MAN MEETS WOMAN'

* solved by Dateline!

Michael Wheeler is an articulate, good-looking businessman in his mid-thirties. Born and bred in London, his work has taken him all over the world. Despite his busy life-style he found time to marry, but unfortunately his marriage failed and he found himself back in London, trying to rebuild his social life.

'My cousin, who lives in London, suggested that I should join Dateline. I must admit, I found the idea appealing because I was aware of Dateline. In fact, I had been a member way back in the sixties. I found no great romantic successes at that time but many, shall we say, nice encounters, so when my cousin suggested the idea again I thought 'Why not, I'm only going to live once, why not make the best of it?'

Michael didn't join Dateline to find 'the woman of my dreams'. 'I joined because after a long absence from a city like London you tend to find that your friends and acquaintances have married or moved away. Although I obviously missed female company, I also found that I had no circle of friends left at all.'

'When my first list of names from Dateline arrived and I began to receive calls from women with whom I had been matched on the computer, my social life improved out of all recognition almost overnight! My only problem was time, because all of the women I spoke to were so pleasant that I felt I had to meet them. In the event, I met four from my first list of names. Two I felt I could quite happily be friends with; the other two meant rather more.'

Michael doesn't mind people knowing he is a member of Dateline. 'There's not the adverse reaction from family and friends that I think some people may expect,' he said. 'I did perhaps feel, as many people probably do, that there's some sort of stigma about admitting to feeling lonely. But that's rubbish as loneliness affects every person at some stage of their life, no matter what their circumstances. It's something that has to be overcome by any means available to us. Dateline may sound cold-blooded to some people, but I have found it certainly isn't. It may perhaps be more socially acceptable to meet people of the opposite sex in pubs or clubs, but really Dateline wins above those places. I don't like competing with smoke and noise, and it's far nicer to know that the woman you're telephoning has the interests and desires you're looking for. It provides a basic understanding before you even say hello. Obviously, all the usual problems of man meets woman are still there, but you have conquered quite a few of the barriers that so often make a relationship fail before its really started.'

He stopped to consider for a moment. 'I don't know what you need from life. All I really want is happiness, and a large part of the happiness I seek is the happiness that can be gained from the relationship between a man and a woman. At least two of the women I have met directly through Dateline have become friends and it's good to know that if I am at a loose end there's someone I can 'phone for a chat or to arrange an evening out.'

Michael has recently suspended his membership of Dateline. He has met a young woman who is a friend of one of his Dateline introductions. Their relationship has blossomed into love and they are now engaged to be married.

If you would like to be one of the many thousands of people nationwide who have been enjoying a new social life, and finding love and happiness through Dateline, complete the simple questionnaire below. We will send you confidentially and completely free, full details about Dateline and how it works, and details of just one of the Dateline members who are compatible with you. Send to:
Dateline Computer Dating, 23 Abingdon Rd., London W8. Tel: 01-938 1011.

EINSTEIN'S RELATIVITY

Dick Leslie

As the cream-coloured computer-Einstein and the wild-and-woolly human-Einstein stare at us from the pages of the computer (and non-computer) press, we dig deep into this Z80 computer and find out why it's so special.

While the media fusses and fumes over the arrival (or non-arrival) of the MSX invasion, there is already in the shops a British-made Z80 micro which can knock the spots off the Japanese invasion force. If you blinked, you would have missed the launch of Tatung's Einstein. Another Z80 micro (yawn) . . .

£499? Well, it does have a 3" disc drive on board. The trouble with low-key launches, by which I mean really mean non-eventful no-promises-broken-launches, is that you tend to miss the significance of the small print. It's time we took the lid off this machine to see what makes it tick.

BUILT TO LAST

The Einstein case is made of strong — and I do mean strong — plastic. The shape is such that a monitor will sit firmly on top of the computer, and of course Tatung make a monitor which will blend with the computer style and colour. However, unlike the Amstrad package, you don't have to buy the monitor. Three separate signals are available so you can connect to your TV via the UHF link, or to a monitor via either the RGB or YUV standard video signals. What Tatung have thrown in for the price is a single-sided 3" compact disc drive, and they have left room for a second identical drive for an easy upgrade path to twin drives.

The keyboard is a professional full-travel affair which seems to have all the appearance of a keyboard meant to last, for this is no spongey set of keys laid out in the 'modern' IBM PC format. They are keys with a crisp feel to them, well staggered and with graphic symbols printed on their sides. There is no cursor pad, which is a great pity, and the cursor keys are awkward to use, there being just two of them, and not positioned either side of the space bar. However, there are eight function keys, with a perspex bar under which the written description of the key can be inserted. Above the function keys and between the 3" drives is an oval loudspeaker of generous proportions. I've seen smaller loudspeakers in TV sets! The micro produces an impressive sound, but I'll come to that later.

UNDER THE LID

The computer case lid is fastened by two screws and it comes off easily. Inside the Einstein is one huge PCB, the disc drive case, the power supply cage and a lot of air. The quarters seem quite spacious, although they would look a little more full with the second disc drive installed. The power supply is a switch mode unit, and has the advantage of running mildly warm, as opposed to uncomfortably hot, which is the case with many other micros.

A PLETHORA OF PORTS

Working around the side of the machine we find a mains switch, a reset pushbutton, and a fairly attached mains cable, which, incidentally, comes from Tatung with a moulded and fused plug on the end of it. The interface ports are standard IDC connectors, with gold-plated pins and strain clamps. DIN sockets are used for the RGB/YUV outlet (6-pin), two for the joysticks/analogue ports (7-pin) and one for the RS232 interface (5-pin domino).

HI-RES COLOUR

The Einstein has the standard 64K of RAM on board, of which something like 56K is available to machine-code programmers and about 43K is available to those writing in BASIC. The resolution of the screen is 256 by 192 pixels. Forty column colour text is available from the Texas Video Display Processor — this is the VDP used in the Memotech and MSX machines. It provides a tolerably high resolution in graphics mode, while at the same time offering the facility of 32 sprites. It has its own dedicated 16K memory (two chips) and runs independently of the main memory. Tatung have made provision for extra ROM, on board, up to 32K, and an 80-column video card. The latter, priced at £80 would seem to allow a low-cost upgrade to full 80-column, CP/M standards.

SOFTWARE ON DISC

The Einstein's high level language is supplied on disc and is not found lurking in a large ROM. The advantage of this is fairly obvious — you don't need to think in terms of the Einstein being a BASIC machine. It could be a FORTH or a Pascal machine. Alternatively, if you like BASIC, you can choose to stay with the Crystal BASIC supplied, or add your own

routines to Crystal BASIC, or change to BBC BASIC.

Crystal is a small software house which has written the operating systems and the BASIC for Tatung. Many Computing Today readers will remember it for the work done for the early Nascom and Sharp computers. For the Einstein, Crystal has written the Machine Operating System (MOS) — that's the system in the 8K ROM, by the way — and the Disc Operating System (DOS), which is a CP/M compatible system supplied on the system disc which comes with the computer.

The three levels of operating system, MOS, DOS and BASIC, are mutually supportive and are explained in some detail in the three manuals supplied with the machine. Initially, Einstein is at the level of the MOS, unless you switch on with a disc in the drive, in which case you enter at the level of the DOS. Potential users would not need to twiddle their thumbs while BASIC loads. Crystal BASIC is supplied as XBAS.COM but you can easily rename it X.COM in which case, assuming you have the correct disc in the drive, switching on and typing X <Enter> will take you into BASIC in about 8 seconds.

You won't need to constantly change discs, either. Each side of the 3" compact disc holds a useable 188K. With XBAS already on the disc, that leaves you with 172K for program storage. That's a figure which could turn some disc-system owners a little green.

The MOS is remarkably reminiscent of the most excellent Nascom 2 operating system. Those of you who knew the Nascom series computers will recognise that in many respects they were ahead of their time. Crystal, of course, knew the Nascom ROM inside out, since they produced a very powerful 8K tape-BASIC for the machine. Now, it would seem, this type of ROM MOS lives again!

The DOS is also easy to use, and has commands similar to the familiar CP/M standard. The discs are used with double-density recording and layout is 512 bytes per sector, 10 sectors per track and 40 tracks per side, giving a formatted capacity of 200K per side. The DOS has the ability to run CP/M programs, and a number are already available for use on the Einstein, in 40 or 80 column mode.

The best possible proof that Crystal MOS and DOS are easy-to-use, well-designed systems, is the amount of software that has been made available at launch time for this 3" disc computer. Crystal BASIC is good, make no mistake about that, but every new computer has BASIC (and some even have bugs to go with it) and so it is the range of software available that counts in the long run.

TWO BASICS

There is no question of one BASIC being better than the other: they complement one another. Crystal BASIC is a medium-fast BASIC (19 sec on average) with very comprehensive editing and file handling facilities, plus sprite manipulation. BBCBASIC (Z80) is very fast (14.8 sec on average) and has an in-line assembler and procedures. It has equally powerful file-handling comands, but, naturally, can't handle the 32 Einstein sprites. This is not the first time BBCBASIC has been run on a Z80 machine — there are versions that run under CP/M — but I would hazard a guess that it's the first time it's been done on a sub-£500 disc computer.

The company that markets BBCBASIC(Z80) is M-Tec Computer Services (UK), and the package costs £59 exclusive of VAT. It comes on a disc as BBCBASIC.COM with about 50 other assorted utilities and demonstration programs. A substantial ring-bound manual accompanies the disc, in the A5 format which matches the Einstein manuals. The sign-on message of BBCBASIC reveals the author as R.T. Russell who has also been involved with the software for the Z80 Second Processor for the BBC machine.

In the M-Tec manual, a general knowledge of BASIC has been assumed, so newcomers are advised to read one of the many books for beginners in BASIC. The manual gives a summary of the commands and functions and describes the minor differences between the BASICs. But, to quote the manual: "... not a lot has been written on file handling with BBCBASIC and it would be a pity if you missed out on some of the unique features. So, at great expense, an explanation of BBCBASIC(Z80) file handling has been included."

Einstein owners are likely to end up knowing their 3" discs inside-out! The Crystal BASIC manual has a substantial section on file handling, and there are worked examples of both sequential and random-access files given in the Crystal manual and the M-Tec manual. M-Tec have thoughtfully typed their examples onto the disc, but whether that is an advantage of my having a 'pre-release' disc I do not know.

The burning question is — do you get all the advantages of BBCBASIC on this non-BBC machine? Tatung have been quite clever about this. For example, the Einstein screen at 256 by 192 cannot match the BBC computer in its very-high resolution mode. In most cases this won't matter. Sections of BBC hi-res graphical details do go missing off the Einstein screen, but the program certainly doesn't crash with "Out of range" messages. Incidentally, in Crystal BASIC the graphics are mapped on a grid ranging from −32768 to +32767 and so there, too, "Out of range" messages are a rarity.

The chips on the Einstein PCB allow both three-voice BBC sound and BBC A-to-D conversions, though in the case of the latter it is four channels and not the full six. TAB(X,Y), POS, VPOS and TIME are supported, although most VDU commands are not recognised. Powerful direct memory manipulation using the indirection operators and sophisticated parameter passing in the CALL statement can be achieved, and multi-line REPEAT-UNTIL statements, multi-line named functions and multi-line named PROCEDURES can be used.

There are utilities on the disc to change internal-format BASIC to ASCII-File BASIC, to protect LISTings and to enable MERGEs. The demonstration programs that I have seen are all very good. They are all fast, yet written in BBCBASIC. One at least features a 'sprite', created in an OSCLI command, and the overall impression is of very powerful graphics commands.

The BBC Micro has often been commended for the quality of its music. The Einstein uses the General Instrument's AY-3-8910 chip rather than the Texas SN76489 which is used by Acorn, but the end result is the same. The MUSIC program on the demo disc can call up any of 15 tunes which put the Einstein through its paces, courtesy of BBCBASIC! Cynics will doubtless say that computer music from these types of chips sounds as if it has been played on a fairground organ, but this would be to totally belittle the bright, crisp and above all, tuneful sounds that a good micro can produce these days.

Tatung and M-Tec are to be congratulated for their Einstein-BBCBASIC : could this be the beginnings of true program compatability between machines? What makes it all possible is Tatung's decision to use a disc-BASIC, thus paving the way for experimentation and flexibility of use.

LANGUAGES

COBOL, FORTH and Pascal are all available under the 'Einsoft' umbrella. Tatung have sensibly set up an "Einsoft approved" system whereby as many software houses can write for the Einstein as want to, and in this way Tatung have already acquired a respectable list of games, utilities, languages and business-application packages.

I tried out two programs from Kuma Computers Ltd, both 'Einsoft approved', and found them to be good value. The first was the Zen assembler. This assembler has been around for a good many years, and although it is not powerful enough for advanced programmers, it is certainly an ideal assembler for beginners. Zen itself includes a machine-code monitor which to some extent overlaps the Crystal MOS monitor, but what Zen does have is a mini eight-byte disassembler, and a full disassembler built in.

ZEN supports any length of label, with all characters

being significant, and can work in decimal, hexadecimal or octal notation. As well as the maths operators addition, subtraction, multiplication and division, the logical operators AND and OR are included, and this is most useful. Conditional assembly is not supported, and the ZEN editor is not particularly fast to use since you can only ever deal with one line at a time. However, the best way to learn machine code is to examine professional source listings, and the ZEN assembler comes with its complete source listings neatly printed in the back of the instruction manual. Armed with this information, you could use ZEN to re-write the Editor section of itself! In any event, you are certainly encouraged to make slight alterations to ZEN's code so that its output can be made to fit your particular printer, should that happen to be one requiring strange control codes.

The other Kuma program I used was their WDPRO, a 40-column wordprocessor. This is a comprehensive program with all the usual basic commands of FIND, REPLACE, COPY and MOVE and a pleasingly long list of text formatting commands. Page numbering, header-lines and footer-lines are supported. Justifying and text centering are likewise supported, and both left and right margins can be set to any column position. Non-printing comments may be embedded in the text, and a pause-print may also be set so that "live" text may be sent to the printer directly from the keyboard.

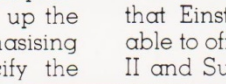
Three methods of printer control are allowed. On simple typewriter-style printers, underlining and emphasising is done by multiple passes on the printed line. Alternatively, commands can be embedded in the text which will turn on and off the various print options such as double-width characters. The best way, however, is to use a special program supplied on the disc to reconfigure WDPRO to meet the requirements of your particular printer. Thus, you can decide if you want a pause at the end of each printed page; you can set up the underlining and emphasising codes; you can specify the character needed to generate the "£" sign, and so on.

Formatted output can be sent to the screen so that you can see what your work will look like before you print to paper. Small blocks of text can be printed independently of the whole document, which is extremely useful. Single space/double space setting is achieved by one single command. Disc operations are simple, but automatic back-up files are not made, which is a pity. Nevertheless, I would rate WDPRO as a powerful piece of software.

It has often been said in the case of micros that "software sells the hardware". The Einstein already has good choice of 40-column-screen software, and it's early days yet. Britain's leading software distributor, Software Ltd, has reached a special agreement with Tatung to provide a full range of CP/M software for the Einstein, although much of this is likely to require the 80-column video card. Nevertheless, it is probable that Einstein dealers will be able to offer Wordstar, dBASE II and Supercalc on 3" compact discs for the 80-column machine by the time you read this.

CONCLUSION

With other micros sprouting a variety of disc drives, wafer drives, and datacassettes in the furious effort to make available mass-storage at a reasonable cost it could be that Tatung have pitched it right. At Autumn 1984 prices, the Einstein package offers good value for money, being much cheaper than its obvious compeitor, the BBC Micro. Competition from the Amstrad cannot be discounted since the machines share the CP/M 3" drive format, but close inspection of the Amstrad's specification shows quite a discrepancy in terms of power rating, and interface capabilities. I can easily imagine the Einstein gaining a lot of ground over the next few months. In short, it is a quality machine with good documentation and a wide range of software — and with reliable onboard disc storage. Isn't that what we've all been waiting for the past two years?



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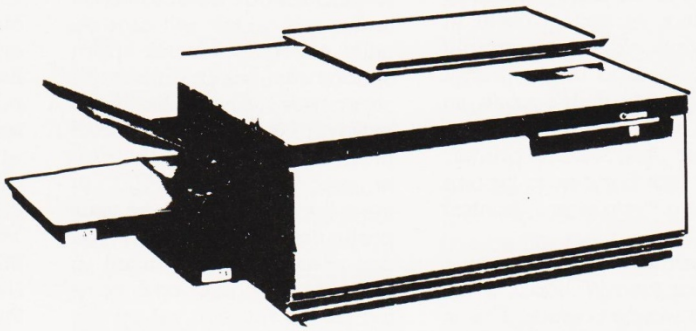

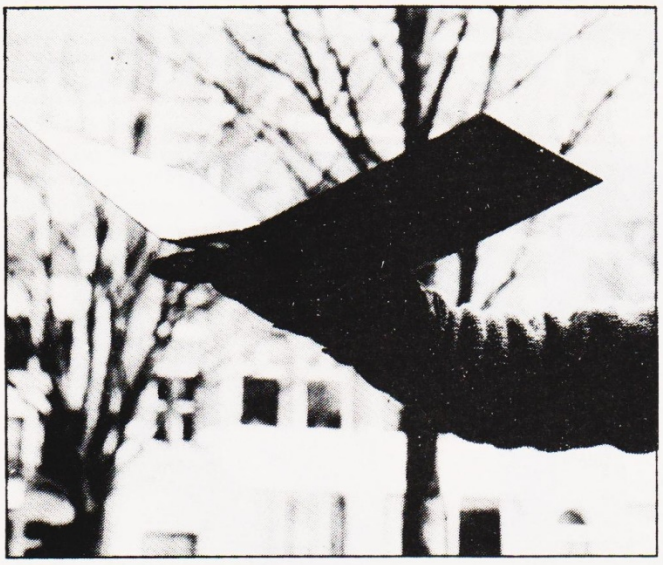

In days gone by, falconry was the sport of gentlemen and kings — this noble and time-honoured tradition is not so prevalent in these technological times, and it is quite a pity, too. Just imagine the pride you'd feel standing in your own back yard while your very own hunting falcon swooped down upon unsuspecting dogs, cats and Ford Sierras.

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MTX LIFE

Nigel Barnes

When Conway invented this game of Life way back when, he little realised what a fascination it would hold in the computer world. Here we present a version for the Memotech computer.

Life was invented by a mathematician at Cambridge by the name of John Horton Conway. It can only loosely be described as a game and bears no resemblance to the other computer stalwarts since there are no invaders to repel and no NORTH to visit. There is, however, no lack of death: in fact the turnover in this game would put even the most bloodthirsty Orc slayer to shame.

LIFE'S RULES

The game is set on a two-dimensional plan which has been divided into identical squares referred to as cells: each is either alive or dead. A set of rules is then applied which determines which cells will die, which will be born and which will remain in the same state in the next generation. The rules are simple and revolve around how many neighbours a given cell has.

- A cell with two neighbours will be in the same state in the next generation.
- A cell with three neighbours will be alive in the next generation.
- A cell with any other number of neighbours will be dead in the next generation.

These rules are applied simultaneously to all the cells, a task for which a computer is well suited.

The cell pattern used in this program is 36 by 20. For each cell the program must know what its state is in the present generation and be able to record what its state will be in the next. This clearly only calls for two bits per cell — devoting a byte per cell seems a bit (no pun) wasteful.

Since the cell pattern is 36 by 20 and a byte records four cells, a buffer of 180 bytes is required. This is located at the end of the program starting at TOP. The machine code part of the program is split into two parts, a routine to display the cell pattern which starts at SCR, and the main routine which works out the state of every cell in the next generation.

Throughout the main routine, BC identifies the cell under investigation and memory locations ROW and COL contain the row and column of the cell under consideration. It is necessary to record these to identify cells at the edge of the pattern.

The subroutine starting at ADR returns the address of the byte containing cell DE in HL and A points to the appropriate two bits. GET then extracts the relevant bits and puts them in the A register. TOTAL calls subroutines which calculate the addresses of the neighbouring cells (if they are not outside by 36 by 20 grid) and finds their state, the number of living neighbours being held in COUNT.

STATE then applies the rules defined above and if the cell under consideration is to be alive in the next generation ALIVE is called. This sets the 'alive in next generation' bit for cell BC.

When this has been done for all the cells MOV is called. This copies the 'alive in next generation' bit into the 'alive in this generation' bit and clears the 'next generation' bit.

The method of displaying the cells is rather convoluted due to the Memotech not having the screen RAM in the main processor's memory map; for the advantages of this approach, visit your nearest BBC owner! A vector therefore has to be sent to the VDP, the processor which handles the screen. One row of the pattern is then sent to video RAM; this is repeated until the entire pattern is displayed. It was found necessary to disable interrupts during this process: they are enabled at the end.

The program then returns to BASIC where the generation counter is updated, and the keyboard is then scanned. If space is held down then the program will pause until it is released. Pressing Q will stop the program; this has the advantage over Break that it will return you to BASIC, while pressing Break may mean you have to come in through the front panel which involves the extra effort of pressing BY.

PLAYING GOD

The rest of the program is the routine to input a new pattern. This is done using the cursor and the numeric keypad. Pressing HOME causes the cell under the cursor to be "born"; mistakes can be wiped out with the Space bar.

ITS A HARD LIFE . . .

It should prove simple to convert this version of Life to any Z80 system. The only problem will be with the code to display the cells; however, it should not be too difficult to overcome. You will need to go through all 720 cells: LD DE with the number of the cell you wish to test, call ADR followed by GET and test the least significant bit of the A register, which will be set if the cell is alive.

Watching how patterns develop is an interesting pastime and you can quite easily find yourself engrossed trying out different initial patterns and watching their evolution.

So lay down your axe/laser for a while and try your hand at being a god.

Listing 1. Memotech Life. The table of 170 NOPs starting at 41C7 looks odd because someone played the game before we listed it, so the cell data has been disassembled. Oops.

```
10 GOTO 30
20 CODE

400F ROW:    DB 0
4010 COL:    DB 0
4011 COUNT:  DB 0
4012         NOP
4013         CALL SCR
4016         LD A,#00
4018         LD (ROW),A
4019         LD BC,#FFFF
401E         NOP
401F NL:     LD A,#00
4021         LD (COL),A
4024         LD A,(ROW)
4027         INC A
4028         CP 21
402A         JP Z,FIN
402D         LD (ROW),A
4030 NEXT:   LD A,(COL)
4033         INC A
4034         CP 37
4036         JP Z,NL
4039         LD (COL),A
403C         INC BC
403D         NOP
403E         NOP
403F         PUSH BC
4040         POP DE
4041         CALL TOTAL
4044         CALL STATE
4047         JP NEXT
404A FIN:    CALL MOV
404D         NOP
404E         RET
404F         RET
4050         RET
4051         RET
4052         RET
4053         RET
4054         RET
4055 MOV:    NOP
4056         LD B,180
4058         LD HL,TOP
405B V1:     LD A,(HL)
405C         AND A
405D         RRA
405E         AND 85
4060         LD (HL),A
4061         INC HL
4062         DJNZ V1
4064         RET
4065 STATE:  NOP
4066         PUSH BC
4067         POP DE
4068         CALL ADR
406B         LD D,A
406C         LD A,(COUNT)
406F         CP 3
4071         JP Z,BORN
4074         CP 2
4076         RET NZ
4077         LD A,D
4078         CALL GET
407B         BIT 0,A
407D         RET Z
407E         CALL BORN
4081         RET
4082 BORN:   NOP          ;BC IS ALIVE NEXT GEN
4083         PUSH BC
4084         POP DE
4085         CALL ADR
4088         PUSH BC
4089         LD B,A
408A         LD C,(HL)
408B         LD A,#00
408D         INC B
408E         AND A
408F         CCF
4090 R1:     RL A
4092         RL A
4094         DJNZ R1
4096         OR C
4097         LD (HL),A
4098         POP BC
4099         RET
409A TOTAL:  LD A,#00
409C         LD (COUNT),A
409F         LD A,(ROW)
40A2         CP 1
40A4         JP Z,M1
40A7         LD A,(COL)
40AA         CALL D1
40AD         CALL D2
40B0         CALL D3
40B3 M1:     LD A,(COL)
40B6         CALL D4
40B9         CALL D5
40BC         LD A,(ROW)
40BF         CP 20
40C1         JP Z,M2
40C4         LD A,(COL)
40C7         CALL D6
40CA         CALL D7
40CD         CALL D8
40D0 M2:     LD A,(COUNT)
40D3         RET
40D4 NE:     NOP
40D5         PUSH HL
40D6         POP DE
40D7         CALL ADR
40DA         CALL GET
40DD         BIT 0,A
40DF         JR Z,NE1
40E1         LD HL,COUNT
40E4         INC (HL)
40E5 NE1:    LD A,(COL)
40E8         RET
40E9 D1:     CP 1
40EB         RET Z
40EC         PUSH BC
40ED         POP HL
40EE         AND A
40EF         LD DE,37
40F2         AND A
40F3         SBC HL,DE
40F5         JP NE
40F8 D2:     PUSH BC
40F9         POP HL
40FA         AND A
40FB         LD DE,36
40FE         SBC HL,DE
4100         JP NE
4103 D3:     CP 36
4105         RET Z
4106         PUSH BC
4107         POP HL
4108         LD DE,35
410B         AND A
410C         SBC HL,DE
410E         JP NE
4111 D4:     CP 1
4113         RET Z
4114         PUSH BC
4115         POP HL
4116         AND A
4117         LD DE,1
411A         SBC HL,DE
411C         JP NE
411F D5:     CP 36
4121         RET Z
4122         PUSH BC
4123         POP HL
4124         LD DE,1
4127         AND A
4128         ADC HL,DE
412A         JP NE
412D D6:     CP 1
412F         RET Z
4130         PUSH BC
4131         POP HL
4132         LD DE,35
4135         AND A
4136         ADC HL,DE
4138         JP NE
413B D7:     PUSH BC
413C         POP HL
413D         LD DE,36
4140         AND A
4141         ADC HL,DE
4143         JP NE
4146 D8:     CP 36
4148         RET Z
4149         PUSH BC
414A         POP HL
414B         LD DE,37
414E         AND A
414F         ADC HL,DE
4151         PUSH HL
4152         POP DE
4153         JP NE
4156 ADR:    NOP          ;CALC ADDRESS
4157         PUSH BC      ;OF CELL DE
4158         LD A,E       ;RETURNING MEMORY
4159         AND 3        ;LOCATION  IN
415B         PUSH AF      ;HL AND BIT POSN
415C         NOP          ;IN A
415D         LD B,#02     ;DIVIDE DE BY 2
415F L1:     LD A,D
4160         AND A
4161         RRA
4162         LD D,A
4163         LD A,E
4164         RRA
4165         LD E,A
4166         DJNZ L1
4168         PUSH DE
4169         POP HL
416A         AND A
416B         LD BC,TOP
416E         ADC HL,BC
4170         POP AF
4171         POP BC
4172         RET
4173 GET:    PUSH BC
4174         LD B,A
4175         CP 0
4177         LD A,(HL)
4178         JP Z,L2
417B L3:     RRA
417C         RRA
417D         DJNZ L3
417F L2:     AND 3
4181         POP BC
4182         RET
4183 SCR:    DI ;PRINT PATTERN
4184         LD BC,#FFFF
4187         LD HL,#1C2A
418A VRAM:   LD A,L       ; SET VECTOR
418B         OUT (02),A ;VIDEO  RAM
418D         LD A,H
418E         ADD A,#40
4190         OUT (02),A
4192         PUSH HL
4193         LD A,#00
4195 LOOP:   PUSH AF
4196         INC BC
4197         PUSH BC
4198         POP DE
4199         CALL ADR
419C         CALL GET
419F         LD D,32
41A1         BIT 0,A
41A3         JR Z,P2
41A5         LD D,79     ; SYMBOL FOR CELL
41A7 P2:     LD A,D
41A8         OUT (01),A
41AA         POP AF
41AB         INC A
41AC         CP 36
41AE         JP NZ,LOOP
41B1         POP HL
41B2         AND A
41B3         LD DE,0040
41B6         ADC HL,DE
41B8         PUSH HL
41B9         PUSH BC
41BA         POP HL
41BB         AND A
41BC         LD DE,718
41BF         SBC HL,DE
```

```
41C1          POP HL
41C2          JP M,VRAM
41C5          EI
41C6          RET
41C7 TOP:     NOP         ;170 MEMORY
41C8          NOP         ; LOCATIONS
41C9          NOP
41CA          NOP
41CB          INC C
41CC          NOP
41CD          NOP
41CE          NOP
41CF          NOP
41D0          NOP
41D1          NOP
41D2          LD B,B
41D3          NOP
41D4          LD DE,#0000
41D7          NOP
41D8          NOP
41D9          NOP
41DA          NOP
41DB          LD B,B
41DC          LD B,B
41DD          DJNZ #41DF
41DF          NOP
41E0          NOP
41E1          NOP
41E2          NOP
41E3          LD B,B
41E4          LD B,B
41E5          NOP
41E6          DEC B
41E7          NOP
41E8          NOP
41E9          NOP
41EA          NOP
41EB          NOP
41EC          DJNZ #41EF
41EE          NOP
41EF          NOP
41F0          NOP
41F1          NOP
41F2          NOP
41F3          NOP
41F4          NOP
41F5          DJNZ #41F8
41F7          NOP
41F8          NOP
41F9          NOP
41FA          NOP
41FB          NOP
41FC          NOP
41FD          NOP
41FE          LD B,B
41FF          NOP
4200          NOP
4201          NOP
4202          NOP
4203          NOP
4204          NOP
4205          NOP
4206          NOP
4207          NOP
4208          NOP
4209          NOP
420A          NOP
420B          NOP
420C          NOP
420D          NOP
420E          NOP
420F          NOP
4210          NOP
4211          NOP
4212          NOP
4213          NOP
4214          NOP
4215          NOP
4216          NOP
4217          NOP
4218          NOP
4219          NOP
421A          LD D,B
421B          LD BC,#4000
421E          NOP
421F          NOP
4220          NOP
4221          NOP
4222          NOP
4223          NOP
4224          NOP
4225          NOP
4226          DJNZ #4229
4228          NOP
4229          NOP
422A          NOP
422B          NOP
422C          NOP
422D          NOP
422E          NOP
422F          DJNZ #4232
4231          NOP
4232          NOP
4233          NOP
4234          NOP
4235          NOP
4236          NOP
4237          NOP
4238          LD B,B
4239          NOP
423A          NOP
423B          NOP
423C          NOP
423D          LD B,B
423E          DEC B
423F          NOP
4240          NOP
4241          NOP
4242          NOP
4243          NOP
4244          NOP
4245          NOP
4246          NOP
4247          NOP
4248          NOP
4249          NOP
424A          NOP
424B          NOP
424C          NOP
424D          NOP
424E          NOP
424F          NOP
4250          NOP
4251          NOP
4252          NOP
4253          NOP
4254          NOP
4255          NOP
4256          NOP
4257          NOP
4258          NOP
4259          NOP
425A          NOP
425B          NOP
425C          NOP
425D          NOP
425E          NOP
425F          NOP
4260          NOP
4261          NOP
4262          NOP
4263          NOP
4264          NOP
4265          NOP
4266          NOP
4267          NOP
4268          NOP
4269          NOP
426A          NOP
426B          NOP
426C          NOP
426D          NOP
426E          NOP
426F          NOP
4270          NOP
4271          NOP
4272          NOP
4273          NOP
4274          NOP
4275          NOP
4276          NOP
4277          NOP
4278          NOP
4279          NOP
427A          NOP
427B          RET
427C          RET
427D          RET
427E          RET
427F          RET
4280          RET
4281          RET

Symbols:
ROW     400F    COL     4010
COUNT   4011    NL      401F
FIN     404A    NEXT    4030
L1      415F    TOP     41C7
L2      417F    L3      417B
GET     4173    TOTAL   409A
M1      40B3    D1      40E9
D2      40F8    D3      4103
D4      4111    D5      411F
M2      40D0    D6      412D
D7      413B    D8      4146
NE      40D4    NE1     40E5
SCRN    4082    R1      4090
SCR     4183    P2      41A7
MOV     4055    V1      405B
STATE   4065    VRAM    418A
LOOP    4135    ADR     4156
```

```
21 RETURN
22 REM ***** A VERSION OF LIFE *****
23 REM *****   FOR THE MTX     *****
24 REM *****     COPYRIGHT     *****
25 REM *****    N S BARNES     *****
26 REM *****   AUGUST 1984     *****
30 GOSUB 380
39 REM    INPUT     NEW  GENERATION
40 LET R=0: LET C=0: PRINT CHR$(27);"X^";: CSR 1,1
50 LET I=ASC(INKEY$)
60 IF I=-1 THEN  GOTO 50
70 LET MX=0: LET MY=0
80 IF I=9 OR I=11 OR I=127 THEN  LET MY=-1
90 IF I=21 OR I=10 OR I=12 THEN  LET MY=1
100 IF I=9 OR I=8 OR I=21 THEN  LET MX=-1
110 IF I=127 OR I=12 OR I=25 THEN  LET MX=1
120 IF R+MX>35 OR R+MX<0 THEN  LET MX=0
130 IF C+MY>19 OR C+MY<0 THEN  LET MY=0
140 LET R=R+MX: LET C=C+MY: CSR R+1,C+1
150 IF I=26 THEN  PRINT "#";: LET M(R+1,C+1)=1: LET MX=1: LET I=1: GOTO 120
160 IF I=32 THEN  PRINT " ";: LET MX=1: LET I=1: LET M(R+1,C+1)=0: GOTO 120
170 PAUSE 100
180 IF I<>13 THEN  GOTO 50
190 GOSUB 290
199 REM MAIN LOOP
200 LET LI=1
210 GOSUB 20
220 CSR 28,23: PRINT LI;
230 LET LI=LI+1
240 LET I$=INKEY$
250 IF I$<>" " AND I$<>"0" THEN  GOTO 210
260 IF I$=" " THEN  GOTO 240
270 CLS : STOP
289 REM SET UP TABLE IN MEMORY
290 LET AD=100: PRINT CHR$(27);"X"
300 CSR 5,23: PRINT "     PLEASE WAIT   ";
310 FOR C=1 TO 20
320 FOR R=1 TO 33 STEP 4
330 LET D=M(R,C)+4*M(R+1,C)+16*M(R+2,C)+64*M(R+3,C)
340 LET A=16839+INT((R-1)/4)+(C-1)*9
350 POKE A,D
360 NEXT : NEXT
370 CSR 5,23: PRINT "LIFE          Generation 0";: RETURN
379 REM SET UP SCREEN
380 VS 5: PAPER 1: INK 3: CLS
390 DIM M(36,20)
400 FOR Y=0 TO 21: CSR 0,Y: PRINT "X";: CSR 37,Y: PRINT "X";: NEXT : FOR Y=0 TO
37: CSR Y,0: PRINT "X";: CSR Y,21: PRINT "X";: NEXT
410 CSR 5,23: PRINT "  Enter new pattern ";
420 RETURN
```

NASCOM STRING SAVE

Peter Gaskell

Nascom users face the annoying problem of being unable to SAVE strings or string arrays. Here we present a routine to solve the problem.

The Nascom was one of the first computers to bring computing within reach of the man in the street and while relatively primitive against today's much cheaper micros, various add-ons over the years have maintained its usefulness. In fact, in my opinion, the easy facility for working in object code has no equal.

However, things like hi-res graphics and colour, which have been available as add.ons for some time, can be achieved more economically by buying a new computer altogether. But there must still be many Nascoms in regular use for how many of us can afford to write-off equipment costing several hundred pounds of hard-earned cash? While satisfactory on the whole, Nascom's Microsoft BASIC has one big failing in its ability to SAVE strings and string arrays. However, necessity being the mother of invention, the following short program makes it possible and easy to save strings and string arrays as a file, and to recover them for re-use in your BASIC program. I have 'burnt' this program into an EPROM, sitting at HEX address AC00, so that it is always readily available. Use of a Hobbit floppy tape system makes the whole screen operation even easier — I won't ever go back to ordinary tape!

Nascom's BASIC work-space contains several useful pointers:

105A	STRSPC	bottom of memory reserved for strings
10AF	LSTRAM	top of user-RAM
10C3	STRBOT	bottom of user string space
10D6	PROGND	end of the BASIC program listing
10D8	VAREND	end of the table of variables used
10DA	ARREND	end of the array-index space

When a program is saved to tape, all the memory contents from 10D6 up to the address stored IN address 10D6 are saved. This excludes the table of variables used by your program, the indexing of all the arrays used and, of course, the actual strings themselves, which are held at the very top of the available RAM. What this program does is to find the number of bytes used for the variables table and the array index and then move the whole lot up to the strings, together with five pointers needed when this data is to be subsequently recovered.

So, we now have just one block of data, the start and end address of which are known, containing the table of variables used, the array-index, the strings, and the five pointers which can be readily saved to tape. The five pointers are STRSPC, VAREND and ARREND together with VARAYL (the number of bytes used for the variable table and the array index) and NVARST (the top of USER RAM where the start of the variable table and array index has been moved to). When the new routine is executed by E AC00, the start and end locations for saving to tape are displayed on the screen.

Recovery is equally simple — executing by E AC5A merely loads the data block into the top of user RAM space and then copies the variable table and array index back down memory to its original position, changing STRSPC, VAREND and ARREND to suit. Then warm-start BASIC and 'GOTO xxx' (not 'RUN') where 'xxx' is the first BASIC line number after DIMensioning the arrays.

Listing 1 The string save routine.

```
                        0010 ; * * * * * * *
                        0020 ; *             *
                        0030 ; * $TRSAV      *
                        0040 ; *             *
                        0050 ; * Pegasus     *
                        0060 ; *             *
                        0070 ; * Apr  84     *
                        0080 ; *             *
                        0090 ; ***************

AC00                    0110          ORG   &AC00

AC00 0049               0130 ICOPY    EQU   &49
AC00 005B               0140 MRET     EQU   &5B
AC00 006C               0150 TX1      EQU   &6C
AC00 105A               0160 STRSPC   EQU   &105A
AC00 10AF               0170 LSTRAM   EQU   &10AF
AC00 10C3               0180 STRBOT   EQU   &10C3
AC00 10D6               0190 PROGND   EQU   &10D6
AC00 10D8               0200 VAREND   EQU   &10D8
AC00 10DA               0210 ARREND   EQU   &10DA
AC00 B003               0220 BPC      EQU   &B003

                        0240 ;SAVE BASIC VARIABLES, ARRAYS & $TRINGS
                        0250 ;After BASIC RUN, return to NAS-SYS
                        0260 ;and EXECUTE &AC00. Then SAVE to tape.

                        0280 ;Find length of Variables & Arrays VARAYL

AC00 B7                 0300 SVBAS$   OR    A ;Clear C flag
AC01 2ADA10             0310          LD    HL,(ARREND)
AC04 ED5BD610           0320          LD    DE,(PROGND)
AC08 ED52               0330          SBC   HL,DE ;HL now VARAYL
AC0A E5                 0340          PUSH  HL ;Save VARAYL

                        0360 ;Find where to send VARAY tables (NVARST)

AC0B 2AC310             0380 MOVTO    LD    HL,(STRBOT)
AC0E 3E00               0390          LD    A,&00
AC10 77                 0400          LD    (HL),A ;00 into STRBOT just in case
AC11 D1                 0410          POP   DE ;Get VARAYL
AC12 D5                 0420          PUSH  DE ;and save again
AC13 ED52               0430          SBC   HL,DE
AC15 010A00             0440          LD    BC,&0A ;Space for 5 extra pointers
AC18 ED42               0450          SBC   HL,BC
AC1A EB                 0460          EX    DE,HL ;DE now NVARST (Ars 2)

                        0480 ;Move VARAY Tables

AC1B 2AD610             0500 MVTABS   LD    HL,(PROGND) ;Ars 1
AC1E C1                 0510          POP   BC ;Ars 3
AC1F D5                 0520          PUSH  DE ;Save NVARST
AC20 C5                 0530          PUSH  BC ;Save VARAYL
AC21 D5                 0540          PUSH  DE ;Save NVARST
AC22 CF49               0550          SCAL  ICOPY
```

```
                    0570 ;Save Pointers

AC24 2AC310         0580 SVPTRS LD   HL,(STRBOT)
AC27 2B             0600        DEC  HL
AC28 ED585A10       0610        LD   DE,(STRSPC)
AC2C 72             0620        LD   (HL),D ;$BOT-1
AC2D 2B             0630        DEC  HL
AC2E 73             0640        LD   (HL),E ;$BOT-2
AC2F 2B             0650        DEC  HL
AC30 ED5B0810       0660        LD   DE,(VAREND)
AC34 72             0670        LD   (HL),D ;$BOT-3
AC35 2B             0680        DEC  HL
AC36 73             0690        LD   (HL),E ;$BOT-4
AC37 2B             0700        DEC  HL
AC38 ED5B0A10       0710        LD   DE,(ARREND)
AC3C 72             0720        LD   (HL),D ;$BOT-5
AC3D 2B             0730        DEC  HL
AC3E 73             0740        LD   (HL),E ;$BOT-6
AC3F 2B             0750        DEC  HL
AC40 D1             0760        POP  DE ;DE now NVARST
AC41 72             0770        LD   (HL),D ;$BOT-7
AC42 2B             0780        DEC  HL
AC43 73             0790        LD   (HL),E ;$BOT-8
AC44 2B             0800        DEC  HL
AC45 D1             0810        POP  DE ;DE now VARAYL
AC46 72             0820        LD   (HL),D ;$BOT-9
AC47 2B             0830        DEC  HL
AC48 73             0840        LD   (HL),E ;$BOT-10
AC49 EF             0850 SAVMES RST  $28
AC4A 53617665       0860        DEFM /Save /
     20
AC4F 00             0870        DEFB $00
AC50 E1             0880        POP  HL ;Arg 1
AC51 ED5BAF10       0890        LD   DE,(LSTRAM)
AC55 13             0900        INC  DE ;Arg 2
AC56 DF6C           0910        SCAL TX1 ;Output HL and DE in ASCII
AC58 0F53           0920        SCAL MRET

                    0940 ;Load your BASIC program first.
                    0950 ;Then LOAD your $trings etc. Execute AC5A.
                    0960 ;WARM start BASIC and GOTO 20 (after DIM)
                    0970 ;NOT 'RUN' !

AC5A 2AAF10         0990 RECBA$ LD   HL,(LSTRAM)
AC5D 3E00           1000        LD   A,$00
AC5F 2B             1010 FIND1  DEC  HL
AC60 BE             1020        CP   (HL)
AC61 20FC           1030        JR   NZ,FIND1
AC63 22C310         1040        LD   (STRBOT),HL ;STRBOT found
AC66 2B             1050        DEC  HL
AC67 7E             1060 RESLAB LD   A,(HL)
AC68 325B10         1070        LD   (STRSPC+1),A
AC6B 2B             1080        DEC  HL
AC6C 325A10         1090        LD   (STRSPC),A ;Restores STRSPC
AC6F 2B             1100        DEC  HL
AC70 7E             1110        LD   A,(HL)
AC71 32D910         1120        LD   (VAREND+1),A
AC74 2B             1130        DEC  HL
AC75 7E             1140        LD   A,(HL)
AC76 32D810         1150        LD   (VAREND),A ;Restores VAREND
AC79 2B             1160        DEC  HL
AC7A 7E             1170        LD   A,(HL)
```

```
AC7B 32D810     1180          LD    (ARREND+1),A
AC7E 2B         1190          DEC   HL
AC7F 7E         1200          LD    A,(HL)
AC80 32DA10     1210          LD    (ARREND),A ;Restores ARREND
AC83 2B         1220          DEC   HL
AC84 56         1230          LD    D,(HL)
AC85 2B         1240          DEC   HL
AC86 5E         1250          LD    E,(HL) ;DE now NVARST (Ars 1)
AC87 2B         1260          DEC   HL
AC88 46         1270          LD    B,(HL)
AC89 2B         1280          DEC   HL
AC8A 4E         1290          LD    C,(HL) ;BC now VARAYL (Ars 3)
AC8B EB         1300          EX    DE,HL ;HL now Ars 1
AC8C ED5BD610   1310          LD    DE,(PROGND) ;DE now Ars 2
AC90 DF49       1320 MVTBIN   SCAL  ICOPY
AC92 C303B0     1330          JP    BPC ;Back to B&PC's MENU

ZEAP Z80 Assembler - Symbol Table

10DAH 0210 ARREND          B003H 0220 BPC
AC5FH 1010 FIND1           0049H 0130 ICOPY
10AFH 0170 LSTRAM          AC0BH 0380 MOVTO
005BH 0140 MRET            AC1BH 0500 MVTABS
AC90H 1320 MVTBIN          10D6H 0190 PROGND
AC5AH 0990 REC0A$          AC67H 1060 RESLAB
AC49H 0850 SAVMES          10C3H 0180 STRBOT
105AH 0160 STRSPC          AC00H 0300 SVBAS$
AC24H 0590 SVPTRS          006CH 0150 TX1
10D8H 0200 VAREND
```

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FUJITSU – GOING FOR GSX

Simon Dismore

The UK arm of the giant Fujitsu empire slipped the Micro 16s into the business market with no fanfare, good prospects for expansion and considerable emphasis on GSX graphics. Could this be the future of the microcomputer?

It's getting harder to review new business machines. Some manufacturers present radically new designs (for example, the IBM PC/AT and the Apple Macintosh) which can't properly be evaluated in a few pages. Others offer unsurprising products which try to do the same old things better than their competitors, so an intricate comparison is called for, which scarcely makes exciting reading. And the spectre of price hangs over any recommendation, thanks to Sanyo's MBC range and the ACT F1.

The Micro 16s from Fujitsu (no connection with Fuji, the film people) falls into the 'unsurprising' category. Why does it deserve a review in the august pages of Computing Today? (I thought this was the January issue — Ed). The fact is that (as any accountant or company secretary will confirm) the buying criteria for computers rarely include the phrases 'revolutionary' or 'surprising'. So we have to take the Micro 16s for what it is — a new product from a company that, through its marketing agreements with ICL and Siemens, is in a good position to take the European market seriously. Yawning already? Don't worry, CT still has some interesting shots to fire . . .

HARD FACTS

First, a brisk tour round the hardware. The keyboard offers a conventional QWERTY layout which works in US ASCII mode (for programmers) and a country-dependent mode with a nationalised character set (for the typical business user). An 'ALT' lock key, complete with an LED indicator, is used for switching between these two modes — useful if you run packages like dBase II which assume the US character set when asking for instructions. Ten function keys are provided, ranged in two groups of five along the top of the keyboard. The function keys (shiftable to produce 30 different functions) are proper typewriter keys, unlike the miniature oblong chunks favoured by some other manufacturers. Fujitsu plan to include a template describing what the keys do, and the bottom line of the screen can be configured to carry appropriate messages.

The cursor keys are arranged into two rows, North-South above East-West, which is a little disconcerting to those who expect the more friendly diamond layout, but Fujitsu score full marks for a calculator keypad with an additional 'comma' key — so useful for multiple entries under BASIC or AutoCAD. Additional shift locks include 'CAPS' and 'INSERT' — both supported by LED indicators.

The system unit houses the system motherboard (with parallel and serial interfaces), processor board, expansion memory, disk drives and power supply. The review machine came with an 8086 processor running at 8 MHz and a Z80A running at 4 MHz (an idea popularised by the Xerox 8/16 bit system) and 128K of on-board memory. Fujitsu will be offering 68000 series and 80286 processors for future Unix-based version of the system.

Memory expansion is by adding a single board offering 128K, 256K, 512K or 1024K of additional memory. With two system slots containing processors (eg: the Z80 and 8086 boards) and one user slot containing the expansion memory board, three user-accessible expansion slots remain free for other enhancements. The 8086 can only address 1024K in total, so (until the newer processors appear) you waste 128K if you go for the maximum expansion. Most of the more advanced packages need at least 192K of memory, so some expansion will be essential if you intend to go beyond SuperCalc 2

and WordStar (both of which are bundled with the system).

The disk drives are trusty 5¼", 320K models, and like most of their kin, are reasonably quiet and irritatingly slow. This might be a problem under CP/M-86, but can be avoided under MS-DOS and Concurrent CP/M-86 by appropriate use of buffers and RAM disks (a further argument for expansion memory). External hard disk units and 8" floppies are available but expensive (£1720 for an entry-level unit) and we thought that an inexpensive internal hard disk unit with a lower capacity should be offered as an alternative. Fujitsu conveniently blur the distinction between formatted and unformatted hard disk capacities, the price lists showing 13MB and 26MB units, while the glossies refer to more realistic capacities of 10MB and 20MB formatted, while the true figures are apparently 11MB and 22MB respectively. The difference is scarcely significant in marketing terms, and one would hope that Fujitsu will clarify these capacities in future.

With the covers off, the Micro 16s has a rugged and reliable look. Cables are tidied away, boards are locked rigidly into position, and the chassis and casing can look as if they will stand plenty of punishment. This makes the system unit a little heavy compared with, say, an Apricot, but the promise of additional reliability should more than compensate for the extra bulk.

The system is completed with a Fujitsu colour (RGB interfaced) or monochrome (composite video interfaced) monitor. We reviewed the colour system which had a bright, steady picture but a rather low resolution (in graphics mode, 640 pixels wide but only 200 pixels high). The graphics memory (variously quoted in the Fujitsu brochure as 48K and 52K of RAM, presumably allowing for 4K of video attribute RAM) is handled by separate 6845 and 6809 processors, which made it very fast for graphics applications. However, we found more conventional text displays under (for example) SuperCalc rather less impressive — faster than an Apricot but still leaving plenty of room for improvement. The monitor includes an 'ergonomic' tilt and swivel base which is well-balanced and very easy to move.

The most interesting feature offered by the hardware is the separation of the processor and 'mother' boards, making upgrades to more advanced microprocessors a simple matter of changing boards. The rest of the hardware is well put together but otherwise unexciting. However, the Micro 16s can offer a valuable insight into the direction of micro systems over the next few years.

THE OS FACTOR

First, consider the operating system. Digital Research's well known CP/M for the 8086 is already available. CP/M has suffered from a rather 'old fashioned' image recently, and trades slow disc accesses for very efficient memory usage (there is virtually no buffering on disk accesses). Despite this, industry statistics suggests that CP/M is beginning to proposer again, after a year in which Microsoft's MS-DOS has been considerably more popular. MS-DOS takes up slightly more memory, but offers more efficient use of disk space and faster access through an improved block allocation system and buffers. Fujitsu will have released the 2.11 implementation by the time this article is published.

Both operating systems have a lot of popular support. Digital Research have drawn ahead through their multi-tasking operating system 'Concurrent' CP/M, which has the capability to run several programs simultaneously (five on the Micro 16s), and a built-in interface to Digital Research's network standard SoftNet. Concurrent CP/M is a greedy user of memory, but provides extensive disk buffering and (in the 3.1 implementation which Fujitsu will launch in the New Year) offers the ability to run some IBM PC and MS-DOS 1.25 programmes.

Meanwhile, Microsoft (the authors of MS-DOS) have announced their intention to provide their own multi-tasking operation system and a network standard. Who will win? This is a key issue to those who must plan strategies for the next three years. Digital Research are slightly ahead on the range of language tools that they sell, the power of Concurrent CP/M, and perhaps the quality of their support in the UK. Microsoft, on the other hand, can point to years of experience configuring their microcomputer version of Unix ('Xenix') for a range of larger systems and their control of the industry standard programming language 'Microsoft BASIC', which they have (rather uncharitably) refused to implement for any new Digital Research operating systems.

So, where does this leave Fujitsu and similar manufacturers? Like any sensible investor, they are backing all the horses. CP/M, MS-DOS and Concurrent CP/M will run on the standard Micro 16s with appropriate memory, and some version of Unix will be offered for the 80286 and 68000 series configurations. This points to a new direction for microcomputer manufacturers — the hardware remains broadly the same for several years, and additional boards and operating systems change the personality according to the user's wishes (and current fashions).

What about expanding the system to cater for multiple users? There's a terrible shortable of multi-user (as opposed to single-user multi-tasking) software around. When it arrives, Fujitsu plan to add up to four 'dumb' terminals around a hard-disk Micro 16s running Concurrent CP/M — the 'host' system can run five tasks, plus one task for each of the terminals. As ICL's recent press advertising showed, this sort of expandability makes a powerful case for micros against minicomputers. Fujitsu also have a high-performance laser printer which (your correspondent guesses) would make an ideal companion to a multi-user office system . . . Watch out for Fujitsu's stand at the Which Computer exhibition.

GRAPHICS AGAIN . . .

The Fujitsu system indicates another strategic direction — Digital Research's Graphics System Extension (GSX). Computing Today profiled this route to machine-independent graphics in a recent review of the Apricot xi, but it's come a long way since then. Fujitsu demonstrated four major software packages which interface to GSX rather than the underlying hardware: Digital Research's DR Draw (for freehand graphics), DR Graph (for business statistics) and a new version of the popular SuperCalc 3 spreadsheet package with a new business graphics option.

Such products represent a very important change in direction for the software industry. 1984 was very much the year of integrated products for the IBM PC. Lotus Development Corporation's 1-2-3 package leapt to Number 1 spot in the IBM PC software stakes, to be followed by Open Access, Framework and Symphony. Lotus jumped

from being a newcomer to the PC software stakes into a key position with an expected $100 million turnover and an order book full to bursting. IBM did very well from all this, but other manufacturers suffered more than they would admit. Off the record, IBM's competitors complain that it takes months to get an implementation of Lotus, costs a fortune and will probably be too late!

To some extent, disillusionment has set in. A recent article in Computing Newspaper (no connection with CT), reports that Lotus are below target on converting 1-2-3 users to their more advanced Symphony package, and the Ashton-Tate (the people who drove you mad with dBase II) are likely to face similar problems with their Framework windowing system.

The problem is that such vendors naturally aim their development towards the IBM PC, making their products terribly machine-dependent in areas like graphics and communications. GSX offers an easy solution to this problem. It is bundled with CP/M-86, MS-DOS and Concurrent CP/M-86, together with a range of device drivers for most CPUs, printers and plotters, and can be interfaced to most programming languages. Digital Research supply a version of their CBASIC Compiler (ask for version 2.0 or higher) which has rich facilites for machine-independent graphics, and London-based Prospero (famous for their high-performance ISO standard ProPascal) now offer GSX libraries for both the Pascal and Fortran languages.

All this makes GSX one of the best graphics standards ever, and it comes as no surprise that key packages like SuperCalc have been written to interface to GSX. Does this mean that Symphony and Framework will become IBM PC-only products? If so, what does this suggest about future trends in microcomputer software? Fujitsu have made a clear choice — they have denied themselves the pleasure of paying large amounts of money to put IBM PC-specific software onto their system, and opened the door to products which can be supported with much less programming effort. All we need now is a communications standard — and Digital Research's SoftNet might even provide that!

So the Fujutsu system, while unexceptionable in many respects, shows some interesting aspects of the manufacturers' planning process. Fujitsu are also being cunning about future products in the office automation environment, not least in the area of databases. To many microcomputer users, databases have become inextricably associated with the highly successful dBase II package. No offence to the authors, but this is scarcely fair to computer uses. dBase is slow, tedious to code, hard to debug and prone to unexpected failures. For many applications, compiled COBOL (gasp) with a decent ISAM library would probably be a better answer, not to mention all the newer data management products: MDBS III, Knowledgeman, Everyman, Delta, Retrieve and DataMaster (not forgetting promising newcomers like Aspect).

Fujitsu are arranging for two such database products to run on the Micro 16s. For typical applications involving one-to-many relationships (the sort that dBase II finds so hard to support), Sapphire Systems' DataMaster package is available. This proved to be easy to use and reasonably secure, though you would probably want to expand your system to 8" drives, a hard disk or RAM disk for better response on large files, as the standard Fujitsu disk drives are easily filled. A more revolutionary step is their interest in the Micro-CAIRS text retrieval package. Micro-CAIRS requires a hard disk system, and offers the sort of search facilities previously restricted to mini/mainframe packages like IBM's STAIRS and AERE's Status II — vital for bibliographic activities like patents filing and legal precedents, but pretty useful for more mundane activities like electronic publishing and office filing. Contact the Leatherhead Food Research Association (the authors of the package) on 0372-376761 for further information.

FACTSHEET	Fujitsu Micro 16s Monochrome configuration — £2080 Colour configuration — £2300
CPUs	Intel 8086, clock 8 MHz Zilog Z80A, clock 4 MHz Motoroloa 6809, clock 2 MHz
RAM	128K standard, expandable to 1152K (1024K addressable)
Bundled Products	Personal BASIC (Microsoft BASIC compatible) SuperCalc 2 (non-graphics version) Wordstar
Dimensions	System — 19¼" by 14½" by 5¾" Keyboard — 18" by 7½" by 1½" (combined weight 15 kg excluding monitor)
Display	80 columns by 25 lines Medium Resolution 640 by 200 under GSX
I/O	Synchronous/Asynchronous RS-232C interface (25-way female) Centronics Parallel interface (36-way female) RGB Interface (DIN) Monochrome Composite Video Interface (DIN) Light pen interface (DIN) Analogue to Digital (DIN)
Disks	2 x internal 320K 5¼" drives (standard) 2 x external 8" drives (optional) — £1460 13MB (nominal) external hard disk (optional) — £1720 26MB (nominal) external hard disk (optional) — £2150
OS	Digital Research CP/M-86 with GSX and device drivers MS-DOS 2.11 with GSX (optional) Concurrent CP/M (optional, due first Quarter 1985
Memory	128K standard, plus 48K video RAM 128K expansion board — £205 256K expansion board — £325 512K expansion board — £600 1024K expansion board — £1100
Options	Intel 8087 floating point processor Multiple protocol (SNA/SDLC/X.25) interface board Add-on 80286 and 68000 series MPUs (not yet available)
Software	DR Draw (Fujitsu distributed) DR Graph (Fujitsu distributed) Digital Research CBASIC 2.0 Compiler (from Xitan) AutoCAD (from Xitan or WH Softeam) SuperCalc 3 with GSX graphics (from Xitan or WH Softeam) DataMaster (from Sapphire Systems) Prospero GSX Library (from Prospero) Micro-CAIRS (check for availability)

CONCLUSIONS

All this puts Fujitsu in an unexpectedly good position for a manufacturer approaching the UK market with an 'unsurprising' product. Through their choice of MS-DOS, they can offer high-performance single task computing, while Concurrent CP/M opens up great possibilities for multi-tasking and small multi-user systems. GSX graphics opens the door to a new range of applications programs, and the careful choice of database products could give them a useful niche in vertical markets. The Micro 16s sits in the middle of the price range, with an intriguing expansion path through 80286 and 68000 series processors with Unix to follow.

Verdict: Not a bad beginning for a 'vanilla-flavoured' product, and a useful pointer for things to come. Start talking to your local Fujitsu dealer in the first quarter of 1985, particularly for office automation applications.

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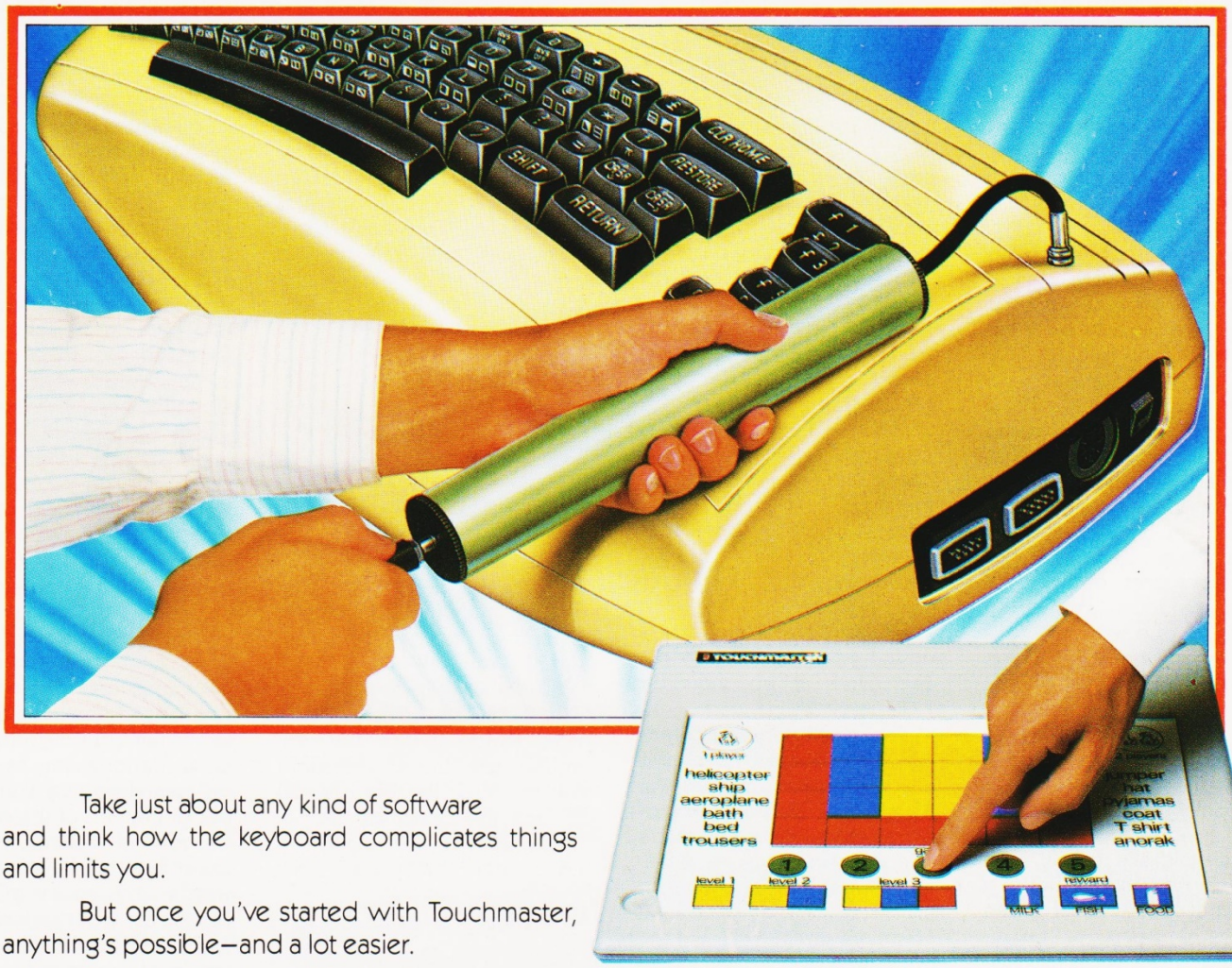

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BOOK PAGE

Garry Marshall

A mixed bag of tomes this month: robots, software for profit, the Apple Macintosh and the Commodore disk drive are the topics covered.

How would you like to build a robot? Or make money from writing software? Do you want to get some idea of what the Macintosh is like? Have you got one of the Commodore 64 disk drives that the editor goes on about (I do? — Ed) and would you like to make full use of it? If these questions draw at least one affirmative response, then this month's books have something definite to offer you. And even if they do not meet one of your exact needs, the books have good deal to say about what is happening in computing today.

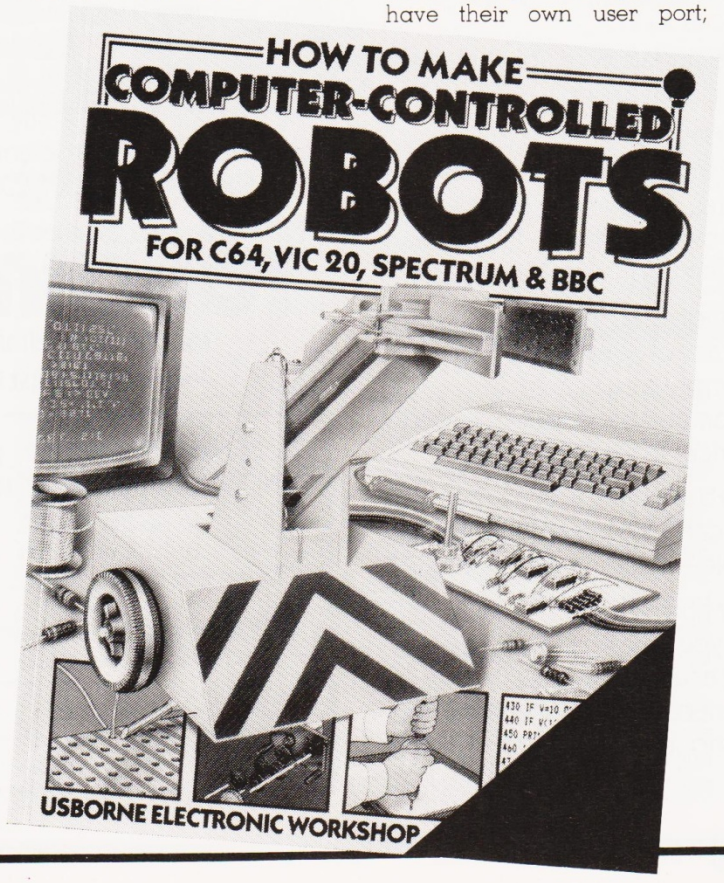
How to Make Computer-controlled Robots is a terrific little book. It is a book for doing rather than for reading. I feel that with its help even the least practical of people (such as me) would have a good chance of being able to build a computer-controlled robot. The necessary instructions are all provided in a clear step-by-step fashion. Templates for the various parts of the robot are provided. Hints on aspects of the various skills required during construction are given at a level to suit even the absolute beginner. The publishers, rather bravely, go to the lengths of giving the address for an 'Electronics Advisor' who will check a reader's project if all else fails to make it work. So if you ever wanted to build a robot but have never been quite sure where to begin, then this is the book for you. But if you do know how to go about it, there is still a good deal that this book can offer by way of hints and suggestions to help you to improve on your robot.

The robot can be just a static arm or it can be fully mobile. The instructions for the robot's physical construction start with the need for nothing much more than plywood, chipboard and a length of fishing line or twine. The attractive Heath Robinson list of materials also includes items such as rubber bands, drawing pins and paper clips. This makes the robot as cheap to make as is possible.

To my eyes it does seem that a few of the constructional problems may be quite severe. After all, putting together something like an item of furniture from an MFI do-it-yourself kit, where all the parts have been carefully machined, never seems to work out absolutely as it should. When the parts are cut by hand, and an unskilled hand to that, the potential sources of difficulty are considerably enhanced. But this does not really matter, for the constructing should be fun, and even if something goes disastrously wrong, the cheapness of the materials means that to abandon an attempt and start again won't be expensive. Hints and suggestions are provided on everything from cutting wood to size and glueing, to ways of customising the final product by giving it an individual finish.

The electronic components needed include relays, resistors, transistors, diodes and Veroboard. None of them are in any way obscure, and all can be easily obtained from any component supplier. The book explains the necessary aspects of electronics absolutely from scratch, starting by explaining what a resistor is and giving the colour codes for resistor values. It also, in a very rudimentary way, goes into the operation of diodes, LEDs and transistors. There are tips on soldering and a careful explanation of how to use Veroboard, and on how to avoid bridging and tracks on the board when soldering. Also, the interfaces needed to connect the robot to the user port of a range of personal computers are illustrated in detail.

The computers to which the robot can be attached and from which it can be controlled are the Commodore 64, the VIC, the BBC Model B, and the Spectrum. All of these except the Spectrum have their own user port; details of the special interface that provides the Spectrum with its user port are also given. To do what is covered by the book, there is no need to be familiar with the operation of the user port or with now it is programmed. An understanding of both will be necessary to take developments beyond what is presented in the book, however.



Having covered the physical assembly of the robot and its electronics, the book gives listings of a BASIC program for each of the personal computers just mentioned that supplies a control language for the robot. This language provides commands for controlling the arm, for moving the robot, and programming structures to facilitate the writing of control programs. With them, the arm can be moved up and down, and the gripper at the end of the arm can be opened and closed; and the robot can be moved forwards and backwards, and turned to the right and the left. Facilities for repeating a group of commands and for making decisions that depend on the state of one of the robot's sensors are supplied.

The book is not large enough to include any real explanation of the BASIC program that implements the control language: it is presented as a program that can be entered, and which will then do a certain job. But with some study, the operation of the program can be understood, although none too easily. The version of the BBC is, needless to say, the easiest to follow, because with its procedures it has been able to impose some structure on the overall program.

I am most impressed by the idea of the book and by the way that it breaks down the really rather complex task of building a computer-

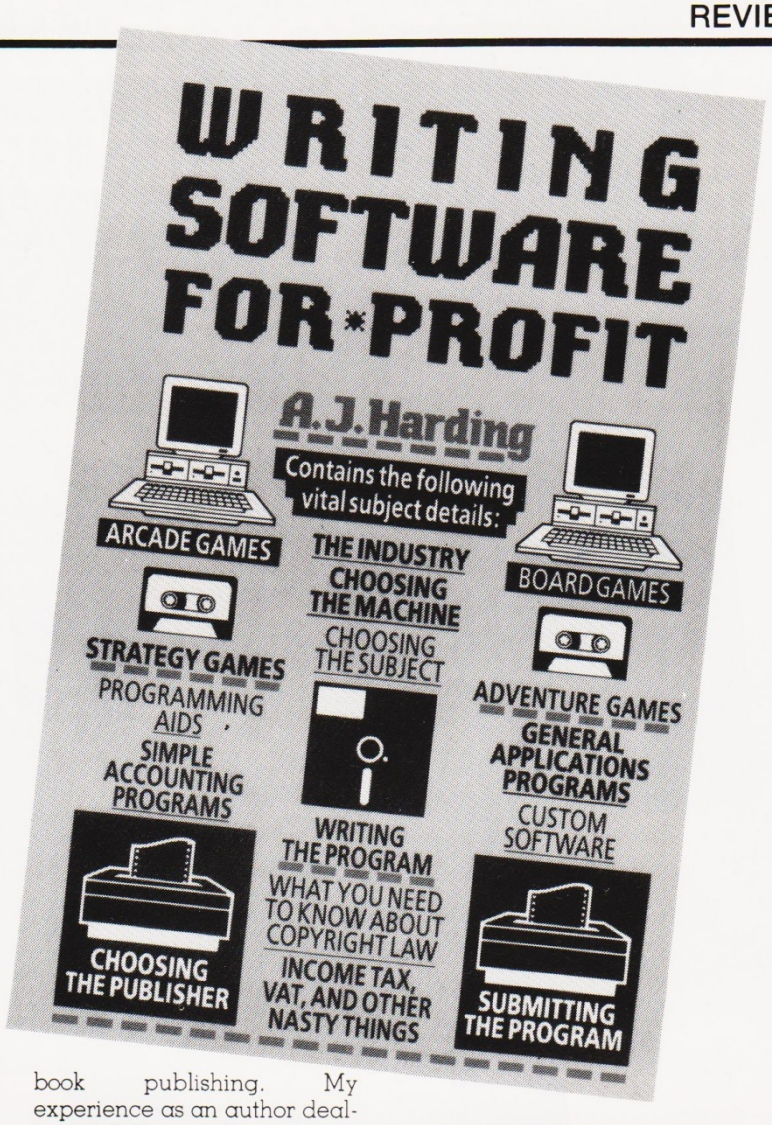
controlled robot to such simple steps. The project could not be better explained. Its cost could not be less. I do have my doubts about what proportion of the robots that are started will be made to work successfully. I wish Usborne's electronics advisor joy, and I hope that he is blessed with much patience.

I do think that this is just the kind of book that should be reaching us now. It is an imaginative step ahead of much of what appears. It has been thought through very carefully. Perhaps Usborne can produce a book in the future that explains what the robot can be used for.

Writing Software For Profit is by A. J. Harding, who has written magazine articles on the same topic. It is something a good many of us should be interested in, for there is undoubtedly the opportunity to make a great deal of money from writing software. A best-selling games program can be a money-spinner, although the hit parade nature of the games market means that even a best-seller is unlikely to make money for long. An item of 'serious' software such as a spreadsheet or a database, or even a program generator or an expert system, might sell at a steady level for a much longer period.

Unfortunately for anyone looking for a magic formula for making money from writing software, A. J. Harding's book is rather poorly titled. It is more an account of the approach of his company, Molimerx, to software publishing. This makes it useful if you want to make money by having Molimerx publish your software, but what the book has to say may not be altogether helpful if you try elsewhere. The author's views on the publishing of software are strongly held and forcefully expressed. But he is a publisher of software and that means his is not necessarily the best position from which to advise potential software authors on how to get the best deals for themselves. A more accurate title for the book (although, admittedly, much less eye-catching) would have been **Harding on Software Publishing.**

Software publishing has a good deal in common with book publishing. My experience as an author dealing with book publishers has been that the author's best interests are only one of several matters concerning publishers when they negotiate the contract for a book! I expect that it is the same with a software publisher. That this book includes the standard contract offered by Molimerx to all its authors is evidence of the fairness of Harding's dealings with his software authors. The use of a standard contract means that all those dealing with Molimex know exactly where they stand. My point is that a publisher, by the very nature of things, is unlikely to be the best person to advise an author on how to make money. My advice, for what it is worth, to anyone wanting to make a living out of writing software would be to get an agent, and preferably a reputable and experienced one.



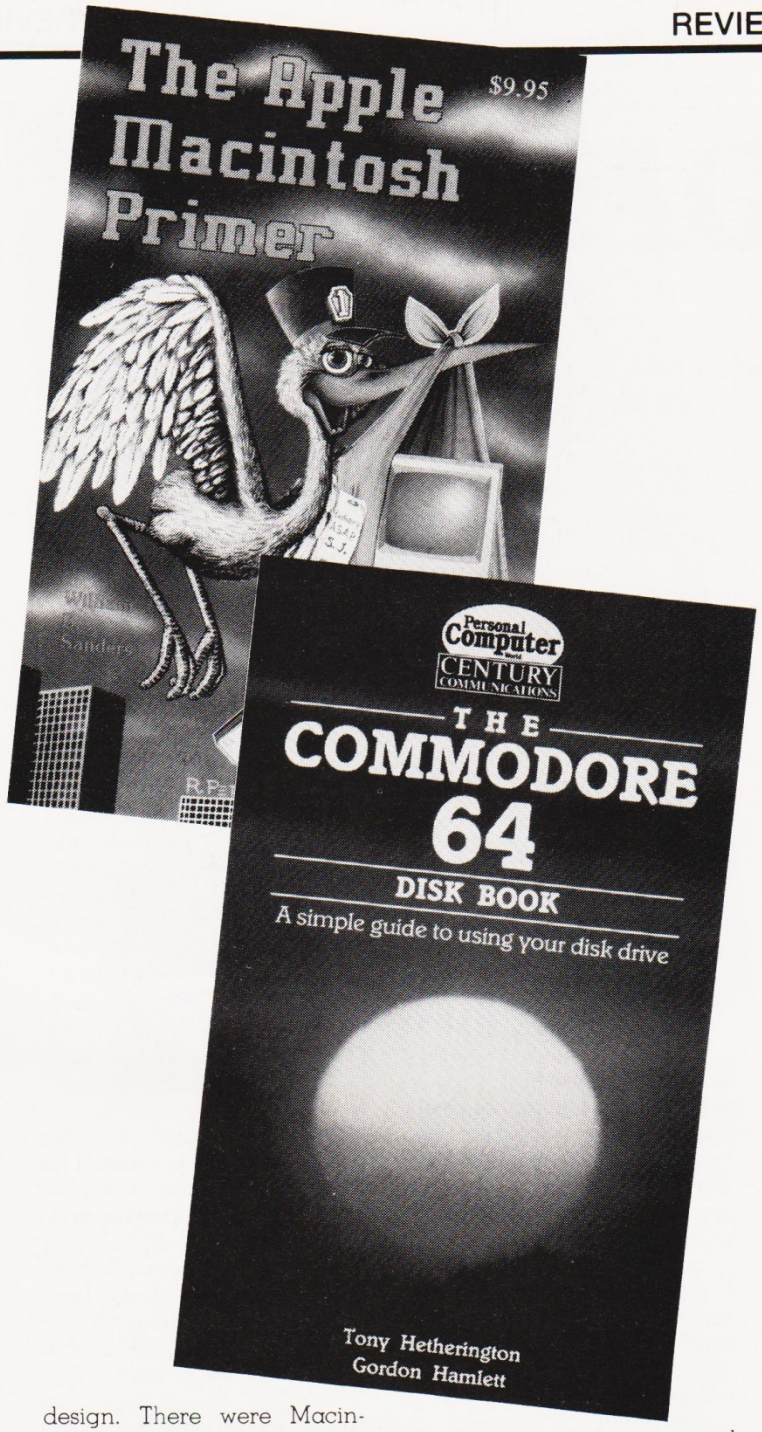
I felt that the book was at its best when read as an account of the author's experiences in the software world. These go back about as far as possible, for he was among the first in the microcomputer software trade. He has encountered most of the inhabitants of this world, and this makes his account of it invaluable reading for anyone proposing to enter it. He is also highly informative on the application of the law in the software business, the copyright law in particular, of course. As he has been a legal executive at Lincoln's Inn Fields, and has been involved in court cases concerning the application of the copyright laws to software publishing, he naturally speaks with considerable authority on this subject. And if you don't know about 'The Anton Pillar Order' or 'Intellectual Property' then you should: Mr Harding will inform you about them.

As far as direct advice to budding software authors is concerned, the book does deal with how to choose the machine for which, and on which, to write programs. It also addresses itself to how the subjects for programs can be chosen and has a little to say on selecting a publisher for the programs. The advice probably embodies a sound approach to the professional writing of software, but I have doubts that it is all practical. I would have thought that a number of people started with a computer and an idea for a program, although I accept that this may not be a good starting point for many reasons. I cannot imagine such people being in a position to be able to chose the computer that seems must suitable, perhaps selecting between an IBM PC, a Macintosh and an Apricot, say, and then being able to decide whether to write an expert system or a spreadsheet or whatever else is in demand.

There is also a chapter called 'Income Tax, VAT and other nasty things'. While we all probably agree with the sentiment of the chapter's title, its contents can be summed up in three words — Get an accountant!

If the best aspect of the book is its account of the author's experiences and views of the software trade, it has several aspects that are less pleasing. It is much too verbose in parts, as in the chapter just mentioned. There are quite a lot of sentences throughout the book that do not say, I am sure, anything like what the author meant to say. For example: 'Of course, it must be remembered that at this time the state of the art of the user was very low.' (page 44). I suppose that in evolutionary terms all we users represent the state of the art, but that has nothing to do with what the author was trying to say. In summing up what is meant by 'leverage' we find: 'If one can write a program that will, with a minimum of effort, cause a maximum of output, then one has achieved leverage.' I don't think so. Lots of output does not necessarily reflect anything. Anyway, in my experience at least, 'leverage' is an Americanism that we have not imported comfortably to this country, even down to its pronunciation. (If you would like an explanation of the word, then I refer you to the introductory article in Scientific American for September 1984.)

These shortcomings could have been dealt with by a sub-editor. The inclusion of an index would also have been an improvement. The illustrations have nothing at all to do with the text of the book: they are just photos of micros



and were presumably scattered throughout the book to break up the text.

So how to summarise? Well, I don't think that the book will tell a potential software author how to make a living from it. But it does contain a great deal of advice, provides much useful information on the practice of the software trade and the relevant laws, and it gives a considerable insight into the whole business. Any of these aspects could easily be worth much more than the price of the book. I suppose, as ever, that you pay your money and you make your choice.

The Apple Macintosh Primer is just what its title says it is. The problem with this book, as with any other introductory book on the Macintosh, is that of writing a book on a computer that is so easy to use that there is really no need at all for such a book. Perhaps the book should be treated as one for people wanting to find out what the Macintosh is and what it can do, and for those collecting and assessing information on it with a view to a prospective purchase. Speaking for myself, if I had two thousand pounds to spare, I would buy a Macintosh at once.

The author reveals his problem in writing the book by spending a fair amount of the first few chapters in 'uneducating' us in the ways of using conventional micros. No need to type, to press Return or to master special codes for use with an editor. Just use the mouse to select an item from a menu and click the button on the mouse. The book provides many illustrations that are direct Macintosh screen dumps, and by this means gives a precise idea of the appearance of the displays, menus and icons.

The author adopts his 'uneducating' approach because he has upgraded to the Macintosh from the Apple II, and he assumes that his readers will have progressed similarly. I suppose that this is true of all but the youngest, and so is a valid approach. Recently, I saw the Macintosh on a stand at the Computer Graphics conference at Wembley Conference Centre, where it was being demonstrated as part of a customised system for graphics design. There were Macintoshes running self-tutoring programs on the stand, showing how to use a mouse with mobile graphics of a hand reaching out to move the mouse and click its button. The older people trying this proceeded slowly, painfully and with awe. But I saw a youngster walk up to it and use it quickly and naturally — no need for a book there!

After the introductions, the book gives descriptions of menus, icons, icon menus and the mousé. An account of folders (for storage), folders within folders, windows and scrolling them, and using disks follows. The last two chapters deal respectively with MacPaint and MacWrite, the drawing and word processing programs that come with the Macintosh when it is purchased. The descriptions of what they can do and of how to use them give a good idea of what the Macintosh can do and of how it is used. Incidentally, the Apple Imagewriter is a printer designed for use with Apple computers, including the Macintosh. Because it is a bit-mapped printer, it can reproduce graphics as well as text, thereby providing a simple solution to the problem of how to incorporate illustrations in documents.

It should be clear that my view is that no-one with a Macintosh needs a book about it: but for those who for any reason do need such a book, this one is a snappy, readable and accurate introduction to the Macintosh, its software and its capabilities.

Finally, **The Commodore 64 Disk Book** is everything that the manual for the Commodore 1541 disk drive should have been. It is simple to understand and easy to read. No assumptions about the reader's state of knowledge are made, and the minimum of jargon is used. It even explains why you might want to do the things that the disk drive can do. It doesn't explain why these things have to be done in the way that they are; but then no-one can do that, for there are no reasons. The book won't help you to speed up the operation of the drive, or to make it store more data on a disk, either. It is a plain, straightforward manual replacement.

An appendix gives some BASIC programs for dealing with disk files and other matters. There is one for displaying the contents of a sequential file, and another for persuading the drive that a disk is write-protected even if there is no label over the write-protection slot. The programs shed light on how the drive operates, and are the book's main contribution to disk drive operation at a level above the elementary.

The book shows what the manual could, and should, have been like. It also shows that it is possible to write documentation that the user can read and understand. It is a pity that it didn't appear a great deal sooner. Also, it is rather pricey, although for anyone who has paid for one of the drives and cannot use it very well, it will prove a sound investment.

This month's books are:
How to Make Computer-controlled Robots by Tony Potter, Usborne, 48 pages, £2.95.
Writing Software For Profit by A. J. Harding, Virgin, 149 pages, £4.95.
The Apple Macintosh Primer by W. B. Sanders, Reston, 117 pages, £9.65.
The Commodore 64 Disk Book by Tony Hetherington and Gordon Hamlett, Century, 82 pages, £5.95.

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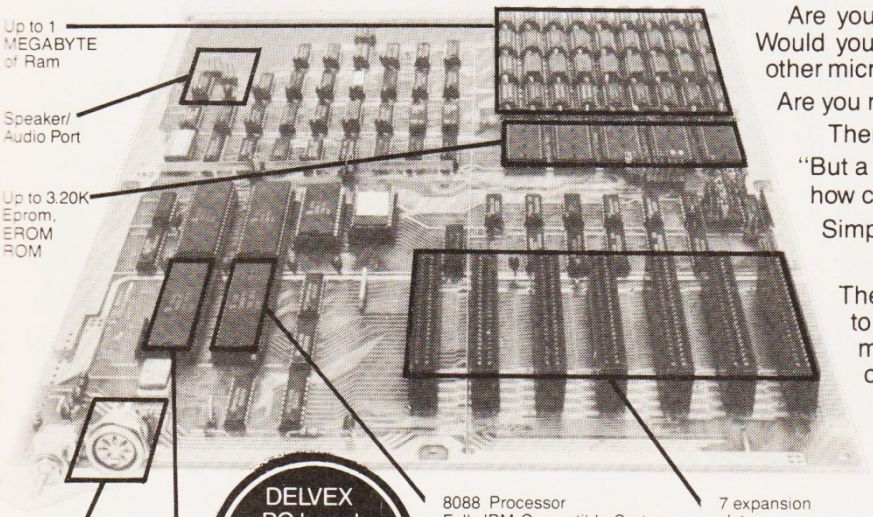

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GAMESMANSHIP

S. Connor

If you're having a go at writing games software, here are a few dos and dont's from someone who has suffered at the hands of commercial software companies.

It isn't the intention of this article to tell you how to invent a brilliant new computer game and make yourself rich. If I knew how to do that, I would be making myself rich. Rather, I intend to have a little chat about some of the things that I like and dislike in commercial software in general, so that you can avoid making the same mistakes as others.

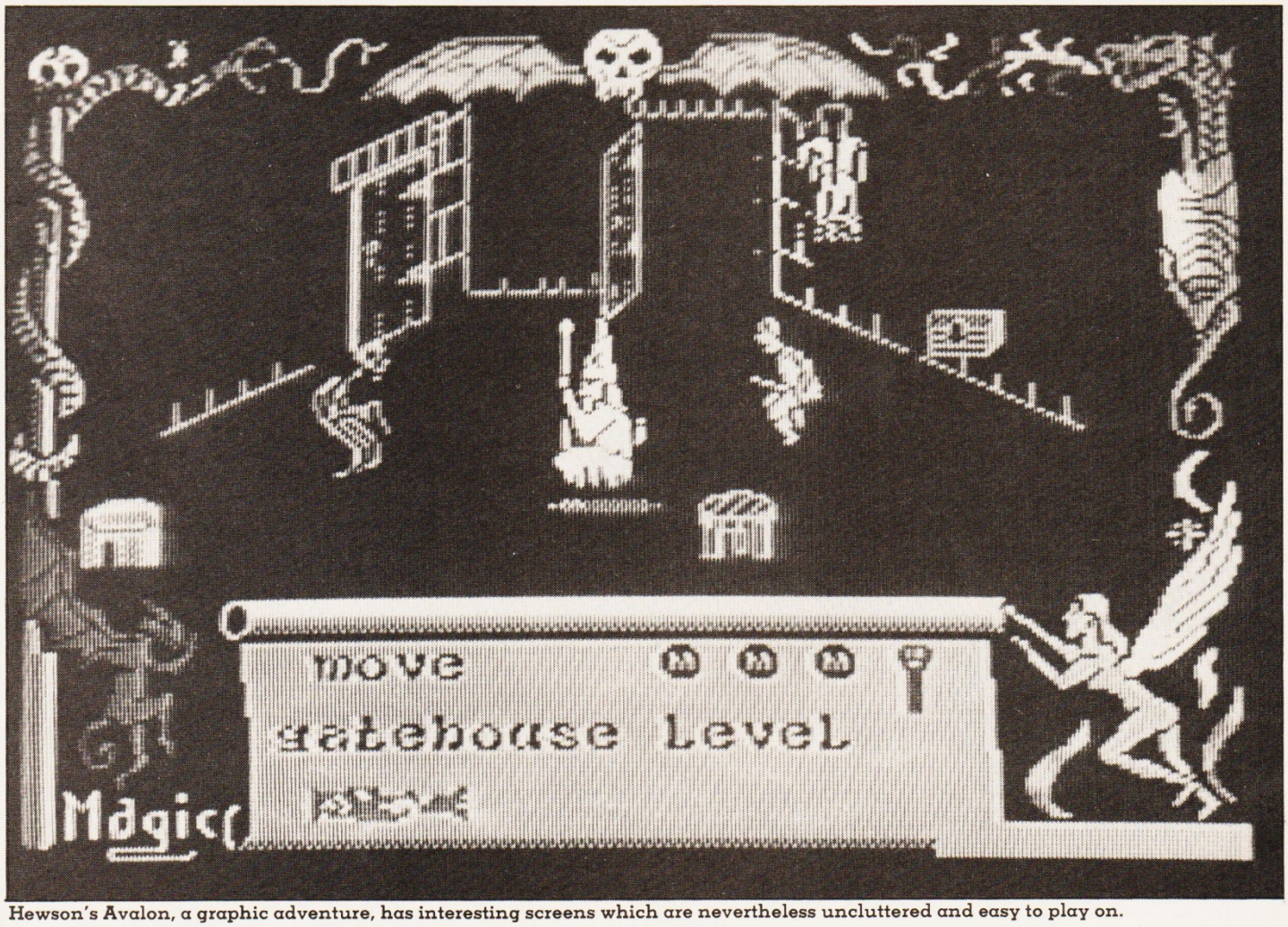
CLEAN SCREENS

You don't have to be a qualified graphics designer to produce a computer game, but it helps! Visual presentation is often the most striking element in a computer game and so often it is neglected.

In a text-only game, such as an adventure, you might think that little can be done to set the mood. However, many computers today allow a user-defined character set, so you can choose the text font appropriate to the storyline: Gothic script for a horror plot and a futuristic style for science fiction. If you are presenting different pices of information at once, such as a location description and an inventory, consider putting them in different areas of the screen with contrasting foreground and background colours, to liven the screen up a bit. The latest generation of computers often support text windows which makes this easier.

While on the subject of text colours, do choose combinations that are easy to read (or allow the user to choose from a menu). Don't do silly things like putting red text on green background: it's a rare and expensive monitor that will display that without any fuzziness. Also to be avoided are tasteful combinations that are too similar tonally, and so equally hard to read. Don't assume what looks fine on your TV is OK on someone else's. I have a Level 9 adventure for my Amstrad which uses grey on black: but the blue gun in my monitor doesn't seem to have enough oomph so the grey is hard to see even at maximum contrast.

For arcade games, the current secret seems to be to make the screens as visually interesting as possible, even if the actual game action is only confined to a small section of the screen. For example, in Beyond's Psytron, the first level features extremely detailed views of a robot city, but the actual game action takes place in a small box at



Hewson's Avalon, a graphic adventure, has interesting screens which are nevertheless uncluttered and easy to play on.

the bottom right, thus combining a minimum of animation with a maximum of visual interest.

Beware of making the screen too cluttered, though. You will annoy the player if you make it too difficult to keep track of vital game information.

SOUNDING OFF

Sound effects can do a lot to liven up a game, but it might be a good idea to steer clear of actual custom-written music unless you have access to someone who can write it for you. Bear in mind that any music written recently is probably subject to copyright and if you use it in a commercial game there are several organisations eager to prosecute you. If it fits the mood you're probably safe with a classical piece, but it never hurts to check.

Whether the sound track is three-part harmony or thudding explosions, remember that it might start to grate after the thirtieth repetition. If the computer you are using outputs its sound through the TV set life is easy: the player can simply turn down the volume. Otherwise it is very user-friendly to include either a volume control or on-off option for the sound: not just at the beginning of the game, but preferably at any point in case the player gets fed up with it.

DON'T BE A BORE

Programmers just naturally love to show off. But don't overdo it. The clever (and long) animation sequence you display every time the player loses a life can be a real drag after surprisingly few performances. Always include a skip option into something like this so that the player can decide when he's had enough: he will love you forever.

Conversely, if part of the program produces an unavoidable delay, give the player something to look at or listen to in the meantime. For example, put some instructions on the screen for the player to read while you're initialising arrays with data. Provide the player with a nice title screen to admire while loading a very long program from tape (but don't bother if the program is so short a loading screen would, say, double the total loading time).

CUT OUT GUESSING

If the player has to guess what to do next, you've failed. It means you haven't explained something, or you've given him too much to remember. If instructions are very complicated and only appear once, at the beginning of the game, you are asking a lot of your victim. Provide a help option that will display the control instructions at any point in the game.

If it is necessary to press any key to continue, for goodness' sake print a message to that effect on the screen. Don't expect anyone to second-guess you: likely as not they'll stare at the TV wondering why the program has hung.

GIVE THEM MORE

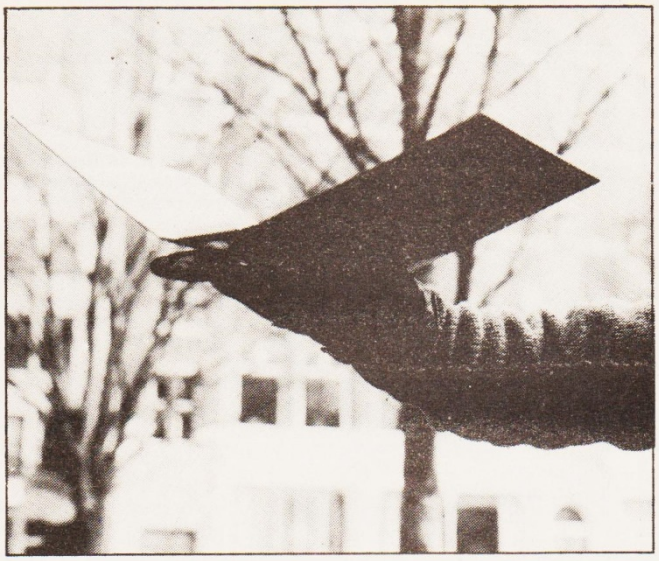
Notwithstanding the cautions mentioned above about boredom, if you can pack in some unusual gimmicks you can find yourself in the money. Here are two of my favourites. In Activision's Ghostbusters, before the game itself the entire theme tune is played through, with lyrics appearing on the screen together with a little singalong bouncing ball on top. Pressing the Space bar causes a software-synthesised voice to say Ghostbusters in time with the music, and naturally you can jump straight to the game at any point.

Second, I've seen a Defender-type game for the Commodore 64 which has a second game as a loading screen! A simple Centipede game is loaded, and while you play that the longer main game is being loaded into memory. Brilliant.

THAT'S THE IDEA

Of course none of this advice is any help in thinking up new games concepts, which is the real secret of making your fortune. Most games fall into predefined categories: shoot-em-up, mazes, ladders and walkways, text adventures . . .

Come up with something new and exciting and the world will beat a path to your computer. Good luck!



In days gone by, falconry was the sport of gentlemen and kings — this noble and time-honoured tradition is not so prevalent in these technological times, and it is quite a pity, too. Just imagine the pride you'd feel standing in your own back yard while your very own hunting falcon swooped down upon unsuspecting dogs, cats and Ford Sierras.

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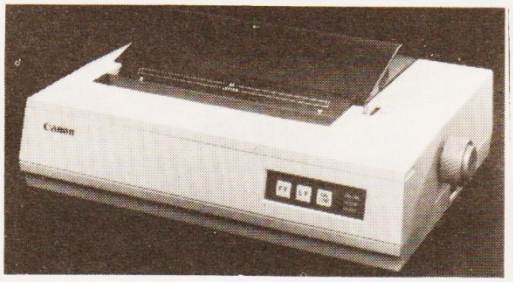

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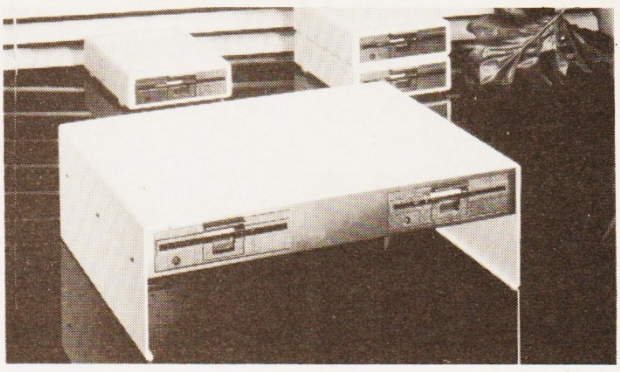

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READABLE COMMODORE LISTINGS

Tony Cross

CT standards were a boon for anyone typing in listings because they made it very easy to know which keys to press for the funny graphics codes. But they had to be inserted by hand into listings. This is a program to do the donkey work.

The editor rang me up the other day. "I've got this problem," he moaned. Naturally I said how sorry I was and had he seen a doctor? but then he explained that it wasn't that sort of a problem. Anyway, this is roughly what he said:

"Here at CT we get a lot of very good program listings for Commodore 64s. The problem is that, instead of printing sensible cursor control messages in PRINT statements, the Commodore 64 prints curious graphics symbols on the actual listing, but by the time it's been photographed, reduced and re-printed, they are hardly readable . . ."

At this point he burst into tears, so naturally I offered to do what I could and put the phone down. . .

Seriously though, the way that the Commodore 64 prints its cursor control codes makes life very difficult for magazines like Computing Today. Not only that, but it makes life very difficult for you and I as well.

Computing Today have partially got round this problem by designing and publishing a set of standard cursor control codes. The problem is, you cannot get your Commodore 64 to print the CT codes instead of the normal graphics characters. Until now, that is . . .

THE CURRENT SITUATION

When you type LIST, the BASIC editor inside the ROM starts printing the BASIC program stored in memory. To do this it converts the numbers stored in memory into printable characters using the standard ASCII character set. Now, the ASCII character set does not contain any characters for cursor control, so the Commodore 64 prints graphics characters to indicate where cursor control characters exist. (Most other home computers do something similar).

Fortunately our editor is one of those rare people who knows exactly what he wants (and believe me that's not common). In its simplest form he wanted a routine that will list a BASIC program with the cursor control codes expanded into the Computing Today standard format. However, during a sudden rush of blood to the brain, he decided that if he's going to get me to write a new listing routine he might as well make it as comprehensive as possible. (He's good like that, is our editor!).

THE FINAL SPECIFICATION

We finally decided that our ideal list routine should contain the following features:

- All graphics/control and cursor codes must be expanded into the Computing Today standard format.
- The routine must not 'split' words at the end of a physical line (ie, if there is insufficient space on the line for the next word, the routine must generate a new line).
- FOR/NEXT loops must be indented for as many levels as is necessary.
- The line numbers must be right-justified on a five character field (so that every line starts in the same place).
- All keywords must be preceded and followed by a single space.
- Colons used as statement separators must be followed by a single space.
- The maximum line width must be adjustable (within certain limits) without affecting any of the above features.
- The routine must be capable of driving either the standard Commodore serial printer, or a standard Centronics printer connected to the User Port.

So, armed with this very impressive specification I locked myself away for a year and a day (well, it seemed that long anyway!). The result is a routine called COTEL (for COmputing Today Extended List routine). I actually wrote two very similar routines, one for the serial printer and one for a Centronics printer. (This was the simplest way of meeting the last specification above).

Now, although COTEL has been written on and for the Commodore 64, the principles used apply to most home computers. This is because they nearly all use the same storage method for BASIC programs. Because of these similarities I have tried to make the routine as 'modular' as possible so that you can see clearly how each part works. Hopefully, you can then write a similar version for your own particular machine.

THE COTEL ROUTINE

As I mentioned above, there are two similar routines (COTEL.SER and COTEL.CEN). Both are included here, but I will stick to describing the serial version. (The important bits are the same anyway, it's only the printer drivers that vary).

In outline the routine works as follows:

- Each physical line in the program is examined in turn until the end of the program is reached.
- As each line is scanned it is copied into an output buffer before being printed, including any extra spaces needed for FOR/NEXT indentation and so on.
- Each keyword token is tested to see if it is either FOR or NEXT. If it is then the appropriate number of spaces is added or subtracted from the current indentation.
- Each character within a quoted string is tested to see if it is one of the graphic/control or cursor codes (by comparing it with a table of the

graphic/control and cursor codes). If it is then the appropriate CT standard code is written into the output buffer.

- When the end of a line has been reached, the output buffer is scanned and carriage return characters (and the appropriate number of spaces) are inserted to accommodate the selected printer line width.
- When the output buffer has been completely formatted it is sent to the appropriate port to be printed.
- When the output buffer has been completely printed it is cleared and the next program line is scanned.
- When the end of the program has been reached control is returned to BASIC.

The full program listing of COTEL.SER is given in Listing 1. It begins with the variable and equates definitions followed by the table of graphic/control and cursor codes. Of course, these are the codes for a Commodore 64: for other machines you should modify the table appropriately.

The first actual piece of code is an initialisation routine which loads the BASIC USR address with the start address of the COTEL routine. This must be executed as soon as COTEL has been loaded in order to 'install' it.

With the routine start address loaded into the USR address, COTEL can be called by using the PRINT USR(x) command from BASIC. The 'x' argument value should be the maximum line width you want to use. (See the specifications above). Most machines support this type of machine code calling command, although the actual keyword may be different.

When COTEL is called in this way execution begins at

Listing 1. COTEL for a Centronics printer. A stamped, self-addressed A4 envelope and a cheque for £1.50 will secure a photocopy of the serial version.

```
                ;###################################
                ;#                                 #
                ;#  COMPUTING TODAY EXTENDED LIST  #
                ;#                                 #
                ;# V 2.0 -- FOR CENTRONICS PRINTER #
                ;#                                 #
                ;#  COPYRIGHT (C)  A.L.CROSS 1984  #
                ;#                                 #
                ;###################################
                ;
                ;
                *=$C000
                ;
                ;
C000 4C63C2     ENTRY       JMP BEGIN
                ;
                ;
                ;SYSTEM VARIABLES
                ;
                TXTTAB      = $2B
                TXTPTR      = $FB
                TABPTR      = $FD
                BUFOFF      = TABPTR
                BUSY        = TABPTR
0000            LNKPTR      WOR $0000
00              QOTFLG      BYT $00
00              COLFLG      BYT $00
00              REMFLG      BYT $00
00              CTLCHR      BYT $00
00              BUFPTR      BYT $00
00              LINLEN      BYT $00
00              NUMCHR      BYT $00
00              SPCNUM      BYT $00
00              WIDTH       BYT $00
                ;
                ;
                ;VARIOUS EQUATES
                ;
                USR         = $0311
                ERROR       = $A437
                POSINT      = $B7F7
                FPA1        = $61
                TYPE        = $0D
                NMTYPE      = $0E
                WORD        = $0F                   ;MAX WORD LENGTH
                PADOUT      = $BC49
                CVTSTG      = $BDDF
                GETSTG      = $B487
                DALSTG      = $B6A6
                RESWDS      = $A09E
                OLDNMI      = $FE47
                NMIVEC      = $0318
                PA2         = $DD00
                PORT        = $DD01
                PA2DDR      = $DD02
                DDR         = $DD03
                FLAG        = $DD0D
                ;
                ;
                ;PRINT BUFFER AREA
                ;
                BUFFER      = *
                *=*+256
                ;
                ;
                ;GRAPHICS/CONTROL CODES TABLE
                ;
C10E 93434C     CTLTAB      BYT $93,'C,'L,'S+$80
C112 13484F                 BYT $13,'H,'O,'M+$80
C116 9D43CC                 BYT $9D,'C,'L+$80
C119 1D43D2                 BYT $1D,'C,'R+$80
C11C 9143D5                 BYT $91,'C,'U+$80
C11F 1143C4                 BYT $11,'C,'D+$80
C122 125245                 BYT $12,'R,'E,'V+$80
C126 924F46                 BYT $92,'O,'F,'F+$80
C12A 205350                 BYT $20,'S,'P,'C+$80
C12E 8546B1                 BYT $85,'F,'1+$80
C131 8646B3                 BYT $86,'F,'3+$80
C134 8746B5                 BYT $87,'F,'5+$80
C137 8846B7                 BYT $88,'F,'7+$80
C13A 8946B2                 BYT $89,'F,'2+$80
C13D 8A46B4                 BYT $8A,'F,'4+$80
C140 8B46B6                 BYT $8B,'F,'6+$80
C143 8C46B8                 BYT $8C,'F,'8+$80
C146 904354                 BYT $90,'C,'T,'L,'1+$80
C14B 054354                 BYT $05,'C,'T,'L,'2+$80
C150 1C4354                 BYT $1C,'C,'T,'L,'3+$80
C155 9F4354                 BYT $9F,'C,'T,'L,'4+$80
C15A 9C4354                 BYT $9C,'C,'T,'L,'5+$80
C15F 1E4354                 BYT $1E,'C,'T,'L,'6+$80
C164 1F4354                 BYT $1F,'C,'T,'L,'7+$80
C169 9E4354                 BYT $9E,'C,'T,'L,'8+$80
C16E C0473E                 BYT $C0,'G,'>,'@+$80
C172 C1473E                 BYT $C1,'G,'>,'A+$80
C176 C2473E                 BYT $C2,'G,'>,'B+$80
C17A C3473E                 BYT $C3,'G,'>,'C+$80
C17E C4473E                 BYT $C4,'G,'>,'D+$80
C182 C5473E                 BYT $C5,'G,'>,'E+$80
C186 C6473E                 BYT $C6,'G,'>,'F+$80
C18A C7473E                 BYT $C7,'G,'>,'G+$80
C18E C8473E                 BYT $C8,'G,'>,'H+$80
C192 C9473E                 BYT $C9,'G,'>,'I+$80
C196 CA473E                 BYT $CA,'G,'>,'J+$80
C19A CB473E                 BYT $CB,'G,'>,'K+$80
C19E CC473E                 BYT $CC,'G,'>,'L+$80
C1A2 CD473E                 BYT $CD,'G,'>,'M+$80
C1A6 CE473E                 BYT $CE,'G,'>,'N+$80
C1AA CF473E                 BYT $CF,'G,'>,'O+$80
C1AE D0473E                 BYT $D0,'G,'>,'P+$80
C1B2 D1473E                 BYT $D1,'G,'>,'Q+$80
C1B6 D2473E                 BYT $D2,'G,'>,'R+$80
C1BA D3473E                 BYT $D3,'G,'>,'S+$80
C1BE D4473E                 BYT $D4,'G,'>,'T+$80
C1C2 D5473E                 BYT $D5,'G,'>,'U+$80
C1C6 D6473E                 BYT $D6,'G,'>,'V+$80
C1CA D7473E                 BYT $D7,'G,'>,'W+$80
C1CE D8473E                 BYT $D8,'G,'>,'X+$80
C1D2 D9473E                 BYT $D9,'G,'>,'Y+$80
C1D6 DA473E                 BYT $DA,'G,'>,'Z+$80
C1DA DB473E                 BYT $DB,'G,'>,'++$80
C1DE DC473E                 BYT $DC,'G,'<,'--$80
C1E2 DD473E                 BYT $DD,'G,'>,'--$80
C1E6 DF473E                 BYT $DF,'G,'<,'*+$80
C1EA A1473E                 BYT $A1,'G,'<,'K+$80
C1EE A2473E                 BYT $A2,'G,'<,'I+$80
C1F2 A3473E                 BYT $A3,'G,'<,'T+$80
C1F6 A4473E                 BYT $A4,'G,'<,'@+$80
C1FA A5473E                 BYT $A5,'G,'<,'G+$80
C1FE A6473E                 BYT $A6,'G,'<,'++$80
C202 A7473E                 BYT $A7,'G,'<,'M+$80
C206 A8473E                 BYT $A8,'G,'<,'£+$80
C20A A9473E                 BYT $A9,'G,'>,'£+$80
C20E AA473E                 BYT $AA,'G,'<,'N+$80
C212 AC473E                 BYT $AC,'G,'<,'D+$80
C216 AD473E                 BYT $AD,'G,'<,'Z+$80
C21A AE473E                 BYT $AE,'G,'<,'S+$80
C21E AF473E                 BYT $AF,'G,'<,'P+$80
C222 B0473E                 BYT $B0,'G,'<,'A+$80
C226 B1473E                 BYT $B1,'G,'<,'E+$80
C22A B2473E                 BYT $B2,'G,'<,'R+$80
C22E B3473E                 BYT $B3,'G,'<,'W+$80
C232 B4473E                 BYT $B4,'G,'<,'H+$80
C236 B5473E                 BYT $B5,'G,'<,'J+$80
C23A B6473E                 BYT $B6,'G,'<,'L+$80
C23E B7473E                 BYT $B7,'G,'<,'Y+$80
C242 B8473E                 BYT $B8,'G,'<,'U+$80
C246 B9473E                 BYT $B9,'G,'<,'O+$80
C24A BA473E                 BYT $BA,'G,'<,'@+$80
C24E BB473E                 BYT $BB,'G,'<,'F+$80
C252 BC473E                 BYT $BC,'G,'<,'C+$80
C256 BD473E                 BYT $BD,'G,'<,'X+$80
C25A BE473E                 BYT $BE,'G,'<,'V+$80
C25E BF473E                 BYT $BF,'G,'<,'B+$80
C262 00                     BYT $00                 ;END OF TABLE
                ;
                ;
                ;
                ;PROGRAM INITIALISATION
                ;
C263 A96E       BEGIN       LDA #<START             ;PUT ROUTINE
C265 8D1103                 STA USR                 ;START ADDRESS IN
C268 A9C2                   LDA #>START             ;USR LOCATION
C26A 8D1203                 STA USR+1
C26D 60                     RTS                     ;AND THEN RETURN
                ;
                ;
                ;MAIN PROGRAM START
                ;
C26E 20F7B7     START       JSR POSINT              ;GET LINE WIDTH
C271 A515                   LDA $15                 ;GET HIGH BYTE
C273 F005                   BEQ GETNUM
C275 A20E       QTYERR      LDX #$0E
C277 4C37A4                 JMP ERROR               ;PRINT ERROR
C27A A514       GETNUM      LDA $14                 ;GET LOW BYTE
C27C C910                   CMP #$10                ;MINIMUM LINE WIDTH
C27E 90F5                   BCC QTYERR
C280 8D0DC0                 STA WIDTH               ;PUT IN WIDTH
                ;
                ;
                ;INITIALISE ALL POINTERS
                ;
C283 A52B                   LDA TXTTAB              ;INIT TO START OF
C285 8D03C0                 STA LNKPTR              ;BASIC TEXT AREA
C288 A52C                   LDA TXTTAB+1
C28A 8D04C0                 STA LNKPTR+1
C28D A900                   LDA #$0
C28F 8D0EC0                 STA SPCNUM              ;SET FOR NO INDENT
                ;
                ;
                ;LOOP ONCE FOR EACH PROGRAM LINE
                ;
C292 A900       MAINLP      LDA #$0                 ;INITIALISE THE
C294 8D05C0                 STA QOTFLG              ;QUOTE FLAG,
C297 8D03C0                 STA BUFPTR              ;BUFFER POINTER,
C29A 8D07C0                 STA REMFLG              ;REM FLAG AND THE
C29D 8D06C0                 STA COLFLG              ;COLON FLAG
                ;
                ;
                ;INITIALISE THE PRINT BUFFER
                ;
C2A0 A8                     TAY
C2A1 990EC0     BUFINT      STA BUFFER,Y
C2A4 C8                     INY
C2A5 D0FA                   BNE BUFINT
                ;
                ;
                ;SET UP TXTPTR FOR THIS LINE
                ;
C2A7 AD03C0                 LDA LNKPTR
C2AA 85FB                   STA TXTPTR
C2AC AD04C0                 LDA LNKPTR+1
C2AF 85FC                   STA TXTPTR+1
                ;
                ;
                ;SET UP LNKPTR FOR NEXT LINE
                ;
C2B1 B1FB                   LDA (TXTPTR),Y
```

the label START in Listing 1. This first block of code 'reads' the argument from the PRINT USR(x) statement, checks it for range and stores it in the WIDTH variable. The range check ensures that the width is greater than 1-5 and less than 256 characters per line. A QUANTITY ERROR message is given if the argument is out of this range.

The next block of code sets up the standard serial printer port. The Commodore 64 Programmers Reference Guide explains how to do this in glorious detail.

The third block of 'start-up' code initialises LNKPTR and SPCNUM. LNKPTR is a two-byte pointer which points to the start of the next line of the BASIC program. It is initialised to the start of the program (held in the system variable TXTTAB on the Commodore 64). SPCNUM is a one-byte variable which contains the current indentation value (in number of spaces). This is used for the FOR/NEXT loop indentations and it is initialised to zero.

The next block of code, starting at the label MAINLP, is the main loop in the program. Execution begins here for each new line of the BASIC program and, naturally enough, a lot of initialisation takes place here. First, QOTFLG, REMFLG and COLFLG are set to zero (OFF). These indicate whether a quote character, a REM token or a colon character have been seen while the BASIC line is being scanned. Second, the 256-byte output buffer is cleared ready for the next line. Third, the two-byte pointer TXTPTR (the pointer used for scanning the line) is set to the current value in LNKPTR (the start of the next line, remember). And finally, LNKPTR is loaded with the contents of the first two bytes in the BASIC program line. These are the link pointer bytes and they point to the start of the next line of the BASIC program.

Following the initialisation there is a test to see if the end of the program has been reached. This is indicated by two nulls where the link pointer bytes should be. It's actually only necessary to test the high byte because (on the Commodore 64) this byte can never be null except at the end of the program. If the end has been reached then the serial printer port is closed, some system variables are cleared and control is returned to BASIC.

If the end has been reached then control passes to the next block of code at the label LIST. This is where we actually start copying the BASIC program line across the output buffer. The first item encountered is the line number, stored in two bytes in standard low/high format. This must be converted to an ASCII string so that it can be printed. This is done by copying the number into Floating Point Accumulator 1 and calling the CVTNUM subroutine. The technique used here was described in my series on 'Extending the 64's BASIC' so I won't go into it here. (Just trust me . . . it works!). Next, the length of the line number string is used to calculate how many spaces to insert before it (it must be printed right-justified on a five-character field, remember). The correct number of spaces are copied across to the output buffer by the loop at SPCLP and the subroutine PRINT. PRINT simply places a byte into the buffer, increments the buffer pointer (BUFPTR) and then returns. Finally, the line number itself is copied across to the output buffer by the subroutine PRTNUM.

This technique for printing the line number could also be used on other machines. However, it depends on a thorough working knowledge of the BASIC interpreter in use — and that sort of information is not always readily available.

After printing the line number any spaces needed for the current level for FOR/NEXT indentation are added. The number of spaces to be inserted is held in the variable SPCNUM and the loop at SPCLOP simply copies the appropriate number of spaces across to the output buffer.

The next block of code, at the label LINELP, is the inner loop of the program. Execution begins here for each new byte in the current BASIC line. And the first thing that happens is that the next byte in the line is read.

Next, a check is made to see if the end of the line has been reached. This is indicated by a null byte, which can only occur at the end of a line. If the end of the line has been reached then the output buffer is printed, by the subroutine PRTOUT, and control is passed back to the label MAINLP so that the next line can be scanned. (I'll look at how PRTOUT works later).

If the end of the line has been reached then control passes to the next block of code at the label NOTNUL. At this point the status of QOTFLG is tested to see whether or not a quote character has already been used on this line. If it has then we are inside a quoted string and we must check for possible graphic/control or cursor codes. If a quote character has not been seen then we must check for keyword tokens in order to ensure that they are preceded and followed by a space (see the specifications). I'm going to deal with the case when QOTFLG is OFF first (quote character NOT seen) because it's a little simpler.

DEALING WITH TOKENS

Checking for keyword tokens is fairly easy because they are the only bytes in the line with their high bits set. So, if this byte dos not have its high bit set then it's not a token. (More on this later). If it is a token then we must first check to see if it is an operator (eg + − * = etc) because they do not need to be delimited by spaces. On the Commodore 64 the operator tokens begin at $AA, so any token with a value greater than or equal to this must be an operator. If the token is for an operator then the operator is copied across to the output buffer by the subroutine SRTTOK and control is passed to the label LINELP so that the next byte can be read.

SRTTOK works by using the token value as a pointer into the reserved words list. The string found at this location is the text of the token and it is copied across to the output buffer.

If the token found is not an operator then we have to check to see whether it is a FOR, NEXT or a REM. If it is a FOR ($81 on the Commodore 64) then the value in SPCNUM (the indentation) must be increased by 4. If it is a NEXT ($82 on the Commodore 64) then the value in SPCN must be decreased by 4. If it is a REM ($8F on the Commodore 64) then REMFLG is set on (−1). This is because COTEL removes unwanted spaces from program lines: however, all spaces in a REM statement are significant and REMFLG ensures that they are not removed.

Control then passes to the next block of code at the label PRTKEY. (Control also passes here if the token was not FOR, NEXT or REM). At this point the status of COLFLG is tested to see if the last character was a statement-delimiting colon (ie not in a quoted string). If it was then it will have been followed by a space (see specifications) and it will not be necessary to include a leading space for this keyword. If the last character was not a statement-delimiting colon then a leading space will be necessary. In either case COLFLG is now turned OFF (0) so that it can be used to mark any further statement-delimiting colons on this line. The keyword is then copied to the output buffer by the SRTTOK routine which we saw earlier, followed by a trailing space. Control is now passed back to the label LINELP so that the next byte in the line can be read.

Now we can pick up the case where the byte we have just read is not a token (see earlier) at the label NOTTOK. In this case we must check to see whether the byte is a space, quote or colon character. If the character is a space then it is ignored (by passing control back to LINELP without copying it across to the output buffer) unless REMFLG is on (−1) when all spaces are copied across. If the character is a quote then QOTFLG is turned ON (−1), the quote is copied to the output buffer and control is passed back to LINELP. If the character is a colon then the status of REMFLG is checked (if this is a REM statement then the colon is just an ordinary colon and it can be copied across to the output buffer and control returned to LINELP). If, however, REMFLG is OFF then this must be a statement-delimiting colon (because QOTFLG is currently OFF). In this case COLFLG is

Listing 1. continued.

```
2190 C2B3 8D03C0            STA LNKPTR
2200 C2B6 C8                INY
2210 C2B7 B1FB              LDA (TXTPTR),Y
2220 C2B9 8D04C0            STA LNKPTR+1
2230 C2BC                   !
2240 C2BC                   !
2250 C2BC                   !IF HIGH POINTER BYTE IS NULL
2260 C2BC                   !THEN END OF PROGRAM REACHED
2270 C2BC                   !
2280 C2BC C900              CMP #$0                 !TEST FOR END OF PROG
2290 C2BE D009              BNE LIST                !CONTINUE IF NOT
2300 C2C0 A900              LDA #$0
2310 C2C2 8561              STA FPA1                !ZERO FPA1
2320 C2C4 850D              STA TYPE                !EXPRESSION TYPE
2330 C2C6 850E              STA NMTYPE              !AND NUMBER TYPE
2340 C2C8 60                RTS
2350 C2C9                   !
2360 C2C9                   !
2370 C2C9                   !GET LINE NUMBER AND PRINT IT
2380 C2C9                   !
2390 C2C9 C8        LIST    INY
2400 C2CA B1FB              LDA (TXTPTR),Y          !GET LINE NUMBER
2410 C2CC 8563              STA FPA1+2              !INTO FPA1
2420 C2CE C8                INY
2430 C2CF B1FB              LDA (TXTPTR),Y
2440 C2D1 8562              STA FPA1+1
2450 C2D3 98                TYA
2460 C2D4 48                PHA                     !SAVE TXTPTR INDEX
2470 C2D5 20BEC4            JSR CVTNUM
2480 C2D8 48                PHA                     !SAVE NUMBER LENGTH
2490 C2D9 AA                TAX
2500 C2DA A920      SPCLP   LDA #$20                !SPACE CHARACTER
2510 C2DC E005              CPX #$05                !HOW MANY SPACES?
2520 C2DE F007              BEQ SPCEND              !SEND A SPACE TO PRINT
2530 C2E0 20AAC4            JSR PRINT
2540 C2E3 E8                INX
2550 C2E4 38                SEC
2560 C2E5 B0F3              BCS SPCLP
2570 C2E7 68        SPCEND  PLA                     !RESTORE NUMBER LENGTH
2580 C2E8 AA                TAX                     !INTO THE X REGISTER
2590 C2E9 20BEC4            JSR PRTNUM
2600 C2EC                   !
2610 C2EC                   !
2620 C2EC                   !ADD IN FOR/NEXT INDENT
2630 C2EC                   !
2640 C2EC AE0CC0            LDX SPCNUM              !GET INDENT VALUE
2650 C2EF F00A              BEQ NOSPC               !IF NONE
2660 C2F1 A920              LDA #$20
2670 C2F3 48        SPCLOP  PHA                     !SEND INDENT TO PRINT
2680 C2F4 20AAC4            JSR PRINT
2690 C2F7 68                PLA
2700 C2F8 CA                DEX
2710 C2F9 D0F8              BNE SPCLOP
2720 C2FB 68        NOSPC   PLA                     !RESTORE TXTPTR INDEX
2730 C2FC A8                TAY
2740 C2FD                   !
2750 C2FD                   !
2760 C2FD                   !LOOP FOR EACH BYTE IN THE LINE
2770 C2FD                   !
2780 C2FD C8        LINELP  INY
2790 C2FE B1FB              LDA (TXTPTR),Y          !GET NEXT BYTE
2800 C300 D006              BNE NOTNUL
2810 C302                   !
2820 C302                   !
2830 C302                   !END OF LINE FOUND - SO PRINT IT
2840 C302                   !
2850 C302 20BEC4            JSR PRTOUT
2860 C305 38                SEC
2870 C306 B08A              BCS MAINLP              !REPEAT FOR NEXT LINE
2880 C308                   !
2890 C308                   !
2900 C308                   !NOT END OF LINE
2910 C308                   !
2920 C308 AD05C0 NOTNUL     LDA QOTFLG              !TEST FOR INSIDE
2930 C30B F003              BEQ QOTOFF              !A QUOTED STRING
2940 C30D 4CA8C3            JMP QUOTON
2950 C310                   !
2960 C310                   !
2970 C310                   !NOT A STRING, SO CHECK FOR TOKENS
2980 C310                   !
2990 C310 B1FB    QOTOFF    LDA (TXTPTR),Y
3000 C312 48                PHA                     !SAVE CURRENT CHARACTER
3010 C313 2980              AND #$80                !IS HIGH BIT SET?
3020 C315 F054              BEQ NOTTOK
3030 C317                   !
3040 C317                   !
3050 C317                   !CHARACTER IS A KEYWORD TOKEN
3060 C317                   !
3070 C317 68                PLA                     !RECOVER CHARACTER
3080 C318 C9AA              CMP #$AA                !IS IT AN OPERATOR?
3090 C31A B049              BCS OPRTOR
3100 C31C 48                PHA                     !SAVE CHARACTER
3110 C31D                   !
3120 C31D                   !
3130 C31D                   !IF IT IS A 'FOR' THEN INDENT
3140 C31D                   !
3150 C31D C981              CMP #$81                !TOKEN FOR 'FOR'
3160 C31F D00C              BNE CHKNXT
3170 C321 A904              LDA #$04
3180 C323 18                CLC
3190 C324 6D0CC0            ADC SPCNUM              !INCREASE INDENT
3200 C327 8D0CC0            STA SPCNUM
3210 C32A 38                SEC
3220 C32B B01D              BCS PRTKEY              !GO PRINT KEYWORD
3230 C32D                   !
3240 C32D                   !
3250 C32D                   !IF IT IS A 'NEXT' DON'T INDENT
3260 C32D                   !
3270 C32D C982      CHKNXT  CMP #$82                !TOKEN FOR 'NEXT'
3280 C32F D010              BNE CHKREM
3290 C331 AD0CC0            LDA SPCNUM
3300 C334 38                SEC
3310 C335 E904              SBC #$04                !REDUCE INDENT
3320 C337 B002              BCS SETSPC
3330 C339 A900              LDA #$0
3340 C33B 8D0CC0    SETSPC  STA SPCNUM
3350 C33E 38                SEC
3360 C33F B009              BCS PRTKEY              !GO PRINT KEYWORD
3370 C341                   !
3380 C341                   !
3390 C341                   !IF IT IS A 'REM' INCLUDE SPACES
3400 C341                   !
3410 C341 C98F      CHKREM  CMP #$8F                !TOKEN FOR 'REM'
3420 C343 D005              BNE PRTKEY
3430 C345 A9FF              LDA #$FF
3440 C347 8D07C0            STA REMFLG              !SET THE REM FLAG
3450 C34A                   !
3460 C34A                   !
3470 C34A                   !PRINT THE KEYWORD AND SPACES
3480 C34A                   !
3490 C34A AD06C0 PRTKEY     LDA COLFLG              !TEST FOR COLON
3500 C34D D005              BNE COLFND              !IGNORE FIRST SPACE
3510 C34F A920              LDA #$20                !SPACE CHARACTER
3520 C351 20AAC4            JSR PRINT
3530 C354 A900    COLFND    LDA #$0
3540 C356 8D06C0            STA COLFLG              !RESET COLON FLAG
3550 C359 68                PLA                     !RECOVER TOKEN
3560 C35A 2051C4            JSR SRTTOK
3570 C35D A920              LDA #$20                !SPACE CHARACTER
3580 C35F 20AAC4            JSR PRINT
3590 C362 38                SEC
3600 C363 B098              BCS LINELP              !REPEAT FOR NEXT BYTE
3610 C365                   !
3620 C365                   !
3630 C365                   !PRINT THE OPERATOR WITH NO SPACES
3640 C365                   !
3650 C365 2051C4 OPRTOR     JSR SRTTOK
3660 C368 38                SEC
3670 C369 B092              BCS LINELP              !REPEAT FOR NEXT BYTE
3680 C36B                   !
3690 C36B                   !
3700 C36B                   !CHARACTER FOUND IS NOT A TOKEN
3710 C36B                   !
3720 C36B 68        NOTTOK  PLA                     !RECOVER CHARACTER
3730 C36C C920              CMP #$20                !IS IT A SPACE?
3740 C36E D00A              BNE NOTSPC
3750 C370 AD07C0            LDA REMFLG              !IS KEYWORD REM?
3760 C373 F088              BEQ LINELP              !IGNORE SPACE IF NOT
3770 C375 A920              LDA #$20                !SPACE CHARACTER
3780 C377 38                SEC
3790 C378 B028              BCS PRTCHR              !GO AND PRINT IT
3800 C37A                   !
3810 C37A                   !
3820 C37A                   !CHECK FOR A OPENING QUOTE
3830 C37A                   !
3840 C37A C922      NOTSPC  CMP #$22                !QUOTE CHARACTER
3850 C37C D00B              BNE TSTCOL
3860 C37E 20AAC4            JSR PRINT
3870 C381 A9FF              LDA #$FF
3880 C383 8D05C0            STA QOTFLG              !SET THE QUOTE FLAG
3890 C386 4CFDC2            JMP LINELP              !REPEAT FOR NEXT BYTE
3900 C389                   !
3910 C389                   !
3920 C389                   !CHECK FOR A COLON (STATEMENT END)
3930 C389                   !
3940 C389 C93A      TSTCOL  CMP #$3A                !COLON CHARACTER
3950 C38B D015              BNE PRTCHR
3960 C38D 20AAC4            JSR PRINT
3970 C390 AD07C0            LDA REMFLG              !IS KEYWORD A REM?
3980 C393 D00A              BNE COLEND
3990 C395 A920              LDA #$20                !SPACE CHARACTER
4000 C397 20AAC4            JSR PRINT
4010 C39A A9FF              LDA #$FF
4020 C39C 8D06C0            STA COLFLG              !SET THE COLON FLAG
4030 C39F 4CFDC2 COLEND     JMP LINELP              !DO NEXT BYTE
4040 C3A2                   !
4050 C3A2                   !
4060 C3A2                   !PRINT AN ORDINARY CHARACTER
4070 C3A2                   !
4080 C3A2 20AAC4 PRTCHR     JSR PRINT
4090 C3A5 4CFDC2            JMP LINELP              !REPEAT FOR NEXT BYTE
4100 C3A8                   !
4110 C3A8                   !
4120 C3A8                   !IN A STRING, CHECK FOR GRAPHICS
4130 C3A8                   !OR CONTROL CHARACTERS
4140 C3A8                   !
4150 C3A8 B1FB    QUOTON    LDA (TXTPTR),Y
4160 C3AA C922              CMP #$22                !QUOTE CHARACTER
4170 C3AC D00B              BNE NOTQOT
4180 C3AE 20AAC4            JSR PRINT
4190 C3B1 A900              LDA #$0
4200 C3B3 8D05C0            STA QOTFLG              !RESET THE QUOTE FLAG
4210 C3B6 4CFDC2            JMP LINELP              !REPEAT FOR NEXT BYTE
4220 C3B9                   !
4230 C3B9                   !
4240 C3B9                   !CHECK FOR A PRINTABLE CHARACTER
4250 C3B9                   !
4260 C3B9 C921    NOTQOT    CMP #$21                !LOW RANGE CHECK
4270 C3BB 900A              BCC CTLCOD
4280 C3BD C980              CMP #$80                !HIGH RANGE CHECK
4290 C3BF B006              BCS CTLCOD
4300 C3C1 20AAC4            JSR PRINT
4310 C3C4 4CFDC2            JMP LINELP              !REPEAT FOR NEXT BYTE
4320 C3C7                   !
4330 C3C7                   !
4340 C3C7                   !POSSIBLE GRAPHICS/CONTROL CHAR
4350 C3C7                   !
4360 C3C7 8D08C0 CTLCOD     STA CTLCHR              !SAVE CHARACTER
4370 C3CA A201              LDX #$01
4380 C3CC                   !
4390 C3CC                   !
4400 C3CC                   !CHECK FOR MORE THAN ONE CHARACTER
4410 C3CC                   !
4420 C3CC C8        NUMLP   INY
4430 C3CD B1FB              LDA (TXTPTR),Y
4440 C3CF CD08C0            CMP CTLCHR              !ARE THEY THE SAME?
4450 C3D2 D003              BNE SCHTAB
4460 C3D4 E8                INX                     !INCREMENT COUNTER
4470 C3D5 D0F5              BNE NUMLP
4480 C3D7 8E0BC0 SCHTAB     STX NUMCHR
4490 C3DA 88                DEY
4500 C3DB 98                TYA
4510 C3DC 48                PHA                     !SAVE TXTPTR INDEX
4520 C3DD                   !
4530 C3DD                   !
4540 C3DD                   !SEARCH CTLTAB FOR THIS CHARACTER
4550 C3DD                   !
4560 C3DD A90E              LDA #<CTLTAB
4570 C3DF 85FD              STA TABPTR
4580 C3E1 A9C1              LDA #>CTLTAB
4590 C3E3 85FE              STA TABPTR+1            !SET UP POINTER
4600 C3E5 A000              LDY #$0                 !ZERO INDEX
4610 C3E7 B1FD    CTLLP     LDA (TABPTR),Y
4620 C3E9 F053              BEQ NOTIN
4630 C3EB CD08C0            CMP CTLCHR              !CHECK CHARACTER
4640 C3EE F00F              BEQ CHRFND
4650 C3F0                   !
4660 C3F0                   !
4670 C3F0                   !FIND THE NEXT TABLE ENTRY
4680 C3F0                   !
4690 C3F0 2037C4 STEPON     JSR INCPTR
4700 C3F3 B1FD              LDA (TABPTR),Y
4710 C3F5 2980              AND #$80                !IS HIGH BIT SET?
4720 C3F7 F0F7              BEQ STEPON
4730 C3F9 2037C4            JSR INCPTR
4740 C3FC 38                SEC
4750 C3FD B0E8              BCS CTLLP               !TRY NEXT ENTRY
4760 C3FF                   !
4770 C3FF                   !
4780 C3FF                   !CHARACTER IS IN THE TABLE
4790 C3FF                   !
4800 C3FF 2037C4 CHRFND     JSR INCPTR
4810 C402 A95B              LDA #'[
4820 C404 20AAC4            JSR PRINT               !PRINT OPEN BRACKET
4830 C407                   !
4840 C407                   !
4850 C407                   !PRINT NUMBER OF CHARACTERS
4860 C407                   !
4870 C407 AD0BC0            LDA NUMCHR
4880 C40A C901              CMP #$01
4890 C40C F00D              BEQ PRTCOD              !IGNORE IF ONLY ONE
4900 C40E 8563              STA FPA1+2              !PUT NUMBER IN FPA1
4910 C410 A900              LDA #$0
4920 C412 8562              STA FPA1+1
4930 C414 20BEC4            JSR CVTNUM
4940 C417 AA                TAX
4950 C418 20BEC4            JSR PRTNUM
4960 C41B                   !
4970 C41B                   !
4980 C41B                   !PRINT THE C.T. CODE FROM CTLTAB
4990 C41B                   !
5000 C41B A000    PRTCOD    LDY #$0
5010 C41D B1FD              LDA (TABPTR),Y
5020 C41F 2037C4            JSR INCPTR
5030 C422 48                PHA                     !SAVE CHARACTER
5040 C423 297F              AND #$7F                !STRIP HIGH BIT
5050 C425 20AAC4            JSR PRINT
5060 C428 68                PLA                     !RECOVER CHARACTER
5070 C429 2980              AND #$80                !IS HIGH BIT SET?
5080 C42B F0EE              BEQ PRTCOD              !REPEAT IF NOT
```

turned ON (−1), the colon is copied across to the output buffer followed by a space and control is then passed back to LINELP. If the byte is none of these special characters then it is simply copied across to the output buffer and control is returned to LINELP.

That completes the case where QOTFLG is OFF (0). Now we can look at the case where QOTFLG is ON (−1).

DEALING WITH CODES

With QOTFLG on (−1) we know that we are inside a quoted string. That means that we must now check for graphic/control and cursor codes. In outline, this is done by checking every character in the string against the table of known graphic/control and cursor codes (CTLTAB). If the character is not in the table then it is copied straight across to the output buffer, otherwise the position of the character in CTLTAB gives the text of the CT standard code that must be substituted. This text is then simply copied into the output buffer instead of the graphic/control or cursor code that was found. So, let's have a look at how this is done in the actual routine.

This part of the routine starts at the label QUOTON where we 'read' the next character in the string and check to see if it is a closing quote. If it is then QOTFLG is turned OFF (0), the quote character is copied across to the output buffer and contol is passed back to LINELP. If the current character is not a quote the control passes to the label NOTQOT.

This block of code checks to see if the current character is a printable character from the ASCII character set. (It does this by simply checking it for the range $20 to $7F, which is the range of printable codes from the ASCII character set). If the character is printable then it is copied across to the output buffer and control is returned to LINELP. If it is not printable (ie outside this range) then it may be a graphic/control or cursor code, in which case control passes to the label CTLCOD.

These two blocks of code (CTLCOD and NUMLP) scan forward in the string to see if there is more than one of this particular graphic/control or cursor code, in which case they are counted and stored in NUMCHR. The block of code immediately following NUMLP searches CTLTAB for the current character. Searching continues until, either the character is found, in which case control passes to the label CHRFND, or the end of CTLTAB is reached (indicated by a null), in which case control passes to the label NOTIN.

The short block of code at the label STEPON steps the CTLTAB pointer (TABPTR) on to the start of the next entry. (Each entry is terminated by arranging that the last character has its high bit set).

The block of code starting at the label CHRFND copies the text of the CT standard code (delimiting by square brackets) across to the output buffer. This is done by repeatedly copying characters from CTLTAB until the last one (with its high bit set (is detected. In addition, if there is more than one occurrence of this character then the number is also printed (using the same technique that we used for printing the line number). After this has been completed control is returned to the label LINELP.

If control has passed to NOTIN (ie the current character is not in CTLTAB) then the character (or characters, if there was more than one) is copied across to the output buffer and control returned to LINELP.

The rest of the line is scanned, in the manner described above, until the null at the end of the line is detected. When this happens the second stage opf the routine begins (the output formatting).

FORMATTING THE OUTPUT

The output must be formatted such that each line is a maximum of WIDTH characters long and that each end of line occurs at a space character (or between square brackets for CT graphic/control and cursor codes).

In outline this is done as follows:

- A pointer is set at WIDTH characters from the start of the output buffer.
- If this character is $0D or $00 then we are at, or past, the end of the line and no further action is needed.
- If this character is a space then we are at a suitable place for a carriage return. Otherwise the pointer is reduced until a space character is found. (The pointer is only reduced a maximum of WORD characters, where WORD is the maximum length of a word allowded. If the pointer has been reduced this far without a space being found then COTEL assumes that this is not a string of words but a string of unrelated characters. In this case the carriage return is inserted at WIDTH characters from the buffer start).
- As well as inserting a carriage return the appropriate number of spaces must be inserted to keep the program text in line (ie Line number justification and FOR/NEXT indentation spaces).
- This process is repeated, starting from each new carriage return character, until the whole line has been reformatted.

The output formatting process begins at the label PRTOUT (control passes here as soon as the null at the end of the line is encountered). The first thing that happens is that a carriage return is written at the end of the line in the buffer.

The next block of code at the label LINEND checks to see if the pointer (LINLEN) is at the end of the line or past it (by testing for the $0D or $00 characters). If it is at or past the end of the line then no further formatting is needed and the buffer can be printed (by the routine at the label OUTPUT).

Otherwise the block of code at the label SPCLP2 scans backwards looking for a space or open square bracket character. SPCLP2 only 'looks back' a maximum of WORD characters and, if no space or bracket character is found, it uses the maximum line width (in LINLEN).

If a space character is found then a six-character gap must be opened (to insert a carriage return plus five spaces). If an open square bracket is found then a seven-character gap must be opened (to insert a carriage return plus six spaces).

The next block of code, at the label MOVBYT, adds in any extra spaces needed for the FOR/NEXT indentation and stores the total in CTLCHR.

The block of code immediately following MOVBYT counts the number of characters remaining to the end of the line (this is the number of characters that must be moved to open up the gap).

The block of code at MOVELP actually opens up the gap by moving the remainder of the line up by CTLCHR number of places. The carriage return character and the appropriate number of spaces are then written into the gap.

Finally, the pointer LINLEN is updated to point to the ideal position for the next carriage return character (if needed) and control is passed back to LINEND.

This process is repeated until the whole line has been formatted. When this has been done control is passed to the label OUTPUT which simply dumps the whole buffer to the serial printer. When this has been done control is returned to MAINLP, via the RTS instruction, and the next line of the BASIC program is scanned.

I chose this method of setting the output format because it is both easy to understand and easy to modify for different machines. However, it does have one major disadvantage on the Commodore 64 (and also on other MOS 6502-based machines) in that the output buffer is only 256 characters wide. With this size of buffer it is possible that very long program lines with many graphics/control and cursor codes could be expanded such that they overflow the maximum buffer size. This will result in 'garbage' being printed (although no damage will be done to either the BASIC program or to the COTEL routine itself). The simple solution to this problem is either to split the offending line into two separate ones that won't overflow the buffer, or to increase the printer line width (thus reducing the number of 'gaps' that need to be opened up for carriage return characters).

```
5090 C42D A95D            LDA #']
5100 C42F 20AAC4          JSR PRINT                 !PRINT CLOSE BRACKET
5110 C432 68              PLA                       !RECOVER TXTPTR INDEX
5120 C433 A8              TAY
5130 C434 4CFDC2          JMP LINELP                !REPEAT FOR NEXT BYTE
5140 C437       !
5150 C437       !
5160 C437       !INCREMENT TABPTR
5170 C437       !
5180 C437 E6FD  INCPTR    INC TABPTR
5190 C439 D002            BNE INCEND
5200 C43B E6FE            INC TABPTR+1
5210 C43D 60    INCEND    RTS
5220 C43E       !
5230 C43E       !
5240 C43E       !CHARACTER IS NOT IN THE TABLE
5250 C43E       !
5260 C43E AE0BC0 NOTIN    LDX NUMCHR
5270 C441 AD08C0          LDA CTLCHR                !GET THE CHARACTER
5280 C444 48    NILOOP    PHA
5290 C445 20AAC4          JSR PRINT
5300 C448 68              PLA
5310 C449 CA              DEX
5320 C44A D0F8            BNE NILOOP
5330 C44C 68              PLA                       !RECOVER TXTPTR INDEX
5340 C44D A8              TAY
5350 C44E 4CFDC2          JMP LINELP                !REPEAT FOR NEXT BYTE
5360 C451       !
5370 C451       !
5380 C451       !EXPAND AND PRINT A BASIC TOKEN
5390 C451       !
5400 C451 AA    SRTTOK    TAX
5410 C452 98              TYA
5420 C453 48              PHA                       !SAVE TXTPTR INDEX
5430 C454 8A              TXA
5440 C455       !
5450 C455       !
5460 C455       !IF IT IS PI THEN PRINT 'PI'
5470 C455       !
5480 C455 C9FF            CMP #$FF                  !TOKEN FOR PI
5490 C457 D00D            BNE NOTPI
5500 C459 A950            LDA #'P
5510 C45B 20AAC4          JSR PRINT
5520 C45E A949            LDA #'I
5530 C460 20AAC4          JSR PRINT
5540 C463 68              PLA                       !RECOVER TXTPTR INDEX
5550 C464 A8              TAY
5560 C465 60              RTS                       !RETURN TO CALLER
5570 C466       !
5580 C466       !
5590 C466       !NOT PI SO SEARCH RESERVED WORDS
5600 C466       !
5610 C466 38    NOTPI     SEC                       !FORM A POINTER INTO
5620 C467 E97F            SBC #$7F                  !RESERVED WORDS LIST
5630 C469 AA              TAX
5640 C46A CA              DEX
5650 C46B       !
5660 C46B       !
5670 C46B       !FIND THE APPROPRIATE KEYWORD
5680 C46B       !
5690 C46B A000            LDY #$0
5700 C46D 2085C4 KWDLP1   JSR SCNWRD
5710 C470 CA              DEX                       !COUNT UP 'X' KEYWORDS
5720 C471 D0FA            BNE KWDLP1
5730 C473       !
5740 C473       !
5750 C473       !PRINT THE REQUIRED KEYWORD
5760 C473       !
5770 C473 B99EA0 KWDLP2   LDA RESWDS,Y
5780 C476 C8              INY
5790 C477 48              PHA                       !SAVE KEYWORD CHARACTER
5800 C485       !
5890 C485       !
5900 C485       !FIND THE NEXT RESERVED WORDS
5910 C485       !TABLE ENTRY
5920 C485       !
5930 C485 B99EA0 SCNWRD   LDA RESWDS,Y
5940 C488 C8              INY
5950 C489 2980            AND #$80                  !IS HIGH BIT SET?
5960 C48B F0F8            BEQ SCNWRD                !REPEAT UNTIL IT IS
5970 C48D 60              RTS                       !RETURN TO CALLER
5980 C48E       !
5990 C48E       !
6000 C48E       !CONVERT A NUMBER IN FPA1 INTO
6010 C48E       !PRINTABLE CHARACTERS
6020 C48E       !
6030 C48E A230  CVTNUM    LDX #$30
6040 C490 38              SEC
6050 C491 2049BC          JSR PADOUT                !
6060 C494 20DFBD          JSR CVTSTG                !EXISTING BASIC
6070 C497 2087B4          JSR GETSTG                !ROM ROUTINES
6080 C49A 20A6B6          JSR DALSTG                !
6090 C49D 60              RTS                       !RETURN TO CALLER
6100 C49E       !
6110 C49E       !
6120 C49E       !PRINT A NUMBER (FROM CVTSTG)
6130 C49E       !
6140 C49E A000  PRTNUM    LDY #$0
6150 C4A0 B122  CPYLP     LDA ($22),Y
6160 C4A2 20AAC4          JSR PRINT
6170 C4A5 C8              INY
6180 C4A6 CA              DEX
6190 C4A7 D0F7            BNE CPYLP
6200 C4A9 60              RTS                       !RETURN TO CALLER
6210 C4AA       !
6220 C4AA       !
6230 C4AA       !STORE A BYTE IN THE PRINT BUFFER
6240 C4AA       !
6250 C4AA 8D08C0 PRINT    STA CTLCHR                !SAVE THE BYTE
6260 C4AD 98              TYA
6270 C4AE 48              PHA                       !SAVE TXTPTR INDEX
6280 C4AF AC09C0          LDY BUFPTR                !GET BUFFER INDEX
6290 C4B2 EE09C0          INC BUFPTR                !INCREMENT IT
6300 C4B5 AD08C0          LDA CTLCHR                !GET THE BYTE
6310 C4B8 990EC0          STA BUFFER,Y              !PUT IT IN
6320 C4BB 68              PLA                       !RECOVER TXTPTR INDEX
6330 C4BC A8              TAY
6340 C4BD 60              RTS                       !RETURN TO CALLER
6350 C4BE       !
6360 C4BE       !
6370 C4BE       !LINE FINISHED, SO PRINT BUFFER
6380 C4BE       !
6390 C4BE AC09C0 PRTOUT   LDY BUFPTR                !GET INDEX
6400 C4C1 A90D            LDA #$0D                  !CARRIAGE RETURN
6410 C4C3 990EC0          STA BUFFER,Y
6420 C4C6 AD0DC0          LDA WIDTH
6430 C4C9 8D0AC0          STA LINLEN                !SET UP LINE LENGTH
6440 C4CC       !
6450 C4CC       !
6460 C4CC       !FIRST SORT OUT THE LINE BREAKS
6470 C4CC       !
6480 C4CC A20F  LINEND    LDX #WORD
6490 C4CE AC0AC0          LDY LINLEN
6500 C4D1 B90FC0 SPCLP1   LDA BUFFER+1,Y
6510 C4D4 F004            BEQ PRTBUF
6520 C4D6 C90D            CMP #$0D                  !AT END OF LINE?
6530 C4D8 D003            BNE SPCLP2
6540 C4DA 4C5AC5 PRTBUF   JMP OUTPUT
6550 C4DD       !
6560 C4DD       !
6570 C4DD       !LOOK BACK FOR A SPACE CHARACTER
6580 C4DD       !
6590 C4DD B90EC0 SPCLP2   LDA BUFFER,Y
6600 C4E0 C920            CMP #$20                  !SPACE CHARACTER
6610 C4E2 F010            BEQ SPCFND
6620 C4E4 C95B            CMP #'[                   !OPEN BRACKET
6630 C4E6 F008            BEQ BRKFND
6640 C4E8 88              DEY                       !DECREMENT INDEX
6650 C4E9 CA              DEX                       !DECREMENT WORD COUNT
6660 C4EA D0F1            BNE SPCLP2
6670 C4EC       !
6680 C4EC       !
6690 C4EC       !NO SPACE FOUND AFTER 'WORD' BYTES
6700 C4EC       !
6710 C4EC AC0AC0          LDY LINLEN                !USE MAX LINE LENGTH
6720 C4EF C8              INY
6730 C4F0       !
6740 C4F0       !
6750 C4F0       !OPEN BRACKET CHARACTER FOUND
6760 C4F0       !
6770 C4F0 A207  BRKFND    LDX #$07                  !MOVE 7 BYTES
6780 C4F2 D002            BNE MOVBYT
6790 C4F4       !
6800 C4F4       !
6810 C4F4       !SPACE CHARACTER FOUND
6820 C4F4       !
6830 C4F4 A206  SPCFND    LDX #$06                  !MOVE 6 BYTES
6840 C4F6       !
6850 C4F6       !
6860 C4F6       !CALCULATE GAP SIZE
6870 C4F6       !
6880 C4F6 18    MOVBYT    CLC
6890 C4F7 AD0CC0          LDA SPCNUM                !INDENT VALUE
6900 C4FA 690E            ADC #<BUFFER              !PLUS BUFFER ADDRESS
6910 C4FC 85FD            STA BUFOFF
6920 C4FE A900            LDA #$0
6930 C500 69C0            ADC #>BUFFER              !ADD IN ANY CARRY
6940 C502 85FE            STA BUFOFF+1
6950 C504 18              CLC
6960 C505 8A              TXA
6970 C506 65FD            ADC BUFOFF                !ADD IN SPACES FOR
6980 C508 85FD            STA BUFOFF                !LINE NUMBER FIELD
6990 C50A A900            LDA #$0
7000 C50C 65FE            ADC BUFOFF+1              !ADD IN ANY CARRY
7010 C50E 85FE            STA BUFOFF+1
7020 C510 8C08C0          STY CTLCHR                !SAVE INDEX
7030 C513       !
7040 C513       !
7050 C513       !FIND END OF LINE IN BUFFER
7060 C513       !
7070 C513 A201            LDX #$01
7080 C515 C8              INY
7090 C516 B90EC0 LCLOOP   LDA BUFFER,Y              !SCAN ALONG
7100 C519 C90D            CMP #$0D                  !FOR END OF LINE
7110 C51B F005            BEQ ENDFND
7120 C51D C8              INY                       !INCREMENT INDEX
7130 C51E E8              INX                       !INCREMENT COUNTER
7140 C51F 38              SEC
7150 C520 B0F4            BCS LCLOOP
7160 C522 8A    ENDFND    TXA
7170 C523 18              CLC                       !FORM A POINTER TO
7180 C524 6D08C0          ADC CTLCHR                !THE END OF LINE
7190 C527 A8              TAY
7200 C528 E8              INX
7210 C529       !
7220 C529       !
7230 C529       !OPEN UP A GAP
7240 C529       !
7250 C529 B90EC0 MOVELP   LDA BUFFER,Y              !MOVE REST OF
7260 C52C 91FD            STA (BUFOFF),Y            !LINE UP
7270 C52E 88              DEY                       !DECREMENT INDEX
7280 C52F CA              DEX                       !DECREMENT COUNTER
7290 C530 D0F7            BNE MOVELP
7300 C532       !
7310 C532       !
7320 C532       !PUT C/R AND SPACES IN BUFFER
7330 C532       !
7340 C532 AC08C0          LDY CTLCHR                !GET INDEX
7350 C535 A90D            LDA #$0D                  !CARRIAGE RETURN
7360 C537 990EC0          STA BUFFER,Y
7370 C53A C8              INY
7380 C53B 18              CLC
7390 C53C AD0CC0          LDA SPCNUM                !CALCULATE NUMBER OF
7400 C53F 6906            ADC #$06                  !SPACES TO INSERT
7410 C541 AA              TAX
7420 C542 A920            LDA #$20                  !SPACE CHARACTER
7430 C544 990EC0 FILLP    STA BUFFER,Y
7440 C547 C8              INY                       !INCREMENT INDEX
7450 C548 CA              DEX                       !DECREMENT COUNTER
7460 C549 D0F9            BNE FILLP
7470 C54B       !
7480 C54B       !
7490 C54B       !UPDATE LINLEN FOR NEXT LINE
7500 C54B       !
7510 C54B 98              TYA
7520 C54C 38              SEC
7530 C54D ED0CC0          SBC SPCNUM                !SUBTRACT INDENT
7540 C550 18              CLC
7550 C551 6D0DC0          ADC WIDTH                 !ADD WIDTH TO INDEX
7560 C554 8D0AC0          STA LINLEN
7570 C557 4CCCC4          JMP LINEND                !REPEAT FOR NEXT LINE
7580 C55A       !
7590 C55A       !
7600 C55A       !PRINTER ROUTINE (CENTRONICS)
7610 C55A       !FIRST INITIALISE THE USER PORT
7620 C55A       !
7630 C55A A200  OUTPUT    LDX #$00                  !INITIALISE THE
7640 C55C 86FD            STX BUSY                  !PRINTER PORT AND FLAGS
7650 C55E 8E01DD          STX PORT
7660 C561 AD00DD          LDA PA2
7670 C564 0904            ORA #$04                  !SET PA2 HIGH
7680 C566 8D00DD          STA PA2
7690 C569 A2FF            LDX #$FF                  !SET PORT B DDR TO
7700 C56B 8E03DD          STX DDR                   !ALL OUTPUTS
7710 C56E AD02DD          LDA PA2DDR                !SET PORT A DDR TO
7720 C571 0904            ORA #$04                  !BIT 2 INPUT
7730 C573 8D02DD          STA PA2DDR
7740 C576 A000            LDY #$00                  !INITIALISE INDEX
7750 C578       !
7760 C578       !
7770 C578       !NOW OUTPUT THE CHARACTER
7780 C578       !
7790 C578 B90EC0 OUTLP    LDA BUFFER,Y              !GET NEXT CHAR
7800 C57B F020            BEQ OUTEND
7810 C57D 8D01DD          STA PORT                  !SEND IT TO PRINTER
7820 C580 AD00DD          LDA PA2                   !MAKE DATA READY
7830 C583 29FB            AND #$FB                  !LOW (PA2)
7840 C585 8D00DD          STA PA2
7850 C588 A202            LDX #$02                  !WAIT LOOP
7860 C58A CA      DELYLP  DEX
7870 C58B D0FD            BNE DELYLP
7880 C58D 0904            ORA #$04                  !RESTORE DATA READY
7890 C58F 8D00DD          STA PA2                   !HIGH AGAIN (PA2)
7900 C592 AD00DD FLAGLP   LDA FLAG                  !WAIT FOR ACK
7910 C595 2910            AND #$10                  !FROM PRINTER
7920 C597 F0F9            BEQ FLAGLP
7930 C599 C8              INY                       !INCREMENT INDEX
7940 C59A 38              SEC
7950 C59B B0DB            BCS OUTLP
7960 C59D 60      OUTEND  RTS
```

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LUCAS MICRO

LUCAS LX

CPU	Z80
MEMORY	64K RAM
LANGUAGE	Microsoft BASIC
MASS STORAGE	Cassette at 300 or 1200 baud Single or twin 5¼" floppy disc drives
OS	CP/M 2.2 (supplied) or NAS-DOS
KEYBOARD	QWERTY, cursor, numeric pad, function keys
INTERFACES	RS-232C, Centronics, interface for 5 Mb Winchester, control bus (see below)
DISPLAY	Monochrome monitor supplied, colour optional
GRAPHICS	80 by 25 text, with user-defined block graphics 392 by 256 eight-colour or 784 by 256 two-colour high-resolution graphics
SOUND	No

Notes. The Lucas LX is a computer which is aimed at the more professional and business users.

SHARP MICRO

SHARP MZ-3541

CPU	Z80A (two), 80C49
MEMORY	128K RAM, 8K ROM
LANGUAGE	Sharp BASIC
MASS STORAGE	Twin integral 5¼" floppy disk drives, total capacity 1.28 Mb
KEYBOARD	QWERTY, cursor, numeric pad, function keys
INTERFACES	RS-232C, Centronics, interface for extra external floppy disks
DISPLAY	Monochrome monitor, colour optional
GRAPHICS	80 by 25 text, 640 by 400 high-resolution graphics
SOUND	Single channel

Notes. The Sharp MZ-3541 is aimed at the businessman. RAM is expandable to 256K, while two disk drives may be added externally to complement the integral pair. Colour is only possible with the optional graphics expansion RAM. One Z80 handles the main CPU activities while the other handles peripheral activities. The third processor handles the keyboard. The availability of CP/M means a ready supply of business software.

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COMMODORE 715B

CPU	6509
MEMORY	56K RAM, 20K ROM
LANGUAGE	Commodore BASIC
MASS STORAGE	No cassette Single or dual 5¼" floppy disk drives
OS	Commodore's DOS
KEYBOARD	QWERTY, cursor, numeric pad, function keys
INTERFACES	RS-232C, IEEE 488, memory bus, eight-bit parallel, cassette port, second processor bus
DISPLAY	Monochrome monitor supplied
GRAPHICS	80 by 25 text, block graphics
SOUND	Three channels

Notes. The Commodore 715B is the top model in the 700 range of business machines. Although built round the 6509 processor, there is a second processor option (8088). The machine has been designed to meet IEC specifications. The black-and-white monitor screen is integral and features tilt and swivel. The keyboard may be detached.

COMMODORE 64

CPU	6510
MEMORY	64K RAM, 26K ROM
LANGUAGE	Commodore BASIC
MASS STORAGE	Cassette unit at 300 baud 5¼" floppy discs available
OS	Commodore's own
KEYBOARD	QWERTY, cursor, function keys
INTERFACES	IEEE 488 bus, cartridge port, cassette port, two joystick/light pen ports
DISPLAY	TV output
GRAPHICS	40 by 25 text, block graphics (user-definable) 320 by 200 high resolution graphics in 16 colours
SOUND	Three channels

Notes. The Commodore 64 is a popular micro with a great deal of games software available. There is also some business software, such as spreadsheets and word processors, available but this suffers from the lack of an 80-column screen. Graphics and sound have extensive capabilities, for example eight multicolour sprites and three channels of sound covering nine octaves each.

ACT MICRODEALER

xi APRICOT

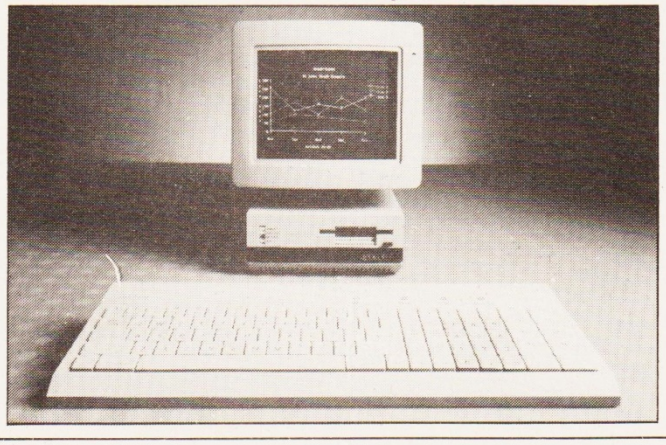
CPU	8086
MEMORY	256K RAM
LANGUAGES	Microsoft BASIC, Personal BASIC
MASS STORAGE	No cassette drive Integral Sony 3½" 315K microfloppy disk drive Integral 5 or 10 Mb hard disk
OS	MS-DOS 2.11 with GSX bundled CP/M-86 (not yet available) Concurrent CP/M-86 (not yet available)
KEYBOARD	QWERTY, cursor, numeric pad, function keys
INTERFACES	RS-232C, Centronics, Microsoft mouse
DISPLAY	Monitor (supplied)
GRAPHICS	80 by 24 text with block graphics 800 by 400 high-res graphics under GSX
SOUND	No

Notes. The Apricot xi is a development of the award-winning Apricot, and replaces one of the latter's disk drives with an integral hard disk, providing vastly increased storage with faster access. Memory may be expanded in 128K increments to a maximum of 768K. The languages and operating systems mentioned above come bundled (except for Concurrent CP/M) and four software tools are also bundled, including an asynchronous package for use with the optional modem card.

APRICOT F1

CPU	8086
MEMORY	256K RAM
LANGUAGES	MS-DOS, Concurrent DOS (Optional)
MASS STORAGE	No cassette drive One integral 3½" 720K Sony microfloppy disk drive
OS	MS-DOS 2.11, Concurrent DOS (optional)
KEYBOARD	QWERTY, cursor, numeric pad
INTERFACES	Infra-red link for keyboard or mouse, expansion slot, RS-232C, Centronics
DISPLAY	TV or optional monitor
GRAPHICS	80 by 24 text 640 by 256 four-colour, 320 by 256 16-colour maximum high resolution
SOUND	No

Notes. The Apricot F1 is designed as a low-cost entry-level machine for small businesses (a cheaper cut-down version, the F1e, is for schools and colleges). It includes several bundled applications including SuperCalc, SuperWriter and SuperPlanner. An optional five-slot expansion bus may be added: also a 10 Mb Winchester unit. There is an optional infra-red mouse/trackball. RAM is expandable to 768K.



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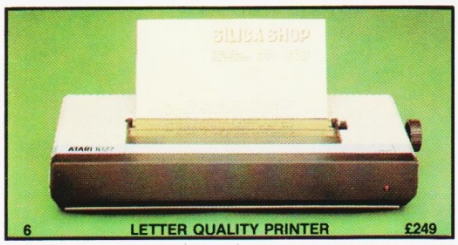

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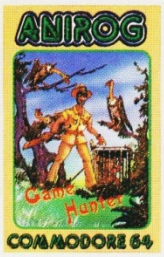

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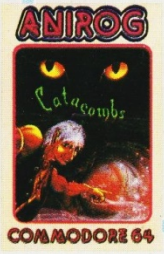

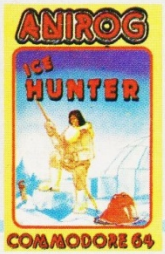

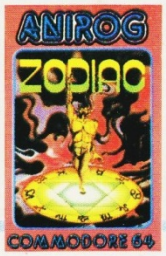

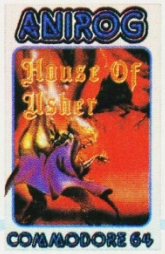

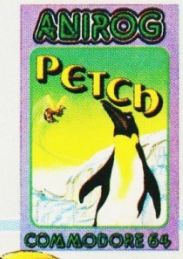

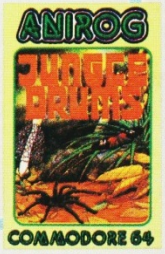

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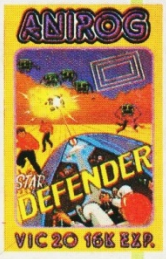

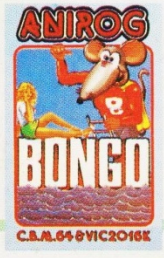

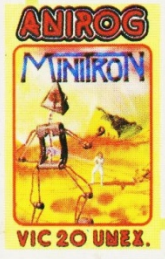

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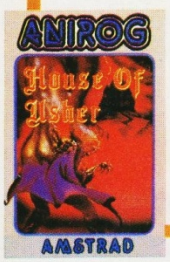

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