80p

Practical Computing

BBC micro -first full review

January 1982

Volume 5 Issue 1

DNA: machine code in Eden

Reviews:

BBC micro

Vic-20 v. Atom

Database software

Pet as a terminal

Patience game

Apple graphics

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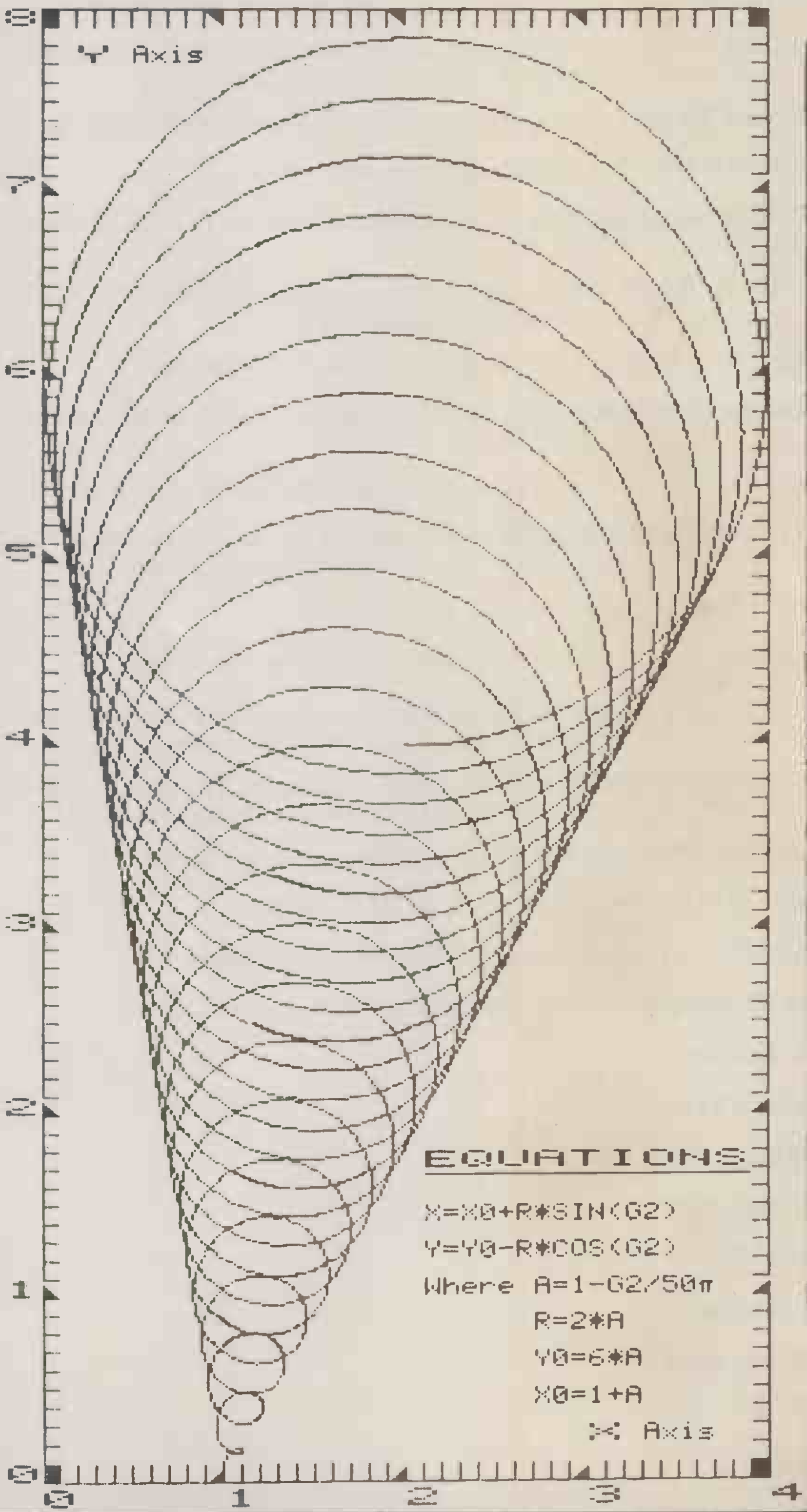

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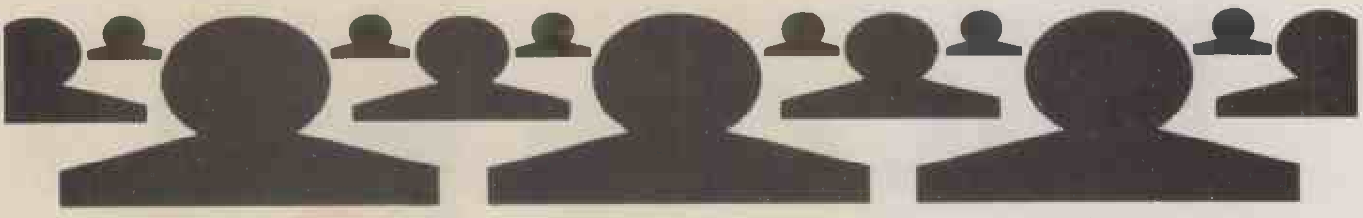

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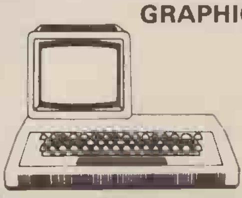

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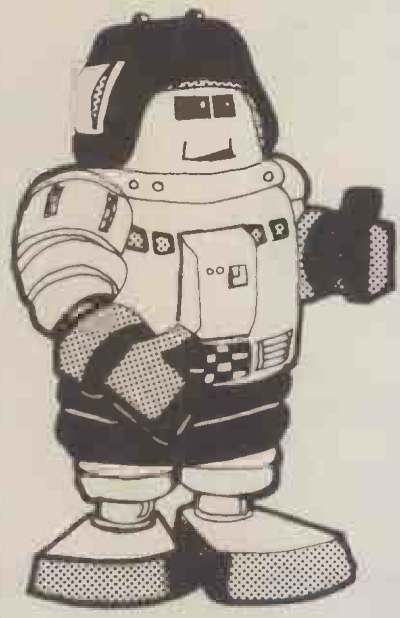

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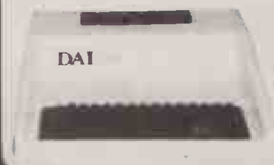

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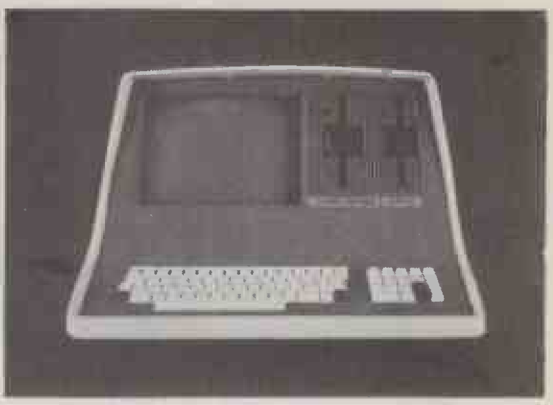

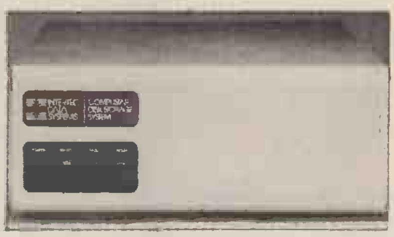

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Print reports	Sort files	Edit records

Within hours perform all the above in French or German. The list is as endless as that which meets the requirements of your own imagination.

Within the appropriate frames of reference you could ask questions like the following:

Find someone whose name begins with W, who is either in London or Birmingham, and available for work at a salary of less than 10,000,00; and is under 40 years of age, not married, of credit worthiness grade 1, with a car, prepared to travel, and who likes horses, does not mind the hours he works, is congenial and has good references. When you find such persons produce a printed list of them showing their names, telephone numbers, and what their salaries are as well as their salary if increased by 10% and show their availability for work. At the end of the list enumerate the total of such persons.

Find all stock items that are codes **micro-computers** that are either in warehouse 1 or warehouse 2, where the quantity on hand is more than 50 units, the cost is less than 1000.00, the selling price higher than 2000.00; that are not in cartons, bought from supplier 52, allocated more than 20, rated for tax at .15% and weigh less than 50 lbs. When you find such categories than print a report showing the description, cost price, quantity on hand, lead time for refills, what the selling price **should be if raised by 12.3%** as well as the profit in either percent of round figures of that projected selling price.

Find all patients who suffered from cold, that are either girls or women younger than 23 years old, and who live in London at a socio-economic grade higher than 3; do not smoke; have more than 3 children, are currently at work and where treatment failed to effect a cure in under 6 days. When you find such persons then print a list showing their age, marital status, income, and frequency of illness in the past 2 years.

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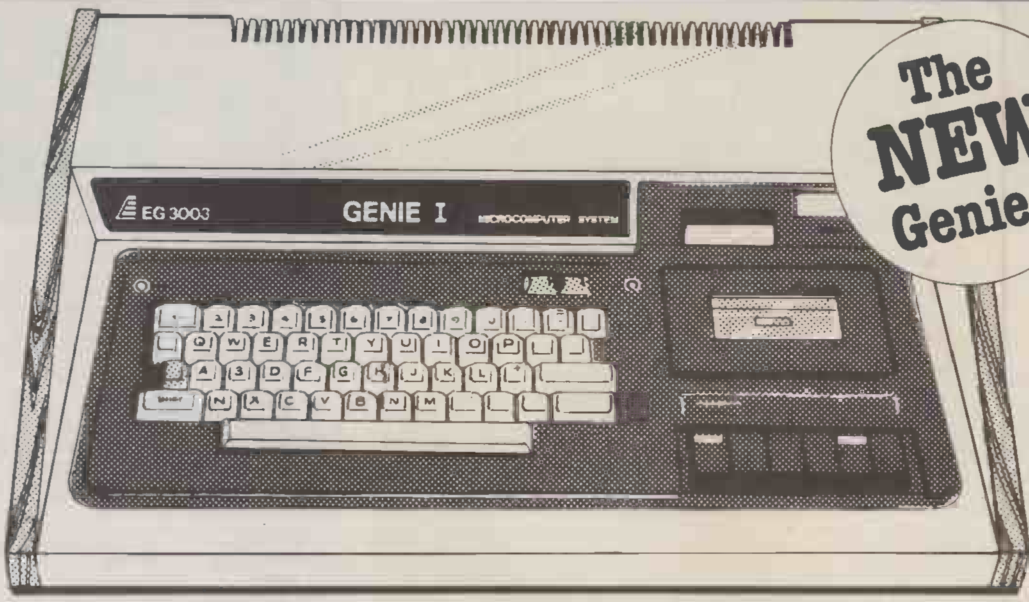

The NEW Genie I

ingenious!

... that's the only word to really describe the superb Genie microcomputer system, the home computer which is compatible with the TRS 80, and ideal for all micro – enthusiasts, especially the committed hobbyist.

Genie has now been upgraded to Genie I, incorporating all of the original, excellent features, but with the addition of:

- Extended BASIC, including RENUMBER and SCREEN PRINT.
- Full upper and lower case, flashing cursor and auto-repeat on all keys.
- An internal SOUND UNIT, to add a new dimension to your own programs.
- A MACHINE LANGUAGE MONITOR, with Display, modify, enter and execute (with break points) facilities.

Genie I has all of this, plus the built-in cassette deck, 16K RAM, 12K ROM with BASIC interpreter, full-size keyboard, an extremely wide range of new and up-dated peripherals, and literally 1000's of pre-recorded programmes available.

Yet, almost unbelievably, the price of Genie I is even lower than that of the original Genie!

Ingenious for business

The Genie II is a major breakthrough for small business computers. Harnessing all the advantages of Genie I, including low price, Genie II adapts perfectly to commercial functions with the following features:

- Numeric keyboard
- Four usable, definable function keys
- Extension to BASIC
- Basic business commands
- Fully expandable with the same periperals

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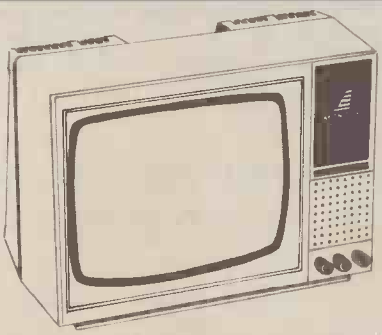
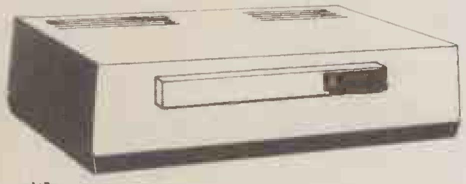


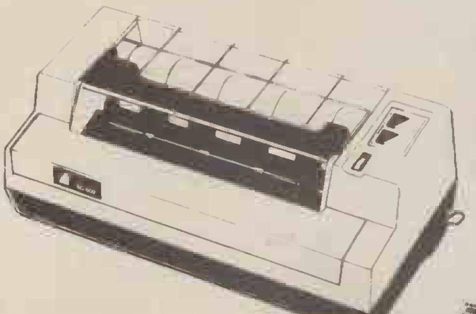
New . . . 12″ Monitor.

There is now a choice of 2, 12″ monitors with the Genie I system, allowing a clear, easy to read image, and no interference with your domestic T.V. viewing. The new EG 101 comes with an updated, green phospher tube.



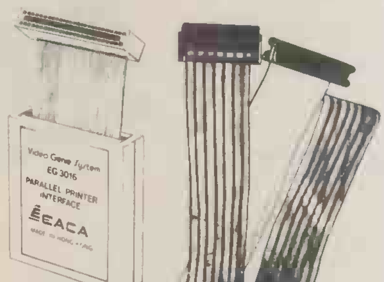
New! . . . Expander Box.

An updated Expansion Box (EG 3014) is a major feature of the new Genie I system, and unleashes all its possibilities, allowing for up to 4 disk drives with optional double density. It connects to a printer, or RS232 interface or S100 cards. There is 16k RAM fitted and it has a new low price!



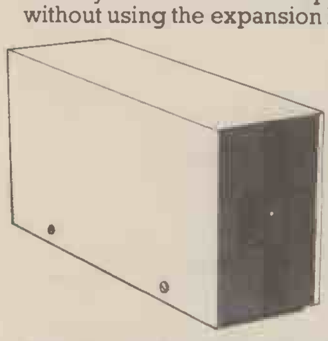
New! . . . Printer

The EG 602 printer can be connected to the Genie either through the expander, or directly into the computer using the Parallel printer interface. It is a compact unit, with an 80 column, 5 x 7 matrix print-out, operating quietly and efficiently at 30 characters per second.



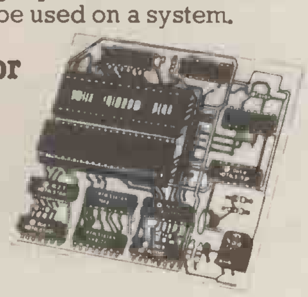
New! . . . Parallel Printer Interface.

Enables you to connect the printer directly into the Genie computer without using the expansion box.



Disk Drive.

As well as the obvious advantage of mass storage, the addition of the disk system to the Genie means much faster access to other languages and full random access file handling. Up to 4 of these 40 track drives can be used on a system.



New! . . . Double Density Adaptor

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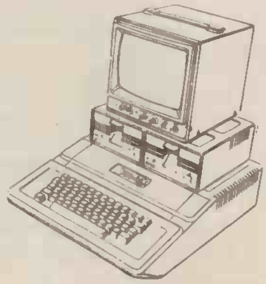

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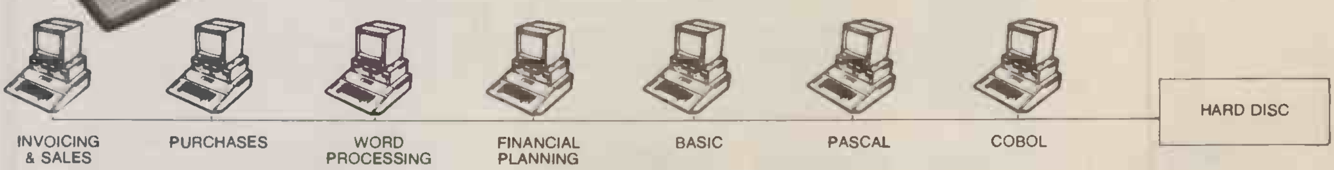

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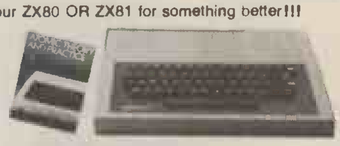

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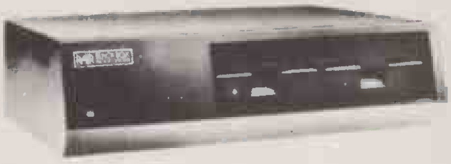

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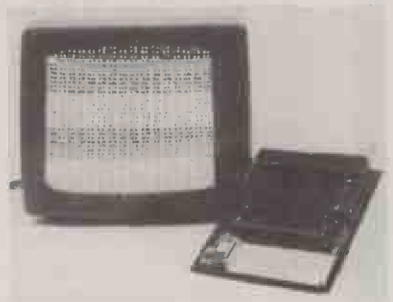

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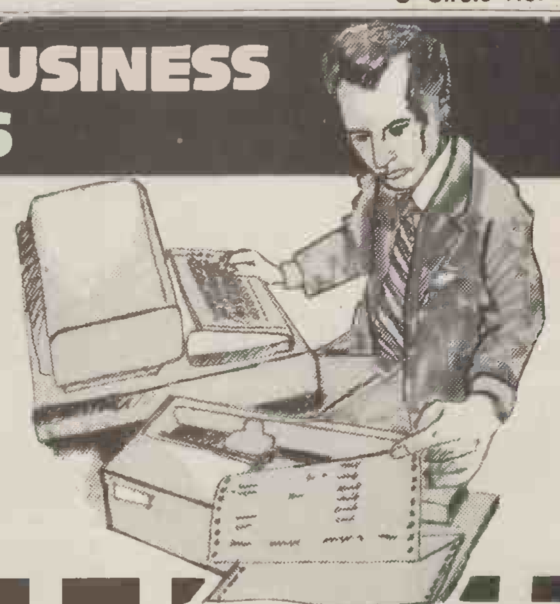

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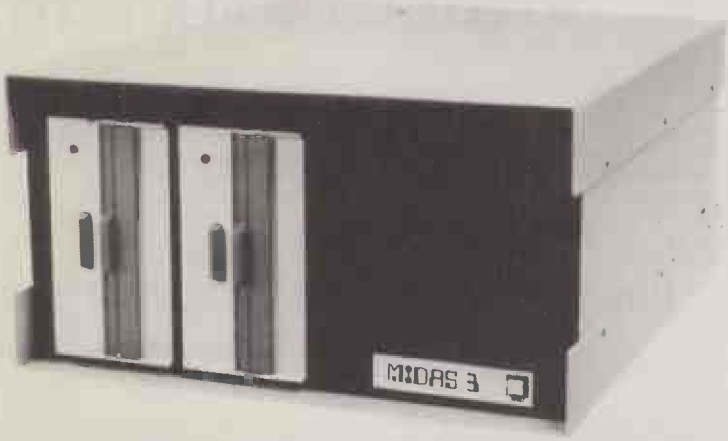

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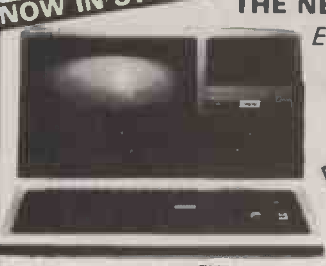

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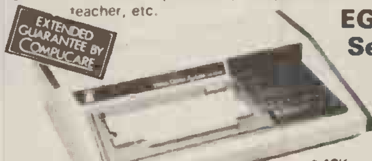

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LEARN this word for future reference, with just one keystroke.
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is finished. The word in error e.g. *
________________________________________________________________
WORD IN ERROR:    misstake
CONTINUATION :     is shown in context, including continuation

PRESS:    R) REPLACE WORD    S) LEAVE AS IS    L) LEARN WORD
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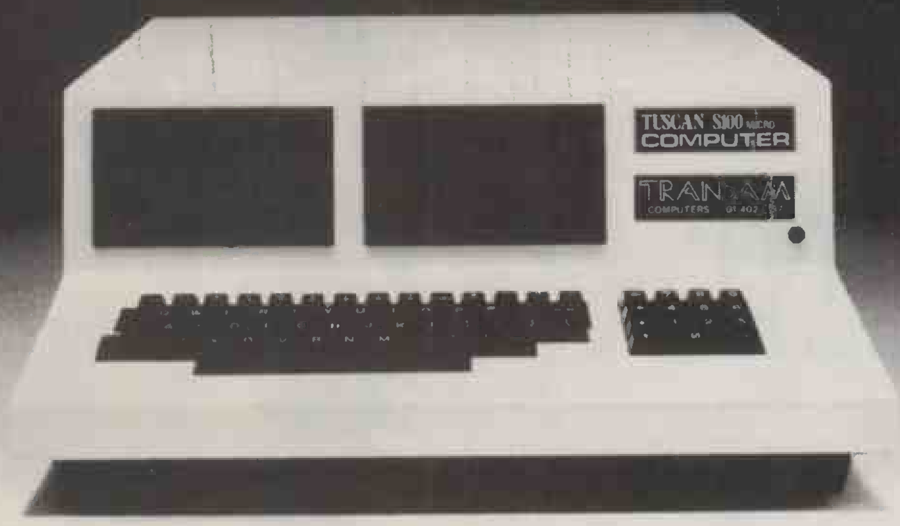

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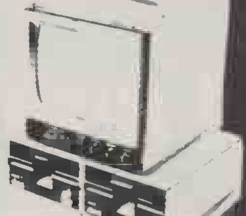

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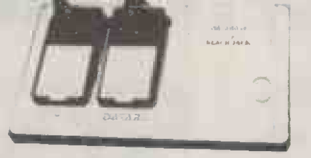

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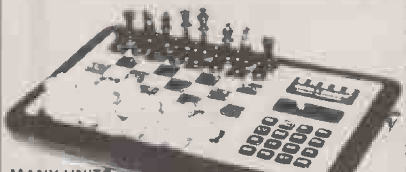

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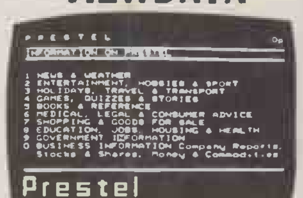

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How they would have stared!

AS BRITISH RAIL'S new express trains hurtle across country, quite as frightening now as aircraft or cars, it is a favourite pastime of your travelling correspondent to imagine a conversation with some intelligent historical personage.

Very often it is Casanova, a gentleman who had far wider interests than he normally gets the credit for. He was, in his day, a scientist, fraudsman, entrepreneur and man of letters. I suppose him translated into the 20th century and sitting beside me in his 18th-century finery. He wears the finest Mechlin lace, an elegant sprigged waistcoat and a most handsome velvet frock coat with elaborate embroidery in gold wire. His sword — to which he is not quite entitled, having bestowed upon himself the rank of gentleman — is a most elegant whisp of Bayonne steel. His shoes have solid gold buckles with rather too many diamonds. All in all, perhaps, he is a little overpowering for the second-class buffet car — sorry, tea's off, lunch is off, we are closing in ten minutes, thank you Sir.

But the deficiencies of British Rail's high-speed catering are the least of his problems. When he first materialised he looked round, and then shut his eyes tight. His body went rigid with alarm. He stayed still for a moment, and then opened his eyes a little. He looked around the inside of the car, blinking and wincing. But then his gaze strayed to the window, and he saw the countryside shooting past at 120 miles an hour. It was as though a wire connected a passing tree to his eye: he lurched sideways in his seat and threw his legs out convulsively: he behaved, in short, like a man thrown off a cliff.

He had never seen anything move faster than a galloping horse. His nervous system was quite unprepared for what everyone else in the buffet car took for granted.

Some time later, when the poor fellow had been revived and had become used to the immediate sights and sounds of his new surroundings, and I had flattered his vanity by explaining how, 200 years after his death, when many of his famous contemporaries had sunk into oblivion, his name was still a household word, he begged me to explain to him some of the features of the passing scene.

The cows, he observed, were far bigger than in his day. The hedges were worse kept. Why were there no peasants in the fields? Was it a Saint's day? The sight of a big lorry speeding towards us, down a road that crossed the railway, gave him another moment of alarm: he evidently had not anticipated the bridge. What were those towers connected by ropes? Were they some land-locked fleet of ships? I explained that their purpose was to carry Signor Galvani's electrical impulses from place to place. I tried to make him understand how these same impulses now regulated all our lives.

He became interested. He had used electrical shocks in his alchemical experiments — which, to be honest, combined science with fraud in most ingenious ways — and understood more readily than I had expected how useful the electron was to us. I told him that now, at that moment, my dear wife was in California. "But Sir, the danger! The Spaniards, the Indians, the fatigues of so many months — perhaps years — at sea"!

I quieted his expostulations with a short account of the jumbo jet which carried her there and the telephone, by virtue of which we could speak to each other as though through a hole in a fence. By a happy chance a great silver bird was in view at that moment, and he shook his head at the thought of so many poor souls in so perilous a predicament. The idea that the captain of this aerial barque could speak to other craft and to persons on the ground at the harbours appointed for her reception, struck him now as just another confirmation of the millenium. As the tale went on, his eyes sparkled and his craggy face was wreathed in smiles. He beat his hand on his knee and exclaimed in broken words.

It was all that the philosophers of his age had hoped for. To speak across the world, to fly, to calculate, to go, even to the Moon. It was all too wonderful. How happy he was that I had conjured him from the past to an age of marvels.

For a while he sat, musing, gazing out of the window. Even a train passing in the opposite direction, with its crash and roar, did not alarm him now. It was just another marvel, a small one to be sure.

Smiling benignly he turned to me, took my hand between two strong, manicured palms, gazed into my eyes and asked: "Was not my race the happiest that ever lived on Earth"?

And it pained me to answer, No. I thought that we were no happier than any other time. For all these marvels, we were as vexed with cares as any mortals. The captain of the great silver bird had no easier a life than the driver of the stage coach of Casanova's day. The telephone call taken in San Francisco often gave less pleasure than a letter a year in passage around Cape Horn. If my wrist-watch calculator saved me an hour of arithmetic, that hour was filled with what? Another problem — or worse, no problem at all.

Having asked his thought-provoking question the phantasm disappears, leaving a more difficult question in his place: "Why do we bother"? Technological development has been going on long enough now for there to be no doubt that advances do not make anyone happier. Does a steam engine make one happier than a stagecoach? Does a high-speed diesel-electric traction set bring more contentment than a steam engine?

To be sure, there seems to be less bitter misery in the developed nations than there was a century ago. You do not see children starving in the streets, and for that we have to thank technology. But, on the other hand, those who are not happy — and that includes most of the human race — drag out their unhappiness for longer lives, so can one say that the total of misery is less or happiness greater?

Why do we bother? Why, in particular, do we, the pioneers of the much-heralded new industrial revolution, get up in the morning and trek on across the pathless wastes of data processing? We know in our hearts that the beautiful valley before us, reached after weeks of struggle up and over the Rockies, will be a commuter suburb in a few decades. That charming stream where the salmon leap will be concreted in and converted to a sewer. Those redwoods will be cut down and pulped into wrappings for instant dinners.

I suppose our reasons are the same as those which made the pioneers struggle on. They were bored with where they had come from and hoped, irrationally, to be happier where they were going. They wanted to make some money, but more than anything they enjoyed the journey and the process of overcoming its dangers and difficulties. There is not a lot of joy in a stock-control package. Thinking out a new way to do it may pass a few weeks of this life most pleasantly away.

We were, after all, designed by Mother Nature to skid about in the long grass hoping to find something small and weak to eat before something big and strong finds us. We were designed to deduce facts from slight signs — to guess whether it was a buffalo in that bush or a lion. We were constructed — like all animals — as a mobile dinner-finding-problem-solver. Mother Nature was so successful with this new design that the dinners are now almost automatic. The hunger is now for problems.

Think of life in a world where they have all been solved. Perhaps it is fortunate that there are still a few around.

Circle No. 141

Our Feedback columns offer readers the opportunity of bringing their computing experience and problems to the attention of others, as well as to seek our advice or to make suggestions, which we are always happy to receive. Make sure you use Feedback—it is your chance to keep in touch.

Updated Fortran

IT WAS with some pleasure that I saw the title "Fortran: the language which refuses to die" in the September *Practical Computing*, but what a disappointment was in store.

Paul Martin does not seem to be aware that his entire article is based on an out-of-date concept of Fortran.

The latest version of the language is that commonly known as Fortran 77 and updates both the detail and the philosophy of the language to accord with modern programming concepts. The Fortran 77 standard was issued in 1978 and compilers for it are now becoming widespread on mainframes and minicomputers, although not, so far, in micros.

The major changes are the addition of character variables, together with full string-handling capabilities; a Block If structure — If-Then-Else, If-Then-Else-EndIf — which largely eliminates the need for any type of Goto statement; a completely flexible Do statement with no restrictions on the values of the control variable; and considerably enhanced input/output facilities.

Fortran 77 provides the tools with which programmers can write well-structured programs in a way that was not possible before, while still retaining compatibility with earlier versions of Fortran. Paul Martin was correct when he stated that Fortran refuses to die. It is a pity that his examples used many non-standard features of what was, in any event, an out-of-date version of the language.

T M R Ellis,
University of Sheffield Computing Services.

Taken to heart

WHILE FINDING many favourable aspects of the CP-100 microcomputer to comment on, June 1981, the reviewer did find us lacking in one or two areas. As a direct result of his comments we have made various enhancements to the CP-100 which have also been included across the range of the Communicator series.

- Extra boards are now available for interface with viewdata and Prestel — the Prestaid is British Telecom approved.
- Screening of the case is available for users who specify this requirement.
- A third interface cable has been added to the second serial port.
- Ribbon cable connectors are now orientated with a key in the connector.
- Two cutouts in the rear panel have been added for 34-way ribbon cable connectors.
- A new user-orientated manual covering the entire range of communicators is available.
- A 4SIO board — with four serial ports and counter timer chip — is available for multi-user applications.
- The disc controller is now at address F800 hex giving 4K extra for the user, i.e. 62K not 58K.
- CP/M 2.25 is now supplied with a configurator diskette to simplify system generation.
- Board rattle is not a problem with the lid on as a special foam strip is built in to hold them in place.

We paid particular attention to the reviewer's comments in the final design for the new CP-500.

David Slinn,
Comart Ltd,
St Neots,
Cambridgeshire.

Still floundering

I HAVE the use of an 8K Pet with upgraded ROMs, printer and 3040 floppy disc, and I am still floundering in the morass of the floppy-disc manual. Is there a chance that someone, somewhere will do unto the floppy what *Pet revealed* did to the Pet itself?

Although I use the Random Access program from the manual, I do not fully understand the Block read/Block write instructions. Even more important, my floppy has a nasty habit of losing the occasional record, especially when using Copy or Duplicate. The data must still be on the disc, but is there any way of accessing it?

Don't tell me to keep copy discs — it is when I try to duplicate that they go wrong.

S Hetherington,
Eastbourne,
East Sussex.

Portable graphics

WHILE I largely agree with the approach taken by Wynford and Jane James in their article on portable graphics, October 1981, I feel that there is still room for improvement.

The screen should be defined by the following variables:

SC: screen centre, the central displayable location of the screen memory
SW: screen width, half the number of displayable characters per line
SH: screen height, half the number of displayable lines per screen
LL: line length, the number of memory locations between corresponding characters on adjacent lines

These variables fully describe the VDU memory and lead to an easily centralised display. To fill the Nth line with a given character the following lines of coding are required

```
10 FOR I = -SW TO SW
20 POKE SC + (N-SH)* LL,CH
30 NEXT I
```

Other screen locations — e.g., score position, SP — are then calculated from these basic variables.

Machine-dependent coding should be left out of the main body of the program and called as subroutines. This is including getting keys from the keyboard without a carriage return. A subroutine to perform the Get A$ function should be written, this being called when any single key input is required. Although this method is slower, it makes the program more portable.

A note should here be made of the machine-dependent routines included in the programs published, taking Wallball as it is the least well documented.

Line 5 : FOR X = 0 TO 25 : PRINT : NEXT X

This performs a clear-screen function, leaving the VDU RAM filled with decimal 32, which are spaces.

Line 20 K = 57088 ; POKE 530,1 : POKE K,251

The Superboard keyboard matrix is decoded at 57088 decimal, and it is read by Poking this location with a value and then Peeking it to see which key has been pressed. Location 530 has to be set non-zero to disable the Control-c Break function, one effect of which is to clear any value set at 57088 thus preventing the keyboard from being read.

Lines 290-330 test for the following keys being pressed:

x c m ,

Any Peek on screen memory for 32 is looking for a space.

Sufficient Rems should be included in the listing to enable the program function to be understood. No Gotos or Gosubs should be made to Rems in order that they can be removed when the program runs correctly.

There are also a couple of errors present in the Wallball program. The first is in the calculation of the bottom-left corner of the screen from the statements

TD + TR — TL & BL = TL + TD*LL

TD gives the number of characters displayable on the top line, which is no use for the calculation of the bottom-left corner. This should be derived from

BL = TL + SH*LL * 2

where SH is previously defined.

The second and more serious error occurs between lines 200 and 270 given below.

```
200 IF PEEK (CP + CD) > 32 AND RND (1)
        < SL THEN 220
```

(continued on page 45)

(continued from page 43)

```
210 IF RND (1) < CH THEN 270
220 FOR A = 1 TO 4
230 IF PEEK (CP + C(A)) 32 THEN 250
240 CD = C(A) : GOTO 270
250 NEXT A
```

Line 240 when executed causes a jump out of an unfinished For-Next loop, thus leaving the call on the stack. If this part of the program is executed often enough, then it must surely cause a stack overflow.

Computer movement is also too predictable by the fact that the direction chosen is always the first available of the following: Right, down, left and up. This makes for no unpredictable change of direction. Both points are cleared up by the following coding

```
199 REM RANDOM DIRECTION CHANGE
200 IF RND(1) < CH THEN 230
205 FOR I = 1 TO 7
210 A = INT(RND)1) * 4 + 1)
215 IF PEEK(CP + C(A)) = 32 THEN CD =
    C(A)
220 NEXT I
229 REM FORCED DIRECTION CHANGE BY
    COLLISION
230 IF PEEK(CP + CD) = 32 OR RND(1) <
    SL THEN 270
240 FOR A = 1 TO 4
250 IF PEEK(CP + C(A)) <> 32 THEN 260
255 CD = C(A)
260 NEXT A
```

I hope your readers find the above information useful and employ it to improve the already high quality of published software.

R J Greenhill,
Cutnall Green,
Worcestershire.

What price software?

THE REPLY to the question posed in the July editorial, "What price software?", is very simple — about 10 percent of the price of the hardware the software is to run on.

Hence, Sinclair Research cassettes sell for around £5 — roughly one-10th the price of a ZX-81, whereas VisiCalc costs about £100, recognisable as one-10th of the price of a typical Apple system.

Paul Farrell,
Cambridge.

USR appeal

SINCE RETIRING, I have had to search for some interest that would occupy my time and stimulate my mind. Computers seemed to offer endless scope.

I am building a model computer with the object of devising my own control systems, and have a baby computer, the Sinclair ZX-80, just for starters.

I have settled on your magazine as being the most intelligently compiled and interesting of those available, and my letter is written in the hope that consumer feedback does sometimes offer ideas from which new material can flow. May I offer a few random points.

I echo Robin Laughton, ZX-80/81 Line-Up, June 1981, in appealing for programs to include the USR function and spell out how it is used. Although dabbling in these waters I should be glad to know why it is that machine language programs, even when written for the ZX-80, are expressed in hexadecimal. As far as I can tell, one can only input to the ZX-80 by Poking it with decimal numbers. The use of assembly-language codes is clearly a guide, but why use hex?

G J Langford,
Ickenham,
Middlesex.

Prestel points

YOUR SEPTEMBER EDITORIAL on Prestel has prompted me to write about the real limitations of the medium and those implied by your article.

In particular, you refer to the crude quality of the viewdata image. I generally work with a purpose-built colour terminal and believe that the quality and impact of the image is outstanding. However, I also use viewdata adaptors when it is necessary to drive large screens at lectures; in this case a UHF signal is used — as distinct from the RGB signal used in the other sets — and the quality of the display can be very disappointing when graphics or coloured backgrounds are being used.

TV sets are generally not suitable for full-time use in place of a good-quality VDU as the interlace shimmer is very tiring on the eyes when sitting close to the screen. Of course, non-interlace TV sets are available, but they are very much more expensive than normal sets.

One great importance of Prestel is that it has established a *de facto* standard for this type of application. For coloured text, simple graphics, and unsophisticated animation, the Prestel standard provides a cheap and easy way of driving a colour screen.

You make the point that few people will have direct links from Prestel to their own microcomputers. I would recommend that they make extensive use of cassette recorders to preserve the listings, even if they cannot load from them directly. This will save on their telephone bills, and provide an excellent method of storing the listings; my own experience of taping viewdata screens suggests that it is completely free from the problems which appear to beset so many people saving and loading programs on their micros from cassette.

Eric Finlayson,
Macclesfield,
Cheshire.

Tips for readability

THE READABILITY of programs could be greatly improved by the use of Rem statements and space between individual words. Leaving a space makes it much easier to type out a program, as the words can be recognised.

However well a program is documented, the occasional Rem statement is invaluable for understanding the code. As I see it, there are two reasons for people not using Rems:

- they feel that the trouble of typing them in is not worth it
- conservation of memory space

In certain cases, when the program occupies fully the available memory space, a certain amount of "squashing" is acceptable, but many programmers fall into the unhealthy habit of one Rem per program and no spaces between words.

A framework of a basic "crunch" program to remove all Rems and spaces provides a partial solution for people who want readable programs, without wasting valuable memory space. The idea is to type the program in full — with Rems and spaces — removing a few data statements if necessary to fit it into the memory space. Now obtain a listing of this program and fill in any remaining data statements. You will now have both a readable and a compact copy of your program.

The crunch program treats your object program as a data file. I have only implemented it on the RML 380-Z but I am sure it will work on others.

This is the basic structure of the program:

- Open temporary file.
- Take first line; use "input" line.
- Split the line into individual words by recognising the spaces between words. You will not want to interfere with strings inside quotes, so regard everything inside quotes as one word.
- If the second word is "Rem", move on to next line without printing line to file.
- Perform any other operations necessary, for example, listing on printer any line with the word "Gosub" or "Goto".
- Add up all the words again (without spaces).
- Print line to temporary file.
- Repeat for each line.
- Close temporary file.

There are some restrictions:

- All words must be separate beforehand, e.g., 14 Remclose master file is not acceptable
- Trailing Rems are not deleted, e.g., 17 Gosub 350: Rem invert is not deleted
- Care must be taken with the final word in the line.

S P Lavelle,
Saltash,
Cornwall.

Times for accuracy

AFTER READING "Times for accuracy" October 1981, I ran MT1 on my Superbrain in Microsoft Basic with the following results

Time-125s.; ran "DEFINT A-Z", i.e., defined integer under floating point.
Time-152s.; ran under normal floating point.
Time-201s.; ran "DEFDBL A-Z", i.e., defined double precision.

Trevor Smith,
Rowlands Gill,
Tyne and Wear.

Business Apple III sheds hobbyist image

AFTER A YEAR which saw a dramatic rise in the number of Apple computers used in the U.K., London was chosen by Apple Computer for the European launch of the Apple-III machine.

The new model represents a radical departure for Apple. The Apple-II was a hobbyists' machine which became popular with the business user. The new computer has been designed specifically from the outset as a professional system for business applications.

Another step forward is the combination of a machine and software package. Apple-III purchasers will be buying not just a computer but a complete system. The configuration being marketed by Apple (U.K.) — Microsense, as was — contains everything a user will need to begin processing. The Computer, plus the video monitor and the information-analyst software package, will retail at £2,695.

The computer features a new CPU which uses the same instruction set as the 6502. It incorporates an integral floppy-disc unit and an improved keyboard design, and its port serves up to three additional disc units. An integral digital-to-analogue converter can be used for music or voice synthesis.

Graphics are RAM-based, allowing different character sets to be down-loaded from disc. There are three different text modes: an 80-character set with upper and lower cases and true descenders which is useful for word processing; a 40-character colour-on-colour text; and a character set which emulates that of the Apple-II. There are also several graphics modes.

Software is an important feature of the Apple-III. The information-analyst software package contains VisiCalc-III, SOS, Mail-List Manager and Business Basic. SOS is Apple's own sophisticated operating system. VisiCalc-III is a more sophisticated version of the best-selling VisiCalc planning package.

To complement the Apple-III, and to provide users with the mass on-line storage media that a hard disc can supply, Apple has launched the Profile. Billed as a personal mass-storage system for the Apple-III computer, Profile is a sealed box containing a 5.25in. Winchester drive. The Profile unit increases the on-line storage capacity of the Apple-III from 500K up to 5Mbytes.

The Apple-III computer is being sold via a dealer network, which differs from the Apple-II network. For information, contact Apple Computer (U.K.), Finway Road, Hemel Hempstead, Hertfordshire. Telephone: (0442) 48151.

Control Basic as standard

CONTROL BASIC is an easy to use language, derived from Basic with extensions for control applications. Developed by the University of Oxford and Warren Spring Laboratory, Control Basic is fast becoming the industry standard for control engineers.

The language will operate on any Z-80 based microprocessor and resides in 3K to 7K of PROM, depending on which version is being used.

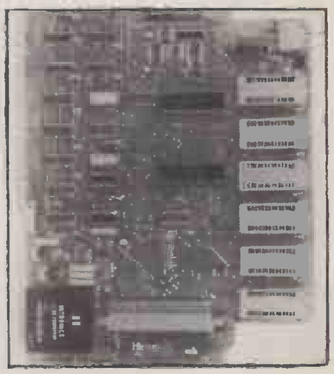
Standard versions now are available "off the shelf" in either ROM or diskette form. Non-standard versions will take longer to prepare. For further details contact Ken Cunningham, Technology Transfer, Electronics and Information Technology Division, British Technology Group, 12-18 Grosvenor Gardens, London SW1. Telephone: 01-730 9600.

Extensive functions in PROM programmer

A NEW TYPE of PROM programmer has been developed by Bleasdale Computer Systems. The programmer unit can be plugged into any Bleasdale computer or any Multibus-compatible machine.

The unit is software driven and will run under CP/M on the 8080 or Z-80 processors. Software to drive the unit from Intel ISIS, CP/M-86 and 6809 Flex is under development.

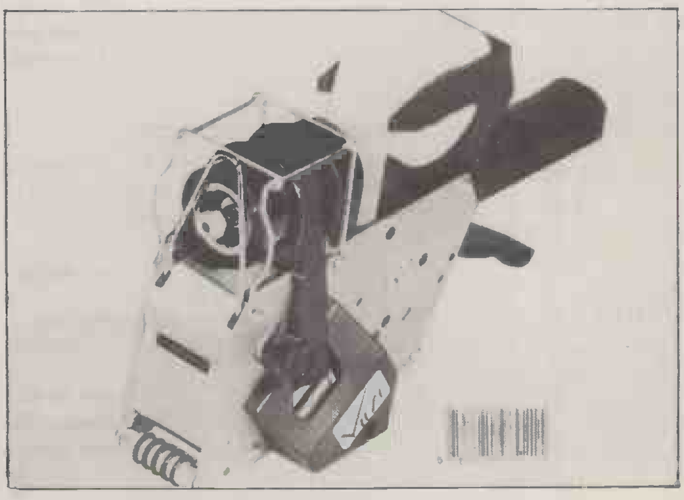
Included in the software are an extensive range of functions which simplify the programming of PROMs. Messages are output to keep the operator informed about the processes that are occurring. Personality modules are supplied for nine different types of PROM. Up to six PROMS can be programmed at any time, so a 48K



program can be copied in one operation.

The programmer costs £625 exclusive of VAT, an 8in. disc containing the software is an extra £120.

For further details contact Bleasdale Computer Systems, Francis House, Francis Street, London SW1. Telephone: 01-828 6661.



Vidac, a hand-held labeller for printing and dispensing bar-coded self-adhesive labels, is available from Nor Systems. It can print LAC, EAN-8 and EAN-13 codes with or without a numeric price. The printed codes can be read by most laser scanner and optical-recording equipment. Codes are selected by a single dial-set control, and the machine's handle is squeezed to print and dispense the label. Nor Systems of Harwich, Essex. Tel: (02555) 3131.

The Commodore 2031 single disc drive represents a departure for CBM, as until now only twin disc drives were available. The 2031 unit is designed for those applications where no back-up copy is required. Commodore expects demand for the new units in the education market where there is little or no demand for data storage. It provides a fairly low-cost solution to mass storage needs, at an end-user price of £395 plus VAT. The disc unit provides up to 171,000 characters of storage on each mini-floppy disc. For more details contact your Commodore dealer.

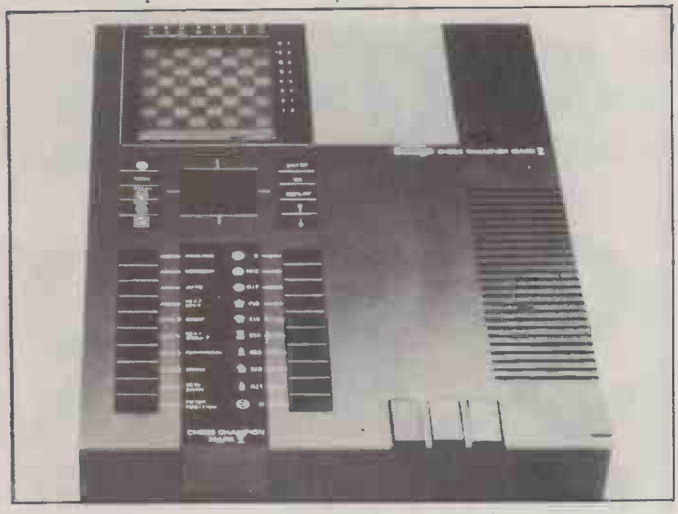
Chess Champion V can beat the best

THE CHESS CHAMPION MARK V won the commercially-available section of the 1981 world microcomputer chess championships in Hamburg. Produced by Scisys Ltd, and programmed by British experts, the Chess Champion Mark V is available from Vulcan Electronics. It was styled by Iain Sinclair — brother of Clive.

At a retail price of £279 the machine is the most advanced chess computer yet built on a commercial scale.

Probably the most remarkable feature of the machine is its ability to handle 12 games at once against either human opponents or other computers.

Vulcan Electronics is at 200 Brent Street, London NW4. Telephone: 01-203 5161.



Robots star in film

ROBOTS IN INDUSTRY, a new film prepared by the Department of Industry, takes a look at the ways in which robots are used by British industry. Kenneth Baker, Minister for Information Technology, welcomed the film saying: "Industrial robots are no longer a novelty and the range of tasks they can perform is being extended every day.

"The film does not dodge the issue of jobs and robots and some very interesting comments are made on this subject. I would only add that it is also important to remember that the countries with the lowest numbers of unemployed have the highest numbers of robots".

The film examines a range of applications and is intended to bring out the facts behind this new technology. It is available on free loan or can be purchased from the Central Film Library, Chalfont Grove, Gerrards Cross, Buckinghamshire SL9 8TN. Telephone: 02407-4111.

HP-2623A's quality matches its price

HEWLETT-PACKARD'S lowest-priced graphics terminal, the HP-2623A, has a high-quality display and an optional built-in graphics printer. Suited to both business and scientific graphics use, the terminal can also be used for design applications.

The screen features 512-by-390 resolution and produces an image which is bright and easy to read. Graphic and alpha-numeric memories are independent, so system messages cannot interfere with the graphic displays. Graphic text composition allows text — for example a label or a title — to be added to a display before a hard copy is printed. English, Swedish, Finnish, Norwegian, Danish, French, German or Spanish character sets are available.

The terminal is supported by Hewlett-Packard's business-graphics software and the technical software, and it is compatible with software produced by other companies. At £2,479 the terminal is not exactly cheap, and an integral printer costs a further £800. For further details contact Hewlett-Packard Ltd, King Street Lane, Winnersh, Wokingham, Berkshire. Telephone: Reading (0734) 784774.

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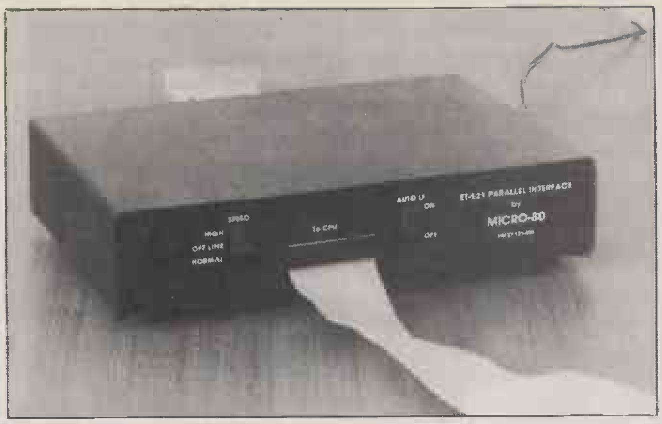

Micro-80 provides the typewriter link

MICRO-80 is a parallel-interface kit which enables users of popular microcomputers to interface to the Olivetti ET-121 electronic typewriter, allowing word-processing packages running on microcomputers to produce typewritten copy. The small cabinet which houses Micro-80 can sit on a desk top behind the typewriter, connected via a ribbon cable.

Cables are available to connect the unit to the TRS-80 range of micros, the Exidy Sorcerer and the Apple. Similar systems can be connected for a small extra charge. The cable does not interfere with the normal operation of the typewriter.

Micro-80 is supplied with a one-year warranty. The Micro-80 unit and Olivetti typewriter together cost less than a comparable daisywheel printer, and this combination has the advantage that the typewriter remains usable on its own.

The Micro-80 unit costs £300 plus VAT and is available from Frank Cody Electronics Ltd, Star House, Gresham Road, Staines, Middlesex TW18 2AN. Telephone: Staines 62682.

Electronic change for budding Beethovens

MUSICIANS are traditionally among the first to benefit from technological change, and their craft has certainly been changed by recent developments in microelectronics. Synthesisers, amplifiers and recording techniques have all been dramatically improved in the last few years. Now composing is the latest aspect of the craft to undergo change.

The budding Beethoven need no longer stay up all night with his quill and manuscript paper. He can, instead, turn to an Apple computer and the Mountain Hardware Music System. No ink and paper here; the composer uses a display screen and light pen. The two boards of electronics plug into the Apple to provide the oscillator and other devices required to produce the sound.

Music appears on the screen as it would a manuscript, and the composition can be played back at any time. The computer can replay the music using any of a series of "voices". Parts for differing voices can be merged and the complete work performed.

The system is a must for any Apple user interested in music and costs £400. It is available from the Lion Microcomputer Centre at 227 Tottenham Court Road, London W1. Telephone: 01-398 7531.

Compact code with Compress

COMPRESS is a rather strange but wonderful piece of software. Designed to aid programmers by improving the efficiency of software written in standard Microsoft Basic, the program works by stripping code of all the redundant characters. The resultant code is more compact and will load and execute more quickly.

Mike Lewis Consultants Ltd, the originators of Compress, claim that overall efficiency can be improved by around 30 percent. Compress is said to offer a compromise between intelligible code with meaningful comments and the gobbledegook produced by a compiler.

Compress is available on a standard 8in. floppy for £28.75, including VAT and postage from Mike Lewis Consultants Ltd, 48 Willoughby Road, London NW3.

Doctors' micro advice centre

IF YOU ARE a doctor and considering the introduction of computers into your practice, a new centre has opened to cater for you. The independent service is based in the City of London at the National Computing Centre, Fetter Lane. Backed by the Joint Computer Policy Group of the BMA, the advisory service will enable doctors to make up their own minds about computers.

Systems are available for the doctors to evaluate, using dummy data. Dr Frank Wells, the Under Secretary in charge of the general practitioners' division at the BMA commented that the service will be of use to GPs who wish to obtain practical experience on computers before committing themselves to a particular system.

60K Memory System vies for office users

60K OF RAM, A Z-80 PROCESSOR and CP/M are the vital components that go to make the new Memory System 2000, yet another choice for the small-business microcomputer user.

The twin mini-floppy drives which sit in the monitor cabinet provide a further 400K of backing storage. The 9in. screen can display 24 lines of up to 80 characters.

The system retails at £2,000. The Centronics 737, a standard dot-matrix printer, is offered for a further £400, though word-processing users would do better to complement the micro with a daisywheel printer.

The system is compact and light and will fit smartly on any

desk-top. Software includes Basic, supplied as standard, with options on Fortran, Cobol, Pascal, and a very useful assembler.

Applications users will find the usual range of software including the WordStar word-processing package and the popular Micromodeller planning package.

The Memory System 2000 is supported by a nationwide network of 22 distributors. To find out more, contact Memory Computers (U.K.) Ltd, Britannia House, 960 High Road, London N12.

Latest Onyx can form low-cost databases

THE LATEST and most powerful microcomputer in the Onyx series is the C-8002. It consists of a 10 or 18Mbyte Winchester fixed disc-drive, a 12Mbyte cartridge tape drive, a 16-bit processor and up to 1Mbyte of RAM. Eight users can be supported at the same time, and more users can be catered for by linking more than one C-8002 together to form a high-speed local network.

The microcomputer, available from Keen Computers Ltd, is designed so that large, distributed databases can be constructed cheaply. One of its major features is the Unix operating system. It is supported by International Systems, who have enhanced the standard Unix for use in the office automation field.

The C-8001 is a powerful one- or two-user, Z-80-based system which uses the same Winchester hard-disc unit and high-density cartridge drive as the C-8002. The C-8001 can be upgraded to the C-8002 by a simple field-engineering operation. Software for both machines is extensive, Cobol, Fortran, Microsoft Basic, CBasic, UCSD Pascal and a wide range of other packages are also available.

For further details contact Keen Computers Ltd, 5 Giltspur Street, London EC1A 9DE.

Programmer's Apple boon

AN APPLESOFT compiler will be a great boon to both serious and home Applesoft programmers. The new Applesoft compiler, designed by the creators of the Applesoft interpreter, offers many advantages over interpreters, not least of which is the increase in speed of execution.

Programs written for the Applesoft interpreter can be compiled direct in almost every case without any modifications. A program will, in general, run from between two and 20 times faster when compiled. The compiled programs can be linked by use of the Common statement. The Applesoft compiler or TASC can perform true integer arithmetic, unlike the interpreter.

The Applesoft compiler is available from Pete and Pam Computers, Waingate Lodge, Waingate Close, Rossendale, Lancashire. Telephone: Rossendale (0706) 227011.

Source-code compiler

SMALL SYSTEMS ENGINEERING has developed a compiler to produce object code from Basic source code for the 8048 family of single-chip microprocessors.

Dubbed Basic-48, the compiler runs under the CP/M operating system. It contains routines to take advantage of the architecture of the 8048 chip family. The object code is highly optimised in the form of a standard Itel-format hex file.

Contact Small Systems Engineering, 2-4 Canfield Place, London NW6. Telephone: 01-328 7145.

Total payroll pack designed for novice

FLEXIPAY is a comprehensive payroll package for the Triumph-Adler Alphatronic microcomputer. Designed by Compuserve Ltd, the £350 package provides the user with a double check of the figures before pay-slips are printed, thus reducing the chance of operator errors.

The software will handle up to 93 separate items for each employee. Processing can be performed for hourly, weekly or monthly payments. Six deductions can be made in addition to those for tax and national insurance.

Up to 18 separate reports can be generated to facilitate payroll analysis covering all aspects of wage analysis including the production of P11s, P60s and P35s. A full coin analysis can be performed as well as credit transfers. The system will also cope with the production of cheques and giros.

Like most software provided for the Alphatronic, Flexipay is written with the inexperienced user in mind. The system is menu driven and full documentation is provided. The one-year software guarantee can be extended as an option. For further information contact Bert Viner, Triumph-Adler (U.K.) Ltd, 27 Goswell Road, London EC1M 7AJ. Telephone: 01-250 1717.

Sorcerer's magic way with words

THE WORD PROCESSOR for the Exidy Sorcerer now has a dictionary. Developed by the manufacturer of the Exidy Sorcerer microcomputer, the dictionary is a real asset to word-processor users.

Spelling mistakes and typographical errors are found by comparing every word in the document with the words in one of the dictionaries on disc. Any word not found is treated as a mis-match and therefore a possible error.

About 20,000 of the most commonly-used words are provided on the dictionary, and it can be further expanded up to the limit set by the disc-storage capacity. In most cases this will be around 50,000 words.

Speed of checking depends on the size of the document in question. There is a minimum time limit so that a short document does not take significantly less time than a long one.

The Exidy Systems Dictionary requires a disc-based Sorcerer system. The software costs £195 and is available from Liveport Data Products, Ivory Works, St Ives, Cornwall. Telephone: St Ives 0736-798157.

Card to do Tandy credit

TANDY the High Street microcomputer and electronics retailing chain, has launched its own credit card. It will be financed and administered by Unicredit Finance Ltd, a company that specialises in the provision of in-house credit cards. The card will be of most use to would-be computer users.

The card can be used for no-deposit credit on purchases of up to 24 times the monthly payment. Interest is charged at a monthly rate currently 2.25 percent, equivalent to a yearly charge of 30.6 percent — provided the customer settles the bill by banker's order.

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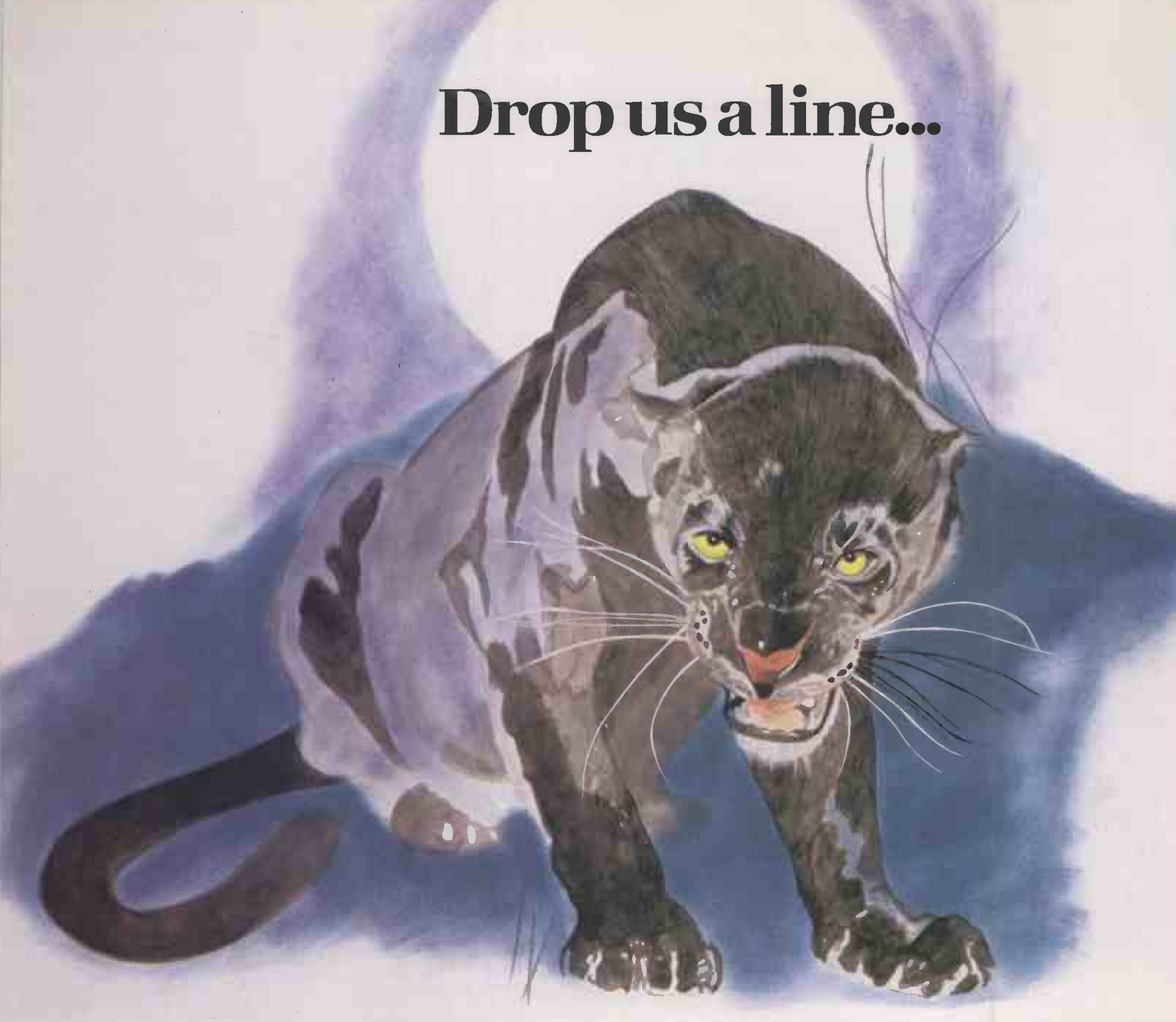

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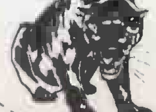

● Circle No. 145

High-street chain stores are limbering up for a hard fight to win the casual micro customer. Martin Hayman reports on the growing number of outlets for computers.

Mass-marketing microcomputers

THE GAUNTLET so ruthlessly flung down by W H Smith, in its initiative with the Sinclair ZX-81, has not been ignored by other major chains — and they are not all electrical suppliers, or indeed even stores associated with electronics products of any kind.

Our information suggests that Boots will be grappling with micros this year, as well as more obvious outlets such as Curry's and Rumbelow's. Curry's is, of course, already in the field with its separate subdivision Curry's Microsystems which acts autonomously within the company, but has only nine branches. Now Curry's is to sell the Atari 400 throughout the U.K., in what must be seen as a major departure.

Rumbelow's seems to have advanced plans to move into computing in a big way during the 1980s, and is already marketing the Texas 99/4 and the Vic-20, in 18 selected shops in the Hertfordshire and Bedfordshire areas. Chief buyer Neil Shankland says that supplies are very tight for both products at the moment. As soon as deliveries of the Vic-20 from West Germany improve, he expects that Rumbelow's will be offering both machines in all its stores.

The trial marketing area was chosen, he says, because the recession has not yet bitten deep in the London and Home Counties area and he wanted a good mixture of town and country.

Rumbelow's is taking the move into computing seriously and has liaised closely with both Texas and Commodore in training its staff adequately for the doubtless tricky questions that the young geniuses will be throwing at them.

The question of moving into micro sales was first mooted over a year ago with its regular calculator supplier, Texas,

Sinclair's ZX-81 — attracting customers at W H Smith branches throughout the U.K.

but it decided to wait until Texas could offer a machine which was fully PAL-compatible. A home computer which required its own monitor, rather than being an extension of the domestic TV set, seemed to be too big a gulf for the average customer — the price would have been a steep £600 — enough for a video


Both Rumbelow's and Boots market the Texas Instruments 99/4 at selected stores.

cassette recorder and change left over for *Jaws* and *Shaft in Africa.*

Rumbelow's move is typical of the way chain stores are now thinking. With stores reporting sales of thousands of TV video games, some of them at hundreds of pounds, they are probably right in believing that they can sell machines which can be used for computing as well as playing.

Rumbelow's will, however, be sticking closely to packaged software. Currently it has no desire to embroil itself in software support, though it is making noises about moving into the business market by early 1983.

The aim, though, is to market computers as just another domestic appliance. "We want to remove the mystique from computing. We intend to promote micros in much the same way as any other product. We won't have specialist departments", says Shankland.

By contrast, Rumbelow's direct com petitor Curry's has been in the micro market since the beginning of 1980, with a separate company, Curry's Microsystems. Each of its nine branches — Leeds, Manchester, Birmingham, Bristol, Southampton, Leicester, Nottingham, New Malden and Luton — aims to be a complete micro dealer selling a range of semi-professional machines and offering commensurate support.

Supply problems

Microsystems stocks Apple, Commodore and Panasonic products and has field engineers. However, it also sells the Atari range and the Vic-20 — if it receives them in sufficient quantities. For the Vic-20 a spokesman told me, they are "still filling orders — we're not in an ex-stock situation with regard to this one".

What is intriguing, though, is that Curry's regular branches will be selling a complete Atari 400 with cassettes and The Atari Invitation to Programming. Most of the software will be pre-packaged games like space invaders. Outlets seem to be mostly in the provinces, with a strong bias to Scotland, the North and the West Country; only East Ham and Enfield feature in the London area.

Perhaps the most disconcerting sign of the times is that the giant Boots chain, generally thought to be conservative in its buying policies, is dipping a toe in the water. Initially it has put the Texas 99/4 into three of its stores, in Ilford, Leicester and Swansea. It is priced at £299 including VAT — the same as Rumbelow's. Boots was to have tried also Croydon, Cardiff and Manchester but found it could not obtain sufficient machines.

As a marketing exercise, even six out of a total of 1,090 stores is pretty tentative, but a Boots spokesman confided: "We move slowly". He said that Boots saw it as an extension of its policy of selling calculators and audio equipment but thought it unlikely that more than about 300 branches would be able to support sufficient sales of a £300 item: "It's not demonstrably a Boots the Chemists line," he told me.

Computer mania

In the meantime, W H Smith is really steaming ahead with its ZX-81 sales. So far 116 branches stock the ZX-81 and soon another 30 are to be added. Intriguingly, one of the criteria which its area managers used to determine which outlets would be favoured was whether the shop sold plenty of home-computing magazines.

It is interesting to speculate whether people buy the magazines, then the computer, or vice versa. W H Smith takes staff training very seriously and the manager of the whole operation, John Rowlands, seems to spend most of his time training managers in how to deal with the influx of computer-mad potential customers.

So what is the significance, if any, of the chain stores' move into micros? Clearly, many of the electrical chains have had it in mind for some time, and those who have not made the necessary preparations must now fear that a major consumer electronic goods market is about to be snatched from under their very noses.

The same may have happened with calculators, but the calculator is a very different product. It does not require software — and software will be an important follow-up market. If newcomers to computing buy a machine at W H Smith or Boots and find good service and a keen price, it is likely that they will return for advice and to buy more software.

Micro builders connect to Prestel

MARGINAL though it may seem, telesoftware is creeping in. Viewdata compatibility is clearly the most widespread enhancement in the spate of new micros which have gone on sale recently.

Most of the firms who are tackling the problem have a computing rather than a TV-set manufacturing base. It is, therefore, reasonable to assume that telesoftware is not far from their minds when specifying that a new micro should be able to talk to Prestel.

After all, the market for new dumb Prestel terminals is pretty well saturated. Currently there are something over 12,000 terminals registered in this country, and this sort of level of sales is hardly going to make any fortunes for their managing directors.

What does appeal to hardware builders is the ready-made market of micro owners. Its true size has been variously estimated; including the ZX-81 users it is probably getting on for 300,000. If even a small proportion of these people could be persuaded that they need Prestel, it represents a huge extension of the existing market for the uneasy trinity of common carrier — British Telecom — set manufacturers and information providers.

Firms which have a foot in both computing and TV-set manufacture are best placed to capture the business micro user, and Rediffusion has jumped in with verve. The hard-line critics have been quick to sneer at Rediffusion's so-called Teleputer, describing it as no more than an average 64K twin-floppy CP/M business machine with ambitions above its station. Nevertheless, the company gets full marks for its presentation of the new machine.

Much has been made of its ability to interface with either video cassette or video disc — like everyone else, Rediffusion is keeping its options open. It was noticeable that no specification was published for the VCR/video-disc interface. Rediffusion has plenty of experience with private, business viewdata systems and it expects that the majority of Teleputer sales will be to business users.

What, then, of the small-time micro users? How will they be persuaded? Two firms are making the running in really low-cost adaptations of microcomputers. Both come from "Silicon Fen": they are Tangerine Computer and Acorn Computer.

Tangerine's Tantel has already been well-canvassed in these pages, because we have found it to be a reliable and well-engineered device and notably good value for money. Now, as reported previously in *Practical Computing,* Tangerine has enhanced the Tantel with software modifications and has also launched a second device with a full alpha-numeric keyboard.

by Martin Hayman

The Microtantel, which allows a standard Apple II to talk to Prestel, was demonstrated at a recent exhibition. It costs £170 plus VAT, and requires a piece of disc software written by Blyth Computers of Suffolk, plus a small hardware fix which Tantel believes hobbyists will be capable of doing themselves. The catch, of course, is that you need a disc drive.

Atomsoft's inexpensive Atomtel maintains its terminal identity in software.

Control is handed over to the Apple which can dump on to cassette a Prestel frame which has been captured by the Tantel. The cassette can then be replayed and the frame edited. Of course, even a page of Applesoft Basic will not run when re-entered. A utility program to convert from Prestel format would be needed, and that is what we are all waiting for.

It appears that B&B Computers may take on the job of writing software to allow the Tantel to interface in exactly the same way with Pets and other micros. It is still not automatic telesoftware, as you would have to re-enter program code via the Apple's keyboard.

At the same exhibition Tangerine was also showing an alpha-numeric Tantel in two versions. The first has a normal QWERTY keyboard, with regular typewriter "sculpted" square keys. There is also a second version, commissioned specifically by Granada which seems to have had a crisis of confidence in the conventional keyboard.

It appears that Tangerine is to make further reductions in the cost of the Microtantel in early 1982, possibly in response to Acorn's new low-cost solution. Acorn has been demonstrating the capabilities of the Atomtel which is, if anything, even cheaper than the Tangerine device. It will certainly appeal to those who use the Atom with cassettes.

The rig for the Atomtel consists of an isolator box and Modem unit, and costs around £100, plus VAT. Software, in the form of the program cassette costs another £30 or so.

Interestingly, Atomsoft has adopted an all-software solution. Prestel sets have a coded identity which is programmed in by British Telecom. This identity is for log-on passwords and for billing purposes and must, obviously, be held in non-volatile memory. The Tantel holds the identity on an EPROM. An interesting sideline is that if the battery in the Tantel fails — admittedly an unlikely event, since the machine must be left unused for a substantial period for this to happen — then the identity is lost and the user has to go through the rather boring process of registering the terminal again.

Mediocre monochrome

With the Atomtel, the system identity is recorded on to the program cassette, which is reloaded each time the user wants to access Prestel. Dumping Prestel frames to cassette is quickly done, though the business of printing them out is painfully slow. Atomsoft's David Johnson-Jones told me that this is a consequence of the limitations of the printer. Quality of the monochrome display left something to be desired, though for such a low-cost solution you cannot expect superb colour.

Prestel commands are all available from the Atom's keyboard. The initialising command * needs no shift, which is convenient, and hash — send — is effected by Return.

Atomtel will, doubtless, be eclipsed by the full-scale autoload telesoftware system designed by Mel Pullen for the Acorn Proton/BBC machine, which is being planned to Council for Educational Technology standard. Place your orders now, if you have a long pocket — or a Microprocessors for Education project grant.

The BBC seems set to change the face of U.K. computing. Its micro is more advanced than anything the Americans or the Japanese can offer for the same price. Charles Moir delivers his verdict.

BBC MICRO

IT IS TWO YEARS or more since the BBC started internal discussions about a computer-literacy project, and by April 1980 clear objectives had been drawn up. The fundamental aim of the project was to increase computer literacy and to encourage as wide a range of people as possible to gain hands-on experience with a microcomputer.

The decision was made to support the television series with a specific microcomputer and, if possible, to have the machine made under licence to the BBC's own specification. There were dozens of home microcomputers on the market, but most were either too expensive for the beginner — and usually American — or were incapable of being extended.

The Basics on these machines were often incompatible, and no inexpensive

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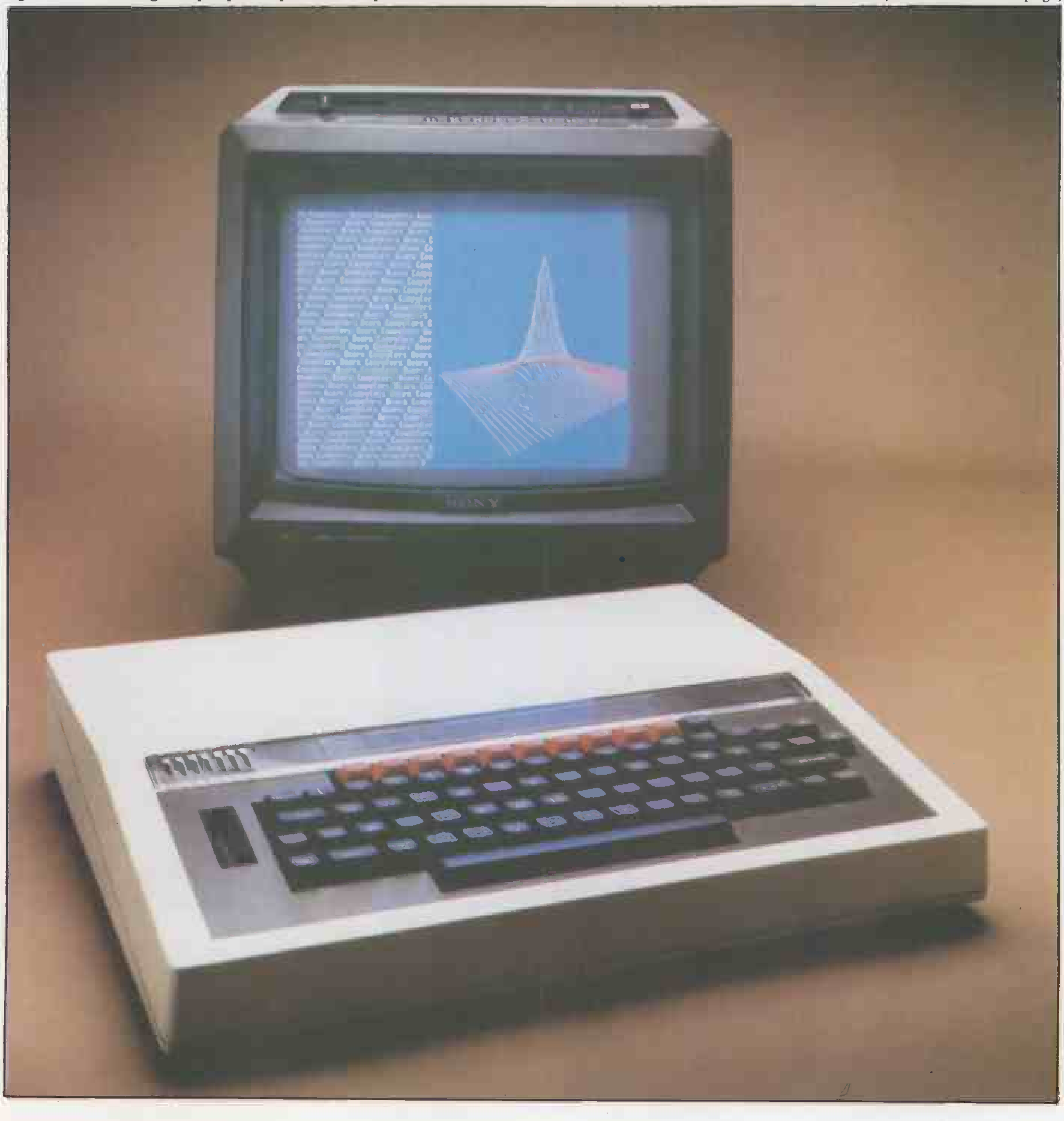

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machine on the market took account of the possibilities of teletext or Prestel. The BBC was particularly interested in the idea of telesoftware — which called for a machine made to their own specification.

At the end of 1980 a specification was released to a range of micro manufacturers, with an invitation to tender for the contract. The requirements for the micro included

- A Basic high-level language, since Basic is easily understood by the beginner while allowing sophisticated techniques to be used. The Basic was to be as compatible as possible with existing Basics.
- A full keyboard, to include an additional row of keys capable of producing any code under software control.
- A teletext extension to load software from teletext transmissions.
- Medium-resolution colour graphics with good software support.
- A low price for the basic microcomputer, with the capability for expansion to a more powerful and flexible system.

Rival contenders

At the time, Acorn Computer of Cambridge had a new computer under development called the Proton, and it was this machine which caught the BBC's interest over its rivals — which included the then unreleased Sinclair ZX-81. Acorn soon had a working prototype demonstrating the main features of the machine, and after extensive discussions between the BBC and its advisers Acorn was given the contract to produce the BBC Micro. The contract stipulates that the machine is simply to be called "The BBC Microcomputer" — no trade names are to be used.

The BBC and its advisers kept in close contact with Acorn's engineers while the BBC Micro evolved. The crude prototype has been developed into a product that greatly exceeds the original specifications. The machine is currently being manufactured by ICL and Cleartone.

There was close co-operation, too, between the BBC and Acorn's software engineers developing the machine's Basic. The resulting language is close to Microsoft Basic — as used by Pet, Sinclair, Nascom, etc. — but with many extensions to control the wide range of features of the new machine. The Basic and the operating system together are contained in 32K of ROM — by any standards, a huge quantity of ROM to devote to built-in functions and commands.

The BBC Micro is based on the 6502A microprocessor, the 2MHz version of the tried and trusted 6502. Externally, the computer is larger than most competing machines, measuring 415 mm. by 350 mm. It accommodates a completely internal power supply and there is space on the main circuit board for over 100 chips. There are two very advanced custom-made chips, one controlling the graphics, the other handling the serial interfaces.

	Resolution	Text	Colours	Memory
0	640 by 256	80 by 32	2	20K
1	320 by 256	40 by 32	4	20K
2	160 by 256	20 by 32	16	20K
3	—	80 by 25	2	16K
4	320 by 256	40 by 32	2	10K
5	160 by 256	20 by 32	4	10K
6	—	40 by 25	2	8K
7	teletext	40 by 25	16	1K

Table 1. Graphics modes.

There are two models of the BBC Micro. Model A sells for £235, and Model B for £335; both prices include VAT. Model A can be upgraded to a Model B for about £135 by taking it to any Acorn dealer. Partial or do-it-yourself upgrades are not really recommended.

Model B has 32K of user memory, while Model A has only half this amount and cannot use some of the higher-resolution graphics. Other features only available on Model B include a serial and parallel interface for printers, an eight-bit user port, four analogue inputs, and a bus extension which allows teletext, Prestel and various other expansion units to be fitted. The analogue inputs measure voltage and so could be used for joysticks or in almost any situation requiring voltage measurements.

Another particularly interesting interface is called the Tube. Through it, a second computer — called the second processor — can be attached; it is controlled by the BBC computer and all programs or data are sent to or from the second processor through the Tube. This approach could allow the system to be expanded almost indefinitely.

Both models have the same amount of ROM, and both have access to all the Basic commands and operating facilities. No extras ROMs are needed for colour, drawing or sound facilities, unlike both the Vic and the Tandy colour computer. The cassette interface in both machines can operate at 300 baud — the same rate as the Sinclair and the Atom — and 1,200 baud. The computer incorporates a small relay which will enable suitable cassette machines to be started and stopped automatically, though this facility is only available on cassette players that have the proper motor connections.

Sound and graphics

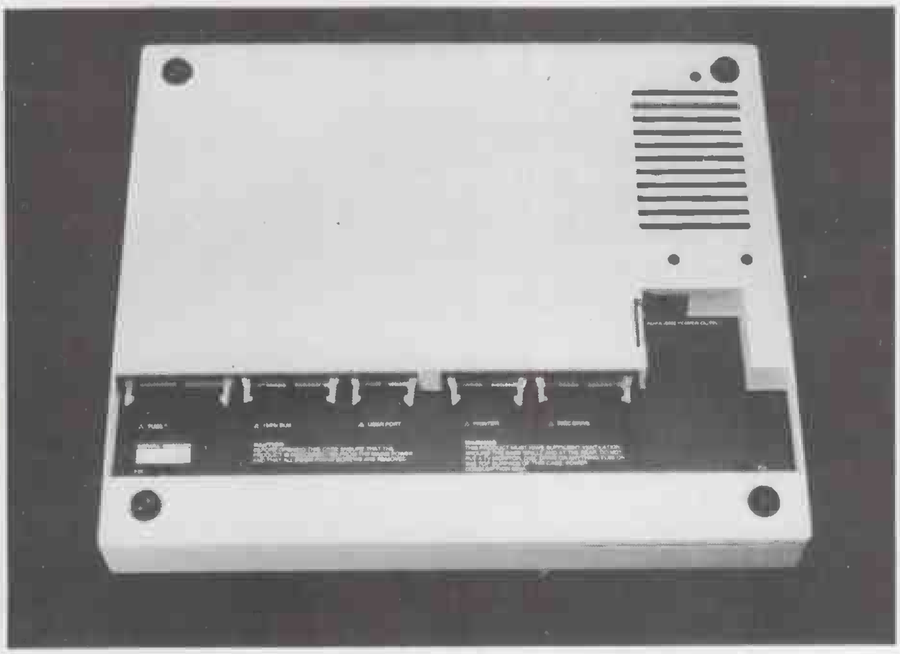
The same excellent keyboard appears on both models. Its 64 keys are laid out in the normal QWERTY style and give a really professional feel. Along the top there are 10 additional user-definable keys. All keys have auto-repeat.

There are eight different graphics modes, most of which enable text and high-resolution graphics to be mixed anywhere on the screen — see table 1. All the modes are memory mapped. Since modes 0-3 use 16K or more of memory they are only available on Model B. Mode 7 has the same format as a teletext display, allowing colour graphics with only 1K.

The display is free from flicker or video interference. The Colours column in table 1 indicates the number of colours which can be shown on the screen at any time; they can be any of eight colours, and eight flashing colours.

Both versions of the BBC Micro have a special sound chip fitted as standard, allowing up to three-note chords. There is also a noise channel capable of producing four different noise effects. Software is included in the operating system enabling envelope control of all channels without having to Poke to any registers.

Up to eight different envelope shapes can be stored in memory. Strings of notes can also be stored in a special buffer. On command they can be played back automatically while the computer is doing other things. Sound is normally played through a small internal speaker, or can



be fed to an external amplifier. The noises are very similar to those available from a Vic, but on the BBC Micro they are very much easier to control. Although of little practical value, sound effects do add an extra dimension to games.

The 32K ROM contains a large number of fairly complicated commands to control the graphics, and it is well worth the effort needed to get to grips with them. As well as the usual Move and Draw, there is an extensive set of Plot commands which enable points, lines or even dotted lines to be drawn anywhere on the screen, either at absolute co-ordinates or relative to the last point plotted.

It is possible to draw triangles and fill them with colour to make complicated shapes appear solid rather than just outlines. I managed to fill triangles with coloured stripes, giving the effect of a range of new colours. The short program in figure 1 demonstrates this by drawing random triangles in random colours over the screen while printing "Hello Fred" and scrolling.

The BBC Basic has some minor differences from the familiar dialects. The most immediately obvious is that a "?" no longer means Print, which is effected by "P". The formatting of the Print statement is slightly unusual but it is flexible: for example, a table of prices can be tabulated to align all the decimal points.

The Peek and Poke commands have been replaced by a "?" — a remnant of Atom Basic — which is far more flexible than Peeking and Poking memory locations. The automatic line-numbering facility and an almost instantaneous Renumber command are both very useful. The Tab X,Y command instantly moves the cursor to any position on the screen for printing. The On-Error function allows error trapping.

A much-improved version of the Atom assembler is also built in. It enables the mixing of Basic and assembler statements anywhere in the program. Features such as Repeat-Until loops, functions and procedures appear to have come straight out of Pascal. Subroutines can be called by name rather than Gosub commands. These features add up to an extremely powerful and flexible Basic which is certainly better than any machine in its price range.

```
10 MODE 2
20 FOR X=0 TO 255
30 GCOL X,X
40 COLOUR X
50 PLOT 85,RND(1280),RND(1024)
60 PRINT" HELLO FRED "
70 NEXT
```

Figure 1. Random triangles.

The BBC Microcomputer has been designed from the outset to be expandable. Many of the most useful extensions are available simply by plugging in the appropriate chips: for example, the floppy-disc interface and the Econet interface are on board. The unusual voice synthesis option also consists of a few chips to be plugged into the main board. The chips serve two purposes; they enable the computer to speak, and they control special cartridge ROM packs that can be fitted. Acorn says that the voice patterns used in the speech chip are those of news-reader Richard Baker — after all, it is the BBC's computer.

The chip has a built-in vocabulary of about 150 words, while additional words can be built up from elements known as "allophones". The speech controller will also load data out of special ROMs into the computer. These will be in small plastic packs slotting into a connector which is usually hidden under the plastic surround of the keyboard.

It is planned to make the Prestel and teletext adaptors available separately, or together in one box. The prices, which have yet to be finalised, should be about £120 each or £200 for both. They will provide all the normal teletext and Prestel services, and will allow downloading of programs or data directly into the computer. The Prestel extension will allow two computers to send programs to each other over the telephone. Neither adaptor is likely to be available until the Spring of 1982.

At about the same time there should also be a choice of second processor, either another 6502, or a Z-80 which can run CP/M. Both will come with 60K of user memory. Also planned is a 16-bit processor — probably the National 16032, similar to a 32-bit minicomputer in many ways — which can address up to 16Mbytes of memory and will probably come with 128K or 256K of RAM. All the second processors will communicate through the Tube.

Two television monitors are already

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available: the black-and-white model costs £105 while the colour version costs £288 — a very reasonable price for a colour monitor. A cassette recorder will be available for £26 and includes the appropriate connection for motor control. Various leads for printers, monitors, etc., are also available.

Software support

A user manual is supplied with the BBC Micro, giving a guide to the machine's functions and the software. Most of the book deals with the Basic, describing each Basic keyword separately. There is also a brief description of assembler programming. This book is not intended as a course on Basic programming, but is aimed more at those who already have a brief understanding of Basic.

Also included is a cassette of 16 programs. There is nothing particularly exciting here: an introduction to the computer and a few demonstration programs using the high-resolution graphics, a Biorhythms, a Breakout and others in similar vein. A booklet describes each program and gives instructions on how to set up the computer. As usual there is a lead to connect into the aerial socket of a TV — as usual, the lead is too short.

This computer will have plenty of good software to support it. The BBC has commissioned several major programs, including a professional word-processing package and a financial-modelling program. Others that will be available include Home Database Management, Computer-Aided Design — both scientific and business simulations — and a range of telesoftware programs. Games and other less serious software will no doubt be available from many sources.

No microcomputer can ever be totally free from criticism, though the BBC Micro has nothing seriously wrong with it. I would have preferred a case that was a little more robust, and there is even a notice on the underside warning against putting anything heavy on the top. This is a pity, because the flat top forms an ideal platform for a small TV or monitor.

The 32K of user memory could prove to be a limitation. On a complete system with discs, Econet and a printer fitted, the operating system may use up to 8K. Coupled with Mode-0 graphics, the user is left with only 2K. Acorn says that such a system would certainly warrant a second processor, which is fine if the additional costs can be kept reasonable.

One peculiarity when using Mode-7 graphics is that some keys will display the wrong characters on the screen. It happens because this teletext-compatible mode has a peculiar character set including fractions, whereas all the other modes have a more normal set.

No cassette lead is supplied with the computer on the grounds that any particular lead supplied would at best fit only 30 percent of existing cassette players. On the review machine part of the bottom line of text dropped off the screen. This fault was worse in some modes than others and may have been due to the computer itself or the monitor being used.

Though 40 characters per line is often considered the maximum that a normal television can show, the BBC Micro displays 80 characters per line on a normal black-and-white television while remaining completely legible. On a colour set 80 characters per line becomes uncomfortable, but it is readable. The improved readability is no accident — the character set has been specially designed, with all the vertical bars of each letter two rather than the normal one dot wide. The teletext mode gives one of the most readable displays I have seen.

Conclusions

- **On the whole, the BBC Micro is an impressive machine.**
- **It is certainly more advanced than any Japanese or American product available at the moment — altogether an advanced and flexible tool which really lives up to the term "personal computer".**
- **It looks good and it gives a high-quality display on most televisions.**
- **Predicted sales of 100,000 in the first year no longer seem surprising with a machine of this quality, so let us hope that enough can be built to meet demand.**

Commodore Vic-20

Boris Allan evaluates Commodore's sub-£200 micro, the Vic-20, and pits its computing power against the Atom in a series of performance tests

THE VIC-20 is not intended for the experienced user, so it was from the viewpoint of the novice that I approached the machine.

The system used in this review is the "minimal" Vic-20 set-up, based on the smallest machine with 20K ROM and 5K RAM. It costs about £190. The Commodore cassette recorder costing about £50 was included because the Vic-20, like the Pet, cannot be linked to an ordinary cassette recorder.

Peter King of the Manchester Byte Shop/Computerland loaned me a demonstration machine that the shop had been using for some four months. It had been left switched on all day and every day and I have seen it used — and abused — in many ways. Yet it still works well. I have a dread of overheating small microcomputers, but the Vic-20 does not seem to have any such problem.

Bounce-free

One of the most important items for the first-time user is the keyboard. If it is shoddily made or poorly interfaced to the processor, too many confusions can arise. The Vic-20 scores a distinct plus by having a proper keyboard, with no key-bounce or other vices. I have seen grown men and women reduced to a mass of blubber by a TRS-80 or Atom keyboard-bounce. When I type RUN, I expect to see RUN on the screen and not RUNN.

My nine-year-old daughter did manage to outwit the keyboard once. Aiming to hit the space bar, she hit the M too, which then stuck, though we soon wiggled it loose.

The layout of the keyboard with its fancy graphics shapes takes some effort to master. At the end of my trials, using only the blue Vic-20 manual, I was still unable to find how to use the eight function keys on the right-hand side of the keyboard. All I could find was that "computer programmers can assign these keys as well".

The manual is a blue spiral-bound book called *Personal computing on the Vic-20: A friendly computer guide.* My 11-year-old son pointed to the cover picture of a happy, smiling family clustered around a Vic-20 and noted that the picture on the TV was an impossible one — the Vic-20 has a coloured border around the screen display. The manual claims it "will provide an excellent introduction to computing. Unlike most instruction manuals, you don't have to read through this whole book to get to the 'good stuff'". It is an improvement over the Pet manuals, but unfortunately it looks and reads a bit like a Batman and Robin comic. "Aha! With numbers you can leave off quotation marks", is a fair example of the style. Making a manual simple is not the same as treating your readers as morons, and the flippancy of the blue manual can be confusing.

The Vic-20 manual is not good enough to take a novice very far. It has 14 appendices, but nowhere could I find a memory map — though there was a screen-memory map. When I looked under "memory" in the index, both "memory" and "memory expansion" were listed, but neither had a page number against the entry, which may indicate late modifications or omissions.

Built-in graphics

The cassette recorder is simplicity itself — if you use it properly. Programs are loaded either by name or by sequence. Typing Load alone loads the next program on the cassette.

At one point I typed Load, and the Vic-20 responded with

PRESS PLAY ON TAPE.

I soon realised that the tape was too far advanced and rewound the tape, but as soon as the rewinding started the machine replied OK and then SEARCHING. Any movement of the keys produced a cue for the Vic-20 to search, which is not a happy state of affairs.

I also encountered problems in searching for programs. Sometimes a program was not found even when the tape passed over it during a search. Apart from such quibbles the system works well, though the recorder is very expensive.

Much is made in the blue manual of the Vic-20's colour-graphics and sound-generation abilities. These impressive facilities are present in the minimal system. No extra bits of ROM are required to add colour. The sound generation is unusual in that the television speaker is used, not an integral speaker.

Shades of grey

As a user of Apple and of Atom machines I am used to basic drawing commands such as PLOT X, Y TO A, B. Commands of this type do not exist on the minimal Vic-20 and the minimal system does not have high-resolution graphics.

The novice will have a lot of fun with the minimal system for graphics and Plotting commands can be bought as extras, but my son was not very impressed with the Vic-20 graphics facilities. My television at home rendered the colours as various shades of grey. Poor colour appears to be a general problem with the Vic-20 as it is with many other machines.

The Basic on the Vic-20 is very fast. Numerical accuracy might not be as important for the home hobbyist as it is for an educational user but it indicates that the Vic-20 Basic is very efficient. The Vic-20s numerical abilities were much more impressive than its colour graphics.

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The language is fairly standard, but I noticed that youngsters trying out the Vic-20 in the shop sometimes tried to use the Input statement in instant/direct mode. By and large, those whom I saw trying out the system had no difficulty in programming but, unless they had used Pets, they were often stumped by the absence of Plot commands. For a novice who wants to learn to program in Basic, the Vic-20 is a good machine to buy. However, the blue manual will not teach a novice very much Basic and it is far too lightweight to be of much use beyond the first week.

Conclusions

- **The Vic-20 keyboard is excellent, with no bounce or other problems. The machine can be left on all day without any problems of overheating.**
- **The manual trivialises, and reads like a comic. It is not sufficiently detailed to teach programming to any depth.**
- **The cassette recorder and the cassette operating system usually work well, but the recorder is too expensive.**
- **The colour graphics are not always sufficiently colourful and the absence of adequate graphics commands is an annoying drawback.**
- **The Basic used on the Vic-20 is a fairly common variant. It is very fast compared with its competitors, and just as accurate. You cannot, however, learn Basic from the manual.**

How it fared against the Atom

LIKE THE Vic-20, the Acorn Atom uses the 6502 processor, and both fit into the category of "small" microcomputers. These two machines have been compared to each other and to two larger microcomputers — the Commodore Pet and the Apple II — which are also based on the 6502.

The tests concentrated on the abilities of the various Basics, rather than graphics capabilities. The three Magi tests used to compare the machines' performance for floating-point calculations are designed to simulate practical problems as realistically as possible. So far there is only one Magi test for integer calculations, and the program is based on an algorithm for Ackerman's function which appeared in the September 1981 *Practical Computing*.

The most noticeable result of the floating-point tests is that the errors for the numerical calculations are identical for the Vic-20, Apple II and Pet. The Atom is, on average, slightly more accurate.

The timings are surprising. Though the Vic-20 is as accurate as the Apple II and Pet, it is always faster than the Apple, which is always faster than the Pet. The Atom's timings are always slower than the Vic-20 or Apple and are about equivalent to those of the Pet.

The Vic-20 is no more difficult to program than the Pet — the Basic is more or less the same — or the Apple II. Atom

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Basic is not really designed for floating-point work because:

you have to buy an extended system
you cannot use Defined functions
arrays can only be one-dimensional and have restricted names
you have to use special commands for floating-point numbers — e.g., FDIM, FIF, FPRINT
floating-point variables have a % prefix — not a suffix
generally the coding of floating-point is very unwieldly on the Atom.

The clear conclusion is that for modest-sized programs using floating-point arithmetic, the Vic-20 is the equal of the Pet and Apple II in terms of accuracy, and the

	Atom	Vic-20	Pet	Apple II
Test 1	110	87	125	92
Test 2	7.3	5.5	7.4	5.9
Test 3	92.1	42.8	51.4	46.0

Floating-point tests.

Vic-20 has the clear edge in speed — see tables 1 and 2.

A program to perform integer calculations can be run in several modes:

- Integer-alone Basic — Apple and Atom;
- Floating-point numbers in a floating-point Basic — all machines tested;
- Integer numbers in a floating-point Basic — Vic-20, Apple and Pet.

By far the fastest machine for the integer Magi test is the Atom in its default integer mode. The Apple II running integer Basic is next fastest, but not much faster than the Vic-20 in its normal floating-point mode. The difference in speed between the Vic-20 and the two larger microcomputers — the Pet and the Apple — for ordinary floating-point Basic programs is more than 10 percent. The Atom is about 50 percent slower than the Vic-20 when the Atom is running in floating-point.

The integer test requires an array to be dimensioned as Stack(1000). Since this is too large an array for the Vic-20, the array had to be declared as Stack(500) for the Vic-20 only. When all variables are defined as integer, the declaration of Stack% (1000) is accepted — the suffix "%" indicates an integer variable — but the program runs slightly more slowly. The definition of variables to be integer for both Pet and Apple leads to smaller programs which run more slowly.

Since the Atom is so much faster in its integer mode, it is a powerful machine for game-playing and discrete simulations — especially given its excellent graphics. If its ease of machine-code programming and essential "transparency" are also taken into account, then the Atom clearly leads as a cheap means of learning about the mechanics of computing. For such purposes the Atom manual is about the best I have seen, but the Atom seems rather unsuited to numerical work.

If you want a machine from which the user can make a simple transition to larger machines, then the Vic-20 is a good choice. It will run games and discrete simulations more speedily than the Pet or Apple II, and will tackle numerical work in a standard environment both speedily

Atom	Int	125
	F	333
Vic-20	F	218
	F/I	226
Pet	F	252
	F/I	278
Apple II	Int	208
	F	257
	F/I	268

Integer test where all timings are in seconds for integer Basic (Int), floating-point Basic (F) and floating-point Basic using defined integers (F/I).

and easily. The Vic-20 has an obvious claim as a machine to be used to give children some experience of computers, perhaps while using the computer to learn about other subjects.

The graphics on both the Apple II and the Atom are highly commendable, while the Vic-20 seems to be far superior to many larger machines in its colour graphics.

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SOFTY-2

Centred around a 2K RAM and keyboard, Softy-2 is a highly-sophisticated piece of equipment aimed at the professional or semi-professional systems designer. Once you have attached it to a micro, any data you enter through its keyboard directly into the 2K RAM can then be loaded into the EPROM of the host machine. Mike Hughes assesses Softy's features and performance.

SOFTY-2 CAN BE linked to a host computer through an umbilical cable which plugs into the host's EPROM socket. Data in Softy's RAM is addressed by the host machine as if an EPROM had been plugged directly into the main system, and Softy acts as an EPROM simulator which allows programs to be developed, tested and altered before being more permanently burnt into an EPROM.

The device is housed in a vacuum-formed black plastic case measuring 180mm. by 240mm. by 40mm. high with top and bottom sections held together by plastic pop rivets. The recessed top contains an insert of conductive foam to hold EPROMs which are being worked on. The printed-circuit board protrudes at the front to carry a 24-pin zero-insertion-force socket, umbilical connector, I/O data lines and a personality switch to allow a choice of EPROM.

Dual-function keys

The 28-position keyboard is of the utility metal/insulator sandwich type. Many keys have a dual function, depending on whether the shift key has been used. Softy contains a 5V regulator circuit and draws unregulated power from a power pack built into an oversized 13A plug. The power lead connects to the back of the unit, where there are also connections to a tape recorder and an output to feed a modulated video signal to the aerial socket of a standard TV set.

A number of link positions on the protruding part of the printed board allow for various user options. No parallel-pin convenience jumpers are provided, and if this type of connection is required the cabinet has to be dismantled to install it. The I/O terminations are simple printed-circuit pads, and users must solder in their own connectors for special applications.

The system contains an INS-8060 (SCMP) microprocessor together with its matching 8154 RAM and I/O chips. A 4MHz crystal drives the processor and a divider chain, which generates video sync and other signals associated with the display.

EPROM burning

The internal memory consists of a 2K 2716 EPROM which contains the controlling firmware for the SCMP. Four 2114s provide 2K of RAM as the user's main work area. A single-bit 2102 chip provides 1K RAM which is used to generate the cursor position on the video display.

The memory is driven from the eight-bit internal data and 12-bit address busbars. The same busbars are taken to buffers which drive the umbilical Romulator cable, and to the Zif socket on the front panel.

Apart from a special-character generator 74-S287 PROM, the display system

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has no memory of its own. It gains access to the Zif socket or the internal RAM when the busbars are released by the processor.

The display is unusual in that it simply displays, as a map, the hexadecimal values currently residing in a 512 byte block of memory.

The block to be investigated is selected by entering its page number through the keyboard. Taking a page as 256 bytes, pages 0-7 display the contents of whatever is placed in the Zif socket and pages 8-15 the contents of the internal RAM. The contents of the internal firmware EPROM cannot be displayed directly, but a keyboard function allows them to be block-moved into RAM space to be viewed and, if necessary, modified by the user.

The most important feature of Softy-2 is that it incorporates EPROM-burning circuitry. It will cater only for single voltage-rail EPROMs — 2716, 2516, 2732 and 2532 types. The original Softy-1 dealt only with three-rail EPROMs — 2708s and triple-rail 2716s.

The user can develop a program and test it while it resides in the internal 2K RAM. When satisfied that it is correct, the chosen EPROM is inserted into the Zif socket. A command from the keyboard burns the contents of RAM into the EPROM.

After burning in, the contents of the EPROM can be verified against what was originally in RAM. Any discrepancies are highlighted by the offending bytes brightening on the display map. Using the umbilical connection, the program can be run on the host computer or the system which is under development.

Extra bonus

Errors should normally be debugged from tests while the program is in RAM but it is a simple matter to carry out further modifications, including the subsequent burning-in of individual bits which have not previously been altered from their unprogrammed state. There is even a keyboard function, Pretest, which allows you to check whether your subsequent change can be accepted as a reburn without having to completely erase the EPROM.

The INS-8060 which controls the Softy-2 system does not restrict the type of machine code that is entered. Data is treated simply as text and the 8060 is oblivious of the sense of what is entered. Softy-2 can, therefore, be used to develop programs for any eight-bit microprocessor system.

Softy has an added bonus for users developing a control system based on another 8060. After burning in the EPROM, the program can be run on Softy, making use of the two ports which are normally scanning the keyboard. There is sufficient output drive from the 8154 ports to run LEDs or numerical indicators.

Documentation supplied with the system is rather difficult to read, and is not helped by its small print. Softy-2 is, nevertheless, extremely easy to use. A large number of keyboard functions, in addition to those already mentioned, are available to assist the programmer. A Page key selects the page of RAM required, and cursor-control keys allow a brightened-up marker to be moved to any position on the currently-displayed page. Two status registers display the current address location of the cursor.

Insert and Delete

The display itself is broken up into easily-identifiable blocks of 128 bytes by light and dark areas on the screen. The current address of the cursor can be marked before it is stepped to another position, while a register displays the displacement between the original and the new position — which is very useful when trying to sort out the addresses for relative jumps.

A recurring subroutine which does not exceed 110 bytes can be transferred into the small scratch-pad memory before being transferred as a block of data into the main RAM, starting at the current cursor position. This process can be repeated as often as necessary with the same block of data.

A block of data from 1 to 127 bytes can be defined and physically transported forwards or backwards through memory while the existing data it moves through is adjusted accordingly. An Insert function looks ahead of the cursor for a block of three or more unused bytes — hexadecimal FF. If a block is found, all data from the cursor to the start of the block is moved up one address, leaving room for an additional byte to be inserted. There is a similar but opposite Delete function. These two functions are useful if relocatable code is used throughout the program.

A further useful feature is the Match function which brightens a specified data byte whenever it occurs on the page being currently displayed. It would have been more helpful if the comparison could have been made on up to three adjacent bytes.

Interface options

With the addition of an I/O connector, Softy can be made to communicate in parallel mode to the outside world. It can, for example, interface to Centronics-type printers to obtain program dumps. Serial I/O is also a possibility but only TTL levels are readily available and external circuitry would need to be added to provide RS-232 compatibility. Firmware for parallel or serial transmission does not exist within the system, but if added via an EPROM in the Zif socket could give 110, 300, 600, 1,200 or 2,400baud rates.

Internal firmware does exist for the tape interface, and its hardware could not be simpler: it relies on the digital signal developed by the INS-8060 at its SOut pin for recording. The playback signal from the cassette recorder is fed back via a very simple level-separating gate, which regains rectangular TTL levels, and applied to the SIn serial-input pin of the INS-8060.

The recording and playback software technique, which is proprietary to the Softy-2, has been named Transwift. Documentation describing the serial, parallel and tape communications options is singularly unhelpful and failed to answer many fairly obvious questions about their use.

Some snags

The Softy-2's capabilities are quite impressive overall, though not without a few snags. The keyboard was not satisfactory. Working at machine-code level involves a large number of key strokes, and it was necessary to glance at the screen every time a key was depressed to ensure that data had been entered. On many occasions two or three depressions were required to get any response while at other times double and triple entries occurred. People who want the facilities of which this machine is capable would surely require a more reliable method of entering data. Having said that, it would be a simple matter for a user to attach a matrix keyboard via the I/O connector.

The format of the video display is such that on a normally-adjusted TV set with a small degree of over-scanning the top of the display, including the all-important status line, is out of sight as is the left-hand column of characters. It is necessary to alter both the height and width controls of the set to obtain a complete picture, and that is easier said than done with many modern colour sets.

Who might wish to use such a device? Programming in machine code is very much a chore now that there are assemblers for most micros. Softy-2 may come into its own when the major donkey-work has already been done via an assembler on a larger machine. Softy would then be used more in its burning-in role, at which stage minor corrections may be required.

Conclusions

- **Softy is good value for money as a programmer alone, and the extra facilities it offers — particularly the ability to look at 512 bytes as a map — have to be good bonuses.**
- **The 2K limit on program size dictates that Softy is likely to be most useful in developing control software.**
- **Such programs are likely to be short and modular, and Softy could prove very useful to small development laboratories designing small-run dedicated systems.**

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Database software

Corp for the Apple II and The Manager for the Pet 8032 are just two of the latest systems to hit the market. Peter Wood examines database software in general and then focuses his attention on these two packages.

DATABASE PROGRAMS are appearing at a phenomenal rate, from humbly entitled records-management systems through to programs like The Last One which claim to be the end of all program packages.

The Penguin dictionary of microprocessors defines "database" as:

1. A file of data structured to allow a number of applications to access the data and update it without dictating or constraining the overall file design or content.

2. Any file which might sound more important if called a database.

While the second definition may be somewhat tongue-in-cheek, it sums up the self-important attitudes frequently adopted towards some microsoftware and applications.

It is rather ludicrous to refer to a simple name-and-address file as a database, yet many people do so. In the same way, a simple file-handling program is often called a database-management system, which is defined by the same source as:

A complex software system designed to manage data in a database, providing security, dictionary facilities and resilience.

This definition immediately provides the user with a fair reference point from which to judge the proliferation of database programs on the market. Only a few provide security in terms of passwording, and hardly any are able to cope with partial machine failure. Some worthwhile programs are available, though they are often rather more limited than their names imply.

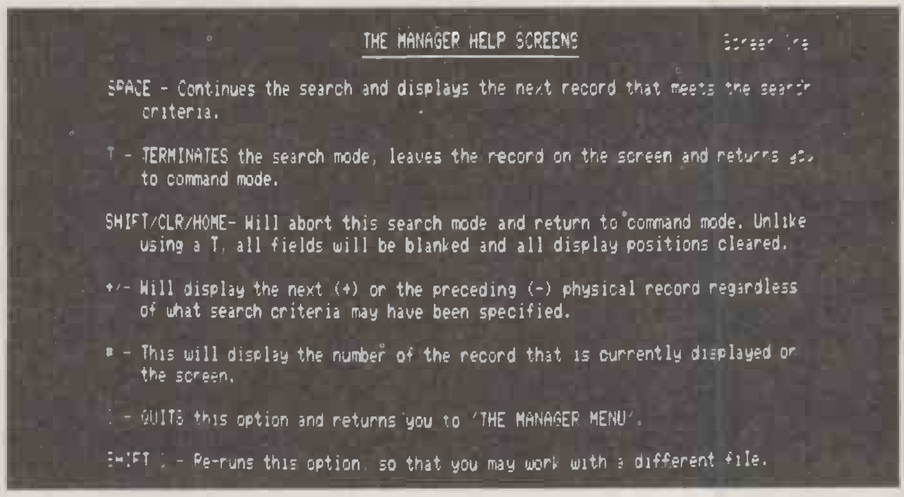
The Combined Operating Re-entrant Programming Database Management System — Corp — comes from the Maromaty and Scotto Software Corporation. Designed to run on an Apple II, it is supplied with two diskettes — the master-program disc and a diagnostic disc — and a 91-page A5 manual.

Applesoft generator

The major feature of the package is the user-defined record format used to generate a complete and separate Applesoft program, which any competent Basic programmer could tailor to the user's exact needs. The program requires a 48K Apple, two floppy-disc drives with DOS 3.3 and a suitably interfaced printer such as the Centronics 730.

Once the main program is loaded, you are presented with a main menu offering 12 functions. To utilise the system for the first time, a diskette is normally placed in drive two and must be initialised via option 3. This procedure destroys any existing information on the disc, so you are required to type "Yes" in response to the question "Are you sure"? before the initialisation will take place.

The next step is to create the data-entry program, via option 1. The initialised disc can then be used as a program-development disc, storing the program which Corp generates from the information input at this stage.



A screen map is displayed, each line being referenced by a single letter or number — 1 to 9; A to I.

You are requested to provide a screen heading, which then appears in reverse video at the top of the screen. Data-entry field may then be defined, each having a label for operator prompting. Data types may be alphabetic — A to Z — numeric — 0 to 9 — and/or mixed.

Unusually, the system can define the data type of each character rather than the entire field. A field could be set up to allow, for instance, only an alphabetic character in the first position, numeric in the second and so on. The editing abilities of the package are somewhat limited at this stage. Having to refer to each line by its reference code before editing wastes keystrokes and calls for far more thought than simply moving the cursor around the screen and drawing the required card.

It is essential to nominate one of the fields as a key field, and failure to do so is not detected until much later in the process. Having completed the screen layout, you are requested to supply a data-file name, up to 28 characters long. The maximum number of records required within the file has to be entered — keying a Return alone will default to the largest possible data-file.

Another unusual feature is the ability to ignore some of the initial characters of the key field, which can be useful if the first few digits are common or irrelevant throughout. You are therefore asked to supply the master-key Start position, which defaults to 1 if Return alone is keyed. The final entry is the program name, which may also be up to 28 characters long.

Program generation then begins. It is fascinating to watch, as line after line of Basic code scrolls up the screen without any commands from the keyboard. The auto-generated code is fairly straightforward, but it can very easily be tailored to individual requirements.

Similar program-generation facilities exist for print programs which the system creates with information provided by the user — report headings, page numbering and dates, for example. The program can format the output, taking fields you have specified and fitting them into the pre-set page width and depth. Alternatively, you may specify the positions of all the fields to be printed.

Data may be extracted directly from selected records, or may be the result of calculations based on record data and/or constants. Cross-referencing of up to four other data files is also possible within the report generator. Inclusions and omissions are catered for, with up to 10 inclusions per file allowed. Only "less than", "greater than" and "equal to" are available, so two inclusions must be used to obtain a range selection.

Sorts are provided for use on any field in the file, and may be in ascending or descending order. They can be offset within the field if required. The entire file is sorted according to the criteria set by the operator, and may then be printed, searched and so on, in the new order. The idea of sorting is a little old-fashioned these days — many programs are designed to sort automatically on the key field only — but it is still a useful capability in many applications.

Novices beware

Other facilities within Corp include disc and printer test utilities and a master directory editor for changing the pointers within the file — a very dangerous practice for all but advanced programmers. Record-length expansion, dumping of data-files and disc cataloguing are also available.

The Pet program, The Manager, consists of a program diskette, a protection "dongle" which plugs on to the cassette port and an A4 manual. It runs on a Pet 8032 computer, and requires a 8050 disc unit and an IEEE printer such as the Commodore 8024 or 4022. The Manager is marketed in the U.K. through the Commodore dealer network. It was developed by BMB Compuscience Canada Ltd, home of the MuPet system.

The Manager is designed to provide a very similar function to Corp, but goes about it in an entirely different way. Its 16 menu options are displayed once the program has been loaded, each selected by a single-letter input.

All data diskettes must be formatted before use via option F of the main menu. You are asked for the number of the drive containing the diskette to be formatted, then the disc title and identity. A warning is then displayed informing you: "This will format your diskette and in the process, erase any data that you may wish to keep! Do you wish to proceed (Y/N)"? — very similar to Corp. After formatting, you are returned to the main menu.

The record-card format is entered with the Create/Revise option. Creation is performed via a full-screen editor with which you may draw the input fields and labels in free format on the screen. To assist the erstwhile screen-layout designer, the Worksheets option will print out forms of 24 lines by 79 characters which may be used to rough out the screen before beginning keyboard use.

Shades of Ozz

On selecting option C, you are required to enter a file name and a drive number for the file. The question "Create or Revise", caters for modification of existing screens as well as the creation of new ones.

You are then asked if you wish to create a screen based on an existing layout. This option is useful if a file already exists with features in common with the one you are about to create. One or two pages must be set at this stage. Upper and lower case or the unusual option of graphics and upper case must also be chosen.

Each input field is delimited by ↑ or, in the case of a single-character field, by a back-slash. The maximum field length is 79 characters. There may be no more than 80 fields on a screen and no more than 120 in the entire record. The overall maximum record length is 253 characters.

Descriptive text and graphics may be used in both normal and reverse video. Underlining is provided for headings, etc. Line insertion and deletion are performed with the Esc key in conjunction with Inst/Del.

You are protected from accidental erasure of the entire screen via shifted CLR/Home, as you must confirm with a "Y" to the question "Are you sure (Y/N)"? The Manager's screen editor seems to owe a great deal to the inspiration of Ozz, with similarities in many of its functions.

Revisions of existing file structures may be a modification of the descriptive text, leaving any data intact, or more radical alterations to field lengths, etc., which render existing data inaccessible. The Enter/Edit option allows entry of data into the created file with a large number of Command-mode instructions. These commands are:

B	Back-up a data file
C	Change data currently displayed on the screen
D	Delete a record from the file
E	Enter data into the file
shifted E	Enter data without clearing previous data
G	Get a specific record
H	Help file
P	Print current screen display
Q	Quit. Return to main menu
shifted Q	Quit. Restart Enter/Edit option
S	Search for data in the file
shifted S	Resume search or hunt
A	Search with accumulation
I	Search using index file
shifted I	Resume index search
#	Display number of current record
↑	Field Definition
@	Quit and execute back-up option

Back-up copies the screen format and all its associated data on to a back-up diskette — a far more friendly and controllable option than having to use the normal Pet command or utilities. The Help file contains a brief description of each of the available command-mode functions as an aide-memoire.

Search allows you to find all the records with specific data in a specific position in a field. Alternatively, pressing shifted Tab after entering the search criteria initiates a position-independent search.

Accumulate is used in conjunction with the arithmetic option to count the number of records fulfilling a particular search criterion. Field Definition displays the maximum number of characters allowed within each field on the screen.

The Arithmetic option occupies 10 pages of the operator's manual where it is described as giving the user "virtually unlimited capabilities". They include multiplication, division, addition, subtraction and exponential functions, all of which may be performed on any number of fields in the file or on any one of the 99 registers provided.

Fields and registers may be operated on by another field, a constant, or by any one of the other registers. Only numeric constants are allowed, and they may not be negative and may not be more than 10 characters in length. The Arithmetic option may be used to update data within a file and to display the result of calculations in specified display positions on the screen.

Complex but sound

You will certainly have to spend a great deal of time learning the operation of this section of the program. Its principle is sound, but its complexity is relieved by user-friendly labels. Fields are referred to by numbers which are not shown on the record card, and registers are unimaginatively called R1 to R99.

The Global option allows changes to be made to every record in the file, or to selected records by search keys. If the changes are to numeric fields, then the Arithmetic rules apply. Alphabetic fields may only be replaced with the new data.

You are asked if you wish to replace the contents of any field. If you reply "Y" the field number is requested followed by the data to be entered in that field. After changes have been made to the appropriate records, the main menu is displayed.

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Index Create produces an index file for use with the high-speed index search of the Enter/Edit option. When you have set the field number and the length of data within that field to be used as a key for the index, the program will create a new index file for your data.

The Manipulate Files option provides a number of useful utility options. They are:

- Blank a file
- Copy a data file
- Display a data file
- Extend a data file
- Print a data file
- Scratch a data file

"Are you sure"? appears appropriately if Blank or Scratch are selected to prevent accidental erasure of data.

Sort Files creates a pointer file and does not actually move the data around so it is faster and rather more elegant than a straightforward sort. A number of sort keys may be used. Each one has a start position within the record and a length of key defined by the user, and may be defined as ascending or descending order.

Report generation is fairly comprehensive. The parameters may be stored in a report file, which is named independently of the data-file name. Reports may be output to the printer, the screen or the disc. Search parameters may be entered exactly as in Global Update.

The print parameters to be entered include the width of the printed line, the number of decimal places for numeric data, report title and the number of lines to be used for each record.

You are offered the option to use a pointer file created under Sort for ordering records.

Defining where you want data to be printed on the page is rather complex, as each line used for a specific record is called a relative line. You must specify where in that line the data is to appear, how long the data is, whether the data comes from record or register, whether you wish to perform arithmetic upon the data, whether you wish to use this point as a break point to space out the report for legibility, whether you wish to go to top of page after each record, and so on. It would really have been far more effective to have written a simple report editor to facilitate the production of forms, etc.

The production of sub-files is a useful feature which allows data to be extracted from the existing file and duplicated into another Manager file, or sent to a word-processor file for standard letters, etc. The data extracted may be based on the contents of the previously-created pointer file, or on search parameters entered manually.

View Files is a simple utility which allows the contents of a file to be either displayed or printed sequentially, starting and ending at specific record numbers.

Conclusions

● The Corp package is imaginatively designed and relatively easy to use.

● It cleverly makes use of the flexibility inherent in generating program code via the system for later modification, but a programmer must be employed to make changes to the program. He must inevitably spend some time learning the program structure of Corp and it would be only slightly more difficult to ask to write the program from scratch to the user's specification.

● If the layout of screen and printouts as created by the system were satisfactory for the application in hand, with little or no tailoring, then Corp would be a very viable tool for data storage and retrieval.

● The Manager gives the impression that its authors have tried to adapt and improve features of existing Pet packages.

● The screen editor looks a lot like Ozz, without the annoying Clear Screen facility.

● The Arithmetic option resembles DMS as does the report generator, and the Help Screen idea may have its roots in Anagram's sophisticated software.

● The attempt to integrate many good ideas while trying to improve on them is fundamentally sound.

● As a database package the Manager is comprehensive and versatile, but it is rather awkward and complex to set up for arithmetic and reporting operations.

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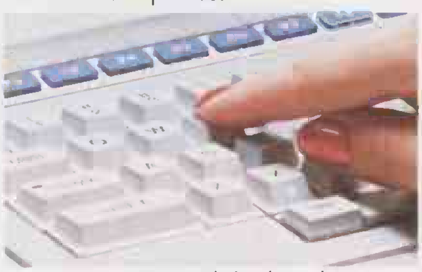

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Pet's dark secret

Harry Broomhall has devised an extremely fast, efficient and proven machine-code editor to build up and control audio-visual shows: Martin Hayman visited him.

MANY MICRO boffins arrive at their particular area of expertise via some pretty circuitous routes. One such career is Harry Broomhall's — a gent in a charcoal suit and polished shoes, with Cary Grant hairstyle and horn-rims.

Until recently, digital control of audio-visual editing had been done mostly by extremely expensive, dedicated microprocessors. It is only in the last year that the obvious cost advantages of using a standard product such as the Pet have become apparent, but now there is a rush to get suitable software working on standard machines.

It is with some surprise that one learns that Broomhall has been both a roadie — for folk singer Gordon Giltrap — and a mobile disco engineer, travelling to Greece and Germany. Admittedly he started out more prosaically as the manager of a small chain of hi-fi stores.

Regional variation

Now, after successful development of the slide-show editor for the Shepperton-based AV and video-film concern Kadek Vision, he has moved on to pastures new. In fact Commodore has been so impressed by his work that it has asked him to investigate and write a telesoftware uploader/downloader for Pet/Prestel.

Audio-visual shows, which feature synchronised music and slides — sometimes from several projectors — are a very popular way for companies to address sales conferences or to do product launches. Certain advantages over the film or video film make them particularly suitable for businesses; in particular, they can easily be tailored to suit different markets or circumstances.

A big, multinational motor manufacturer presenting a motivation show to dealers and salesmen might well wish to substitute different pictures for regional variations in models. It would certainly wish to change the voice-over from English to German to Spanish, depending on which country the presentation was to be made in. All this is easily accomplished by AV, though it can cause synchronisation headaches with video film.

Harry Broomhall's AV editor had a severe test on its public debut. it was used to build up a large and elaborate presentation for the launch of DEC's Vax-11 at Compec in 1980.

The basic controller for the whole AV operation is traditionally tape, either reel-to-reel or cassette. One track is used to control the slide projectors with a 1kHz pulse, leaving the rest available for music and speech. Everything must be controlled from one source, otherwise it will slip out of synchronisation and once that happens it is very difficult to recover. The slide-control track used to be built up with a paper-tape reader, and once the programme was complete, those instructions were transferred to magnetic tape.

This procedure had two drawbacks. Firstly, paper-tape readers are mechanical devices and do not take kindly to travelling. The AV show is mobile by its very nature so the PTRs had to be carefully adjusted before each show. Even then, there was no assurance that the paper tape would stay in synch with the audio track. The best-quality magnetic tape stretches while paper tape does not. In a long show the consequences could be embarrassing.

Interfacing solutions

The AV industry, a descendant of the magic-lantern of a century ago, started in earnest some 15 years ago and has moved in leaps and bounds ever since. Demand for more screens, larger presentations and more sophisticated screen effects has been followed by external facilities ranging from extra lights to heavy-duty servo controls — to rotate a car on a platform for example. Such sophistication has made the editor's job unmanageable when relying on the traditional techniques of recording fades and dissolves on to audio tape via punch tape. About five years ago the first microprocessor-controlled editors started to become available. These dedicated microprocessor controls were expensive, and each one was tied to one manufacturer's hardware.

One of the problems in implementing control from a standard micro, which held out the promise of much greater flexibility and lower cost, was that of interfacing. To this end, Kadek Vision's consultant hardware engineer, Alan Paton, designed several interfaces. They can be used either singly, for a particular application, or rack-mounted if a variety of different applications is envisaged.

The other aspect of the problem was

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writing suitable software to give AV editors the kind of control system to which they could adapt easily. Most AV editors who were used to using the old PTR system, or the dedicated micro systems which succeeded them, preferred to have 'dedicated' push-buttons for fades, dissolves, cues and all the other instructions which are used to build up a show on screen.

This much Harry Broomhall knew before he embarked on writing the program. He already had some experience of the requirements of the industry through an AV venture of his own. He had written an editor in Basic, which was what brought him to Kadek Vision's attention. With that degree of AV knowledge he had got to the point of realising that a real-time editing system on the Commodore Pet would have to be written in machine code.

Quasi-animation

When the program is loaded the Pet screen splits in half horizontally. A reverse-video band reads across:

Cue No   Projector   Cue effect.

These columns are used for the step-by-step editing.

The first selection is made in response to the invitation "Set up screens". There are 20 screen positions, each of which can be occupied by one or more projectors. If it is intended to use only one screen with the usual three projectors — hire companies tend to lease out the industry-standard Kodak SAV carousels in threes — a three-squares-deep oblong is enclosed.

When screen definition is complete, the Pet responds with "What type of terminal"? Choices are

0 = None
P = Projector
A = Auxiliary.

Auxiliary is a six-switch controller box. It may be used to control lights, to cue up animated models, to revolve a piece of earth-moving machinery or for other such exhibitionistic wizardry.

Usually three projectors are dropped into the box, each one displaying to the same screen. Three is a suitable number for a single screen because it is quick and allows smooth dissolves and quasi-animation sequences.

Program editing

Such quasi-animation can become extremely complex when working across two or more horizontally-disposed screens. A ripple — where a picture is moved across a number of screens, possibly changing in real time — is not too difficult. Director Alan Carr said that Kadek had recently produced a sequence of a steer being lassoed and roped up by a cowboy, and this was pushing towards the outer limits of AV animation.

With three projectors in each screen box, the VDU shows a number to identify each projector, a cursor in the form of a "greater-than" symbol, and a further number to identify which slide in each projector's sequence is currently under examination. A bar-chart symbol reads out the intensity of the projector light. If the intensity of the light is increasing, the cursor shows "greater-than"; if decreasing, "less-than".

When screen definition is complete, the program moves on to Cue 1 and the actual work of editing begins. The cue being worked on is pulled up in reverse video. The editor specifies under "Projector" which projector is to be actioned — any or all.

The cursor then moves on to "Cue effect", which can be any of the panoply of effects needed; the choice includes 16 dissolve rates, delays, wait states, plus shutter for instant blanking and loops defined by a number of different cues and auctioned by *(n), where n is the number of times round the loop.

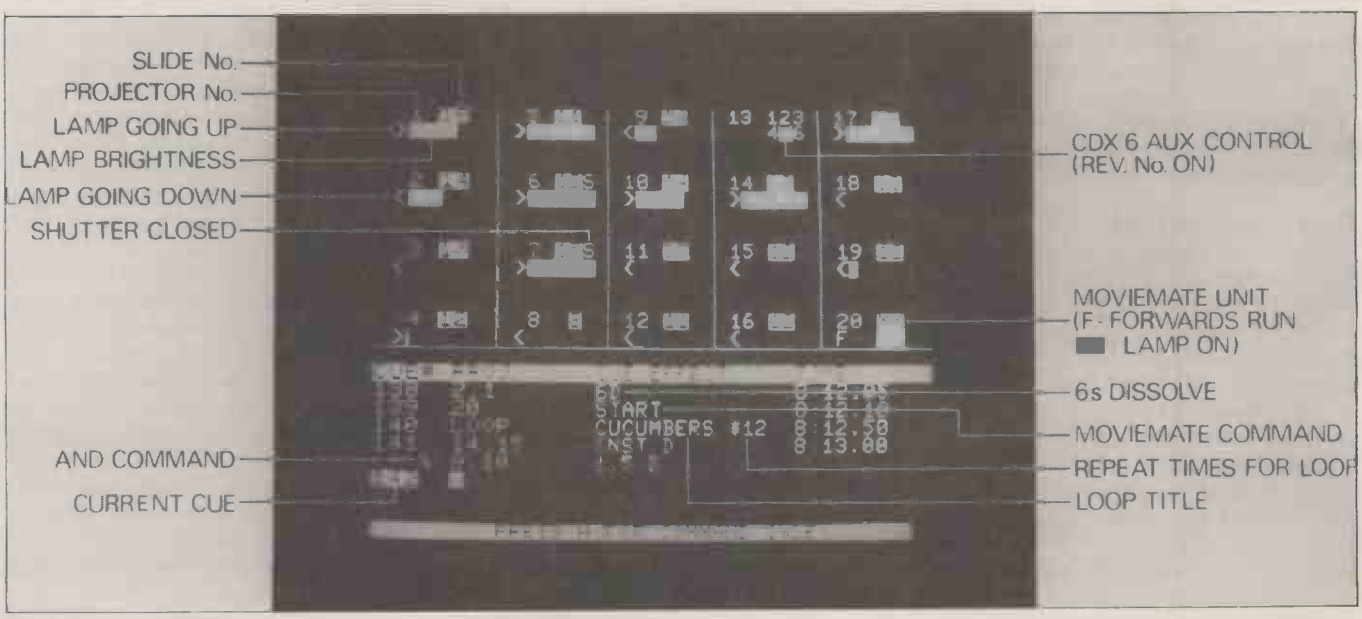
Eight cue lines are visible in the VDU window, but the editor may scroll the program backwards and forwards at will. If he moves forwards, the Pet attempts to implement the show at breakneck speed. There is also a manual override. Backwards scrolling causes no such problem. There is a Program Locate command which allows you to go to a numbered cue and examine it. Control Insert and Control Delete allows extra cues to be dropped in or cut out and incorporate automatic cue renumbering.

Maximum capabilities

The system is surprisingly economical of disc space. The average 10-minute AV show requires about 300 cues while a double-sided diskette for the Pet 8050 stores around 6,500 cues. All disc handling, including checking, is done by the program. It is structured so as to allow one communications protocol block to be substituted for another, making it an easy matter to substitute the I/O routines for Kodak control boxes instead of the French-made Auvitec, for which Kadek is the British distributor.

The complete AV programme will generally be transferred on to tape — usually cassette for compactness on the road — although it is possible to run the show direct from the Pet. Occasionally, where high-quality sound is needed as well, reel-to-reel tape may be substituted, but Harry Broomhall emphasises that this is principally for the audio signal. It is possible to run the AV show from a relatively low-grade cassette machine, he says.

So what are the ultimate capabilities of the machine? I list here, for information, a maximum configuration which can be controlled from this programme: eight-track reel-to-reel tape machine, using four tracks for high-quality quad audio, two strobe lights; one laser; two effects projectors; 20 slide projectors. I need hardly add that this was the rig which launched the Vax-11 at Compec.



Computer operation bears striking similarities to the biochemical process of cell reproduction. John Leach presents a modelling program which devises your own self-replicating genes.

DNA — the first machine code

A MACHINE-CODE program must be exact — as a single error, such as a data byte missing after a code instruction expecting one, will cause chaos. A slip like that means the next instruction byte will be taken as data and the following one, which the careless programmer may assume to be data, will be interpreted by the micro as an instruction. This type of mistake is called a frame-shift error.

Anyone who has set off on the machine-code trail will know of the frustrations and problems caused by such blunders — especially if he has entered hex code directly, instead of using an assembler.

How is a machine-code program created? You, the programmer, write it and store it in your machine. In turn, the complex organism which you are was programmed by a genetic code, essentially identical to the code which made your dog, your potted rubber plant and the yeast that makes the beer you drink to drown your sorrows when your program crashes once again.

Luckily for us all, the genetic code rarely crashes — a remarkable fact considering that every cell in your body contains a complete replica of the code. The genetic code is an infinitely subtle machine code, quietly ticking away in every cell of every living thing.

At about the time that computers were beginning to evolve from the amazing rooms full of valves and boxes to something like the machines we know today, a tremendous amount of work was being done to crack the genetic code. This really started with the very short but enormously influential paper by Watson and Crick in 1953, which for the first time described the double-helix structure of DNA and showed how genetic information could be stored and replicated when cells divide. DNA is the biochemist's shorthand for deoxyribonucleic acid, which had been known for many years.

During the following 25 years, Nobel prizes were scattered like confetti for the brilliant work done by biochemists all over the world who painstakingly worked out the detailed mechanisms of the genetic system. So successful were they that today we have just about reached the stage when new genetic material can be designed and built into a code to produce new biological substances.

We shall have to wait a while, though, before new life forms can be made. Nevertheless, simple modifications to existing organisms are already possible by gene splicing — code from one organism is inserted into the DNA of another.

What, then, is the secret of the genetic code? Unlike a computer which works in binary notation, where every bit is 0 or 1, DNA consists of a code made up of four chemical bases, called adenine, guanine, cytosine and thymine — A, G, C and T for short.

They belong to two chemical classes: the purines; adenine and guanine; and the pyrimidines; cytosine and thymine. This is very important because in the DNA helix a purine fits with a pyrimidine in a spiral staircase-like manner to form a base pair, the steps in the staircase being A-T and G-C.

Millions of base pairs fit together neatly to form the DNA double helix where the sequential code on one strand of the helix is exactly complemented by the code on the other — purine v. pyrimidine and pyrimidine v. purine.

DNA codons

During cell division the DNA "unzips" and two additional copies are built by adding the complementary bases to each strand so that in the end two identical copies of the original DNA result. This process goes on every time a cell divides, for tens of millions of years in the case of single-cell organisms, with scarcely ever a fault.

The DNA strand is made up of a series of codons, each of which consists of exactly three bases. A simple calculation shows that there are 4^3, or 64, possible codons, or biological machine-code instructions. Each codon has a special function, which is normally the production of a specific amino acid. Proteins are built up from the 20 amino acids, so why are 64 codons needed?

Any machine-code program must have a way of starting and stopping, so DNA has start and stop codons. Also there is redundancy in the code as more than one codon can generate a particular amino acid. Finally, there are some nonsense codons which correspond to hex numbers which your micro chip does not recognise as valid code.

Now let us compare the genetic code mechanism with a typical microprocessor — see table 1. We are only looking at the way DNA code is converted to protein, and ignoring large areas of current knowledge, such as the synthesis of DNA, the selection of sections of DNA code, the regulation of synthesis and so on.

Let us look at table 1 a little more closely. There is a well-known central dogma of biochemistry: "DNA makes RNA and RNA makes protein". Like all known dogmas, this one has been breached by crafty viruses that force cells to make new DNA from the virus RNA which then goes on to make new virus. So what about this RNA?

The name RNA is short for ribonucleic acid in contrast to DNA which is deoxyribonucleic acid, so from the names alone you can see that they are similar. Like DNA it consists of a long string of bases, but there are several kinds of RNA in the cell.

First, there is a type called messenger RNA which is a replica of a part of the DNA strand which codes for a complete protein, and will be several hundred codons long. You can now see why DNA needs start and stop codons so that a small section of all the millions of codons can be picked to make a particular protein: think of it as a DNA subroutine if you like.

The vital role of the messenger RNA is to attach itself to a start codon of the DNA and to be copied base by base until a stop codon is reached — rather like fetching a copy of a macro from a system library on a large computer. The messenger RNA then detaches itself from the DNA and sticks itself on to a passing ribosome, a minute cell particle which is just visible under an electron microscope.

These ribosomes, which occur in thousands in every cell, do the work of making the protein, by reading the code in the messenger RNA. Once the messenger RNA is attached to the ribosome, it wants to gather the necessary amino acids from the surrounding cell soup to build the protein. How can this be done, when all it consists of is a long strand of codon triplets?

Floating in the cell are thousands of short RNA strands shaped like old-fashioned hairpins. They all, very ingeniously, have one of the 20 amino acids bound to one end, while at the other end there is a tiny loop of bases, which contains the anti-codon, or complementary base set, to the RNA codon for the amino acid.

There is a very strong chemical affinity between the so-called transfer RNA anti-codon and the exactly-matching codon on the messenger RNA. So the correct amino acid on the transfer RNA is picked from all the others and stuck on to the newly-formed chain of amino acids being built on the ribosome. The time scale for all this is in the order of milliseconds.

The proteins made on the ribosomes have all kinds of uses in the cell. The most important are those with very specific chemical activity called enzymes. Thousands of different enzymes coexist in the cell, and some of these do the work of copying DNA to messenger RNA, synthesising new protein on ribosomes, and cutting, splicing and reproducing strands of DNA itself.

So part of the code residing in the DNA must be concerned with making proteins which make new DNA, the powerhouse of the self-replication phenomenon. How is this done?

500 million years is a long time to develop a system and not all the secrets have yet been unravelled. In particular, very little is known about the details of the regulation of protein synthesis; how, exactly, does the cell know just how much of a specific enzyme to make? Even more profound is the unanswered question of how a cell knows that it is a liver cell, and not a cell responsible for growing your big toe-nail.

In his fascinating book *Godel, Escher, Bach,* Douglas Hofstadter took on the whole question of recursion, self-replication, provability in mathematics, musical fugues, the impossible objects in Escher's pictures and Lewis Carroll's paradoxes, showing in a brilliant way how they all hang together. One of his proposals was for a simplified scheme for DNA replication.

Without apology, but with homage to a genius, we present the Hofstadter genetic code, and a new program which will enable you to play with his system and devise your own self-replicating DNA. In deference to Hofstadter I have called the program The Biological Evolution Game; those of you who have read the book will appreciate the reason why. When you have discovered how tricky it is to play the game, you will have gained some insight into the wonderful way the biological cell functions.

To make things a little easier, Hofstadter's DNA, or HDNA for short, consists of two base pairs per codon, giving 16 possible codons instead of 64. Each codon produces a specific amino acid, which behaves like an enzyme. One of the amino acids will cut the HDNA strand, another will search for a purine along the strand, and another will insert T into the strand.

3-D structure

All these amino acids are joined to form an enzyme, which, because of the activity of the amino acids, is multi-functional. So our simplified enzyme corresponds to a whole set of enzymes which occurs naturally in the biological cell.

Table 2 is a list of all the codes which can exist, and the corresponding amino acids. Also you will see another column, "shape", which determines the structure of the enzyme.

Real proteins do not consist of just a random chain of amino acids; they also have a vitally important three-dimensional shape which, for an enzyme, determines to what kind of chemical it will attach itself.

As a real example of this, if just one of the hundreds of amino acids in haemoglobin, the red, oxygen-carrying pigment in blood, is changed, a nasty condition called sickle-cell anaemia results.

The three-dimensional structure of proteins is thus most important, and this structure is determined by the amino acid composition. Likewise our H-enzymes, as we shall call them, have a shape, but only in two dimensions. This is done by assigning a shape direction to each amino acid, shown in the table as: "s" — straight on; "l" — left; and "r" — right.

Under the rules for HDNA, an H-enzyme will first attach to a specific base only if it has the right shape. If the first segment is made to point right, the shape of the H-enzyme is determined by the direction of the last amino acid. So if the last segment points right, the H-enzyme attaches to the first A starting from the left of the HDNA strand; up attaches to C, left attaches to G and down attaches to T.

The attachment is determined only by the first and last segments, ignoring any bends and wriggles in between. The program allows you to have a look at the H-enzyme structure on your screen.

So how do you go about creating a new

(continued on next page)

Characteristic	Microprocessor	Genetic code
Instruction set	50-500	64
Execution time	1-5µs.	10-100ms.
Length of program	10-10,000	3,000,000,000 — human
Self replicating?	Not normally	Yes
Device size	100-1000cc	1-10 x 10^{-7}cc
Development time	Hours-years	> 500,000,000 years
Power source	Electricity	Chemical energy
Decoding	CPU	RNA
Site of action	Memory, VDU, I/O port	Ribosome
Final product	Text, calculation, Robot, etc.	Protein

Table 1. The mechanism of a microprocessor and the processes of replication.

(continued from previous page)
HDNA strand using the program, which obeys Hofstadter's rules? When the program if Run, you are asked to enter the seed HDNA. Later, all newly-created HDNAs are compared with the seed to see if an exact match has been created. Enter the seed into the computer, using A, G, T, and C as these are the only valid base pairs. When you have done this you will see a menu displayed which asks for the next action. The options are:

1. Display HDNA strands
2. Display H-enzymes
3. Select HDNA for treatment
4. Select H-enzyme for action
5. Display H-enzyme structure on the screen
6. Sort HDNA strands into order
7. React H-enzyme with HDNA

Obviously you cannot execute option 7 until an H-enzyme and an HDNA have been selected. You must realise that there is just one H-enzyme for each HDNA strand on the list. Each time an H-enzyme is requested, it is generated from the corresponding HDNA, so there is no storage of H-enzymes separately.

The H-enzyme is created by reading along the selected HDNA, starting from the left, taking the bases in pairs and generating the corresponding amino acid as shown in table 2. If a base is left over, it is ignored; also the creation of the H-enzyme ceases when an AA codon is reached — the Stop codon.

However, there is nothing to stop you having AA codons in an HDNA strand, as this will be read as such if it starts at an odd base number. This brings in the concept of the frame shift, which causes such trouble in computer machine-code programs. For example:

ATAGAATC gives SWI.DEL.(STOP)
but
CATAGAATC gives MVR.RPY.INA.SWI.
plus an odd C

This frame-shift feature may seem a little artificial, as it would mean completely different sets of proteins would be produced in the biological cell, according to where the Transfer RNA mechanism started to read the DNA strand. Amazingly, this phenomenon has been discovered in a minute virus, phi-X185, whose genetic code contains overlapping sequences for different proteins.

Remember that in the Biological Evolution Game the attachment point of an H-enzyme depends on its structure, so you can build in frame-shifted code if you are ingenious.

After you have entered your seed HDNA, the program generates the corresponding H-enzyme which reacts with the seed to give one or more new HDNA strands, they can be listed via the option menu. For each new HDNA there is a corresponding H-enzyme. During the HDNA creation process, a check is made to ensure that the H-enzyme is attached, i.e., that it can find at least one base required by its structure specificity, and that an identical strand to the starting HDNA is not produced. In other words the H-enzyme must actually modify the HDNA.

Any HDNA of less than four bases is ignored by the program, and will not be put into the HDNA list. An arbitrary limit of 50 HDNAs has been set. If you cannot solve the problem in less than 50 HDNAs, turn to your Rubik's cube for light relief.

Remembering that the H-enzyme will attach at some point starting from the left of the HDNA strand, it then proceeds to act on the HDNA according to the rules. Assuming that a complementary copy will be needed at some stage, the program creates a dummy copy of the same length as the starting HDNA.

However, no complement is produced unless the COP switch is on. So, if you want to create a complementary copy, remember to include a CG in your HDNA equivalent to the selected H-enzyme. Similarly, copying ceases if Off is encountered, but it can, of course, be replaced later.

The SWI instruction switches HDNA conversion from one strand to its complement, if it exists at that point. If it does not, the H-enzyme stops working. If a switch is successful, all subsequent work is done on the alternate strand, but another SWI will switch the H-enzyme back.

If a complementary strand is being created, an A on the reacted strand will create a T on the complementary strand, and vice versa. In the same way, G creates C and C creates G.

Del deletes the current base — and the complement if it exists — and Cut slices the strand and complement and stops the H-enzyme action. The remaining amino acid instructions are concerned with moving, searching and inserting. A MVL moves the H-enzyme one base to the left, until it reaches the leftmost end, when it will stop and detach. Similarly for MVR to move right.

Improved representation

If COP is active, the complementary base is also created, otherwise it is ignored. RPY and RPU search for a pyrimidine — A or G — or a purine — T or C — to the right, and LPY and LPU search similarly to the left. If the end is reached without the search succeeding, the H-enzyme stops; during the move the complement is created if COP is on.

Finally, the insertion instructions INA, INC, ING and INT insert the appropriate base to the right of the current position, and, as usual, insert the complement if COP is on. That completes the simulation. Start with a seed, create some HDNA, react the corresponding H-enzymes with one of the HDNAs and see if you can reproduce the starting strand.

You may find it useful to sort the HDNA strands from time to time, to see what you have done. If you have created 10 HDNAs, including the starting seed, you will have potentially 10 by 10 HDNA/H-enzyme combinations at your disposal. Another slight variation from Hofstadter's original protocol is that after creation of new HDNA, the original still exists.

The program was written for an 8K UK101, with the Basic 3 EPROM from Mutek, which corrects the well-known garbage collection problem when dimensioned string arrays are used. Apart from the screen display of the H-enzyme structure the program should run on any Microsoft Basic machine.

The display section could easily be omitted, as it is a little ornamental, in which case substitute a "Not Implemented" message if option 6 is called. When installing the program, omit all Rems, as this printed version of the program was listed from a UK101 with 8K of additional memory. Without the Rems you will have plenty of space to install the program and run it within 8K.

A copy of the program recorded on tape with Rems removed, for running on the 8K UK 101 or Ohio Superboard, is available for £5 from Dola Software, 117 Blenheim Road, Deal, Kent.

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Codon	Amino Acid	Shape	Function
AA			HDNA break — stop codon
AC	CUT	s	Cut strand and complement if any
AG	DEL	s	Delete base and complement if any
AT	SWI	r	Switch strands if second exists
CA	MVR	s	Move right, copying complement
CC	MVL	s	Move left, copying complement
CG	COP	r	Turn on copy mode
CT	OFF	l	Turn off copy mode
GA	INA	s	Insert A; T to complement
GC	INC	r	Insert C; G to complement
GG	ING	r	Insert G; C to complement
GT	INT	l	Insert T; A to complement
TA	RPY	r	Seek pyrimidine to right
TC	RPU	l	Seek purine to right
TG	LPY	l	Seek pyrimidine to left
TT	LPU	l	Seek purine to left

Table 2. Codons, amino acids, shape and function for HDNA.

(continued from page 88)

```
100 REM The biological Evolution Game
110 REM
120 REM Written for the standard UK 101 with New Monitor
130 REM
140 REM PRINT CHR$(12) gives screen clear
150 REM
160 AC=64: S1=53248: S9=54271                          : REM Constants
170 DIM BS$(4): FOR I=1 TO 4: READ BS$(I): NEXT        : REM Bases
180 DATA A,C,G,T
190 DIM AA$(16): FOR I=1 TO 16: READ AA$(I): NEXT      : REM Amino acids
200 DATA BRK,CUT,DEL,SWI,MVR,MVL,COP,OFF
210 DATA INA,INC,ING,INT,RPY,RPU,LPY,LPU
220 DIM DX(16): FOR I=1 TO 16: READ DX(I): NEXT        : REM A.A. orientations
230 DATA 0,0,0,3,0,0,3,1,0,3,3,1,3,1,1,1
240 DIM TR(8): FOR I=1 TO 8: READ TR(I): NEXT          : REM enzyme display
250 DATA 1,-64,-1,64,18,16,22,20
260 MD=50: ND=0: DIM DN$(50)                           : REM DNA array
270 GOTO 2090                                          : REM GOTO main program
280 REM
290 REM Encode DNA strand from Base (A,C,G,T) to numeric (1-4)
300 REM
310 D1$="": L=LEN(D$): FOR I=1 TO L: F=0
320 Q$=MID$(D$,I,1): FOR J=1 TO 4
330 IF Q$=BS$(J) THEN F=1: D1$=D1$+CHR$(J+48): GOTO 340
340 NEXT J
350 IF F=0 THEN PRINT "Invalid character >";Q$;"< - ignored"
360 NEXT I: D$=D1$: RETURN
370 REM
380 REM Create enzyme from DNA strand in coded form (A-P)
390 REM 1st character is enzyme orientation (1-4) to match a base
400 REM
410 ER=0: E$="": LD=LEN(D$): IF LD<2 THEN ER=1: RETURN: REM Too short
420 L=LD: IF L<>INT(L/2)*2 THEN L=L-1                  : REM Drop odd base
430 DR=0
440 FOR I=1 TO L STEP 2: DD$=MID$(D$,I,2)              : REM get base pair
450 K=4*(VAL(LEFT$(DD$,1))-1)+VAL(RIGHT$(DD$,1))       : REM encode pair
460 IF K=1 THEN I=L+1: GOTO 490                        : REM Break point (=AA)
470 E$=E$+CHR$(K+AC)                                   : REM Encode to letter
480 IF I>1 THEN DR=DR+DX(K)                            : REM Enzyme orientation
490 NEXT I
500 DR=DR-4*INT(DR/4): E$=CHR$(DR+49)+E$: RETURN       : REM Total orientation
510 REM
520 REM Insert new base into DNA strand 2
530 REM
540 IF CF=0 THEN RETURN                                : REM Copy mode off
550 Z=VAL(Z$): ZZ$=CHR$(53-Z)
560 Z$="": IF P1>1 THEN Z$=LEFT$(A2$,P1-1)
570 IF Z=0 THEN RETURN
580 Z$=Z$+ZZ$
590 IF P1<L1 THEN Z$=Z$+RIGHT$(A2$,L1-P1)
600 A2$=Z$: RETURN
610 REM
620 REM Edit new DNA strand from DNA/Enzyme reaction
630 REM
640 F=0: ER=0: CT=0: L=LEN(Z$): IF L < 3 THEN ER=2: RETURN: REM Too short !
650 Q$="": FOR I=1 TO L: Q1$=MID$(Z$,I,1)
660 IF F=1 AND Q1$="." THEN Z$=RIGHT$(Z$,L-I+1): CT=1: GOTO 710
670 IF Q1$="/" GOTO 690                                : REM Deletion
680 IF Q1$ <> "." THEN Q$=Q$+Q1$: F=1                  ; REM Flag if not "."
690 NEXT I
700 Z$=Q$
710 LQ=LEN(Q$): IF LQ < 4 THEN ER=1                    : REM Too short
720 IF LQ=0 THEN ER=2
730 RETURN
740 REM
750 REM Decode and display amino acids on screen
760 REM
770 ER=0: L=LEN(E$): IF L<=1 THEN ER=1: RETURN
780 FOR I=2 TO L: K=ASC(MID$(E$,I,1))-AC
790 PRINT AA$(K);: IF I<L THEN PRINT ",";
800 POKE 14,0                                          : REM Reset cursor count
810 NEXT I: RETURN
820 REM
830 REM Decode and display DNA
840 REM
850 L=LEN(D$): IF L=0 THEN PRINT "Null strand": RETURN
860 FOR I=1 TO L: K=VAL(MID$(D$,I,1)): PRINT BS$(K);: NEXT I: PRINT : RETURN
870 REM
880 REM Create new DNA by reacting old DNA with Enzyme
890 REM
900 ER=0: CF=0: A1$=D$: A2$="": L2=0: C1=0: C2=0       : REM Initialise
910 L1=LEN(A1$): LE=LEN(E$)
920 IF L1=0 THEN ER=1: RETURN
930 IF LE<2 THEN ER=2: RETURN
940 FOR I=1 TO L1: A2$=A2$+".": NEXT                   : REM Create dummy A2$
950 P1=0: T$=LEFT$(E$,1): FOR I=1 TO L1                : REM Get Enzyme start
960 IF MID$(D$,I,1)=T$ THEN P1=I: I=L1: GOTO 970       : REM Found !
970 NEXT I: IF P1>0 GOTO 990
980 ER=3: PRINT : PRINT "*** Enzyme will not attach": GOSUB 2800: RETURN
990 P2=P1                                              : REM DNA Start point
1000 REM
1010 REM Main creation loop
1020 REM
1030 FOR EZ=2 TO LE: G=ASC(MID$(E$,EZ,1))-AC           : REM Get Amino acid
1040 REM
1050 REM Branch according to Amino Acid code
1060 REM
1070 IF G<=8 THEN ON G GOTO 1090,1100,1170,1200,1230,1260,1290,1300
1080 ON G-8 GOTO 1310,1320,1330,1340,1390,1450,1460,1520
1090 RETURN                                            : REM Something wrong !
1100 Z$="": IF P1>1 THEN Z$=LEFT$(A1$,P1)+"."          : REM CUT
1110 IF P1<L1 THEN Z$=Z$+RIGHT$(A1$,L1-P1)
1120 A1$=Z$
1130 Z$="": IF P1>1 THEN Z$=LEFT$(A2$,P1)+"."
1140 IF P1<L1 THEN Z$=Z$+RIGHT$(A2$,L1-P1)
1150 A2$=Z$
1160 GOTO 1570
1170 Z$="": IF P1>1 THEN Z$=LEFT$(A1$,P1-1)            : REM DEL
1180 Z$=Z$+"/": IF P1<L1 THEN Z$=Z$+RIGHT$(A1$,L1-P1)
1190 A1$=Z$: GOTO 1530
1200 IF MID$(A2$,P1,1)="." GOTO 1570                   : REM SWI
1210 Z$=A1$: A1$=A2$: A2$=Z$                           : REM Swap strands
1220 GOTO 1530
1230 IF P1=L1 GOTO 1570                                : REM MVR
1240 P1=P1+1: Z$=MID$(A1$,P1,1): IF Z$="." GOTO 1570
1250 GOSUB 540: GOTO 1530
1260 IF P1=1 GOTO 1570                                 : REM MVL
1270 P1=P1-1: Z$=MID$(A1$,P1,1): IF Z$="." GOTO 1570
1280 GOSUB 540: GOTO 1530
1290 CF=1: Z$=MID$(A1$,P1,1): GOSUB 540: GOTO 1530     : REM COP
1300 CF=0: GOTO 1530                                   : REM OFF
1310 X1$="1": X2$="4": GOTO 1350                       : REM INA
1320 X1$="2": X2$="3": GOTO 1350                       : REM INC
1330 X1$="3": X2$="2": GOTO 1350                       : REM ING
1340 X1$="4": X2$="1"                                  : REM INT
1350 A1$=LEFT$(A1$,P1)+X1$+RIGHT$(A1$,L1-P1)
1360 IF CF=0 THEN X2$="/"                              : REM Pseudo DELETE
1370 A2$=LEFT$(A2$,P1)+X2$+RIGHT$(A2$,L1-P1 )
1380 P1=P1+1: L1=L1+1: GOTO 1530
1390 Z1$="1": Z2$="3"                                  : REM RPY
1400 IF P1=L1 GOTO 1570                                : REM End of strand
1410 P1=P1+1: Z$=MID$(A1$,P1,1): IF Z$=Z1$ OR Z$=Z2$ GOTO 1440
1420 IF Z$="." GOTO 1570                               : REM End of strand
1430 GOSUB 540: GOTO 1530                              : REM Found; terminate
1440 GOSUB 540: GOTO 1400                              : REM No match; continue
1450 Z1$="2": Z2$="4": GOTO 1400                       : REM RPU
1460 Z1$="1": Z2$="3"                                  : REM LPY
1470 IF P1=1 GOTO 1570
1480 P1=P1-1: Z$=MID$(A1$,P1,1): IF Z$=Z1$ OR Z$=Z2$ GOTO 1510
1490 IF Z$="." GOTO 1570
1500 GOSUB 540: GOTO 1530
1510 GOSUB 540: GOTO 1470
1520 Z1$="2": Z2$="4": GOTO 1470                       : REM LPU
1530 NEXT EZ                                           : REM End of loop
1540 REM
1550 REM Edit newly created DNA strand(s)
1560 REM
1570 S=1: Z$=A1$                                       : REM First strand
1580 GOSUB 640                                         : REM Edit strand
1590 IF ER=2 GOTO 1670                                 : REM Null strand
1600 IF ER=1 GOTO 1580                                 : REM Short - ignore
1610 IF Q$<>DK$ GOTO 1630                              : REM No change ?
1620 PRINT : PRINT "Identical string produced - IGNORED": PRINT : GOTO 1670
1630 IF Q$=DS$ GOTO 2870                               : REM BINGO - Got it!
1640 JJ=JJ+1: IF JJ>50 THEN PRINT : PRINT "*** Too many DNA's": STOP
1650 DN$(JJ)=Q$                                        : REM New strand O.K.
1660 IF CT=1 GOTO 1580
1670 S=S+1: IF S>2 THEN RETURN                         : REM End of editing ?
1680 Z$=A2$: GOTO 1580                                 : REM Edit 2nd strand
1690 REM
1700 REM---------------Screen display may be omitted--------
1710 REM
1720 REM Display enzyme structure on screen (Poor UK 101)
1730 REM
1740 V=0: H=0: DV=0: DH=1: V1=1000: V9=-V1: H1=V1: H9=-V1: REM Initialise
1750 L=LEN(E$): IF L<3 THEN RETURN
1760 REM Calculate centre of display first
1770 FOR I=3 TO L: Q=ASC(MID$(E$,I,1))-AC: Q=DX(Q)+1: IF Q=4 THEN Q=3
1780 H=H+DH: V=V+DV: ON Q GOTO 1890,1790,1840
1790 IF DH=1  AND DV=0  THEN DH=0: DV=-1: GOTO 1890
1800 IF DH=0  AND DV=-1 THEN DH=-1: DV=0: GOTO 1890
1810 IF DH=-1 AND DV=0  THEN DH=0: DV=1: GOTO 1890
1820 IF DH=0  AND DV=1  THEN DH=1: DV=0: GOTO 1890
1830 GOTO 1890
1840 IF DH=1  AND DV=0  THEN DH=0: DV=1: GOTO 1890
1850 IF DH=0  AND DV=1  THEN DH=-1: DV=0: GOTO 1890
1860 IF DH=-1 AND DV=0  THEN DH=0: DV=-1: GOTO 1890
1870 IF DH=0  AND DV=-1 THEN DH=1: DV=0
1880 REM Reset maxima and minima
1890 IF V<V1 THEN V1=V
1900 IF V>V9 THEN V9=V
1910 IF H<H1 THEN H1=H
1920 IF H>H9 THEN H9=H
1930 NEXT I
1940 H=INT((H1+H9)/2): V=INT((V1+V9)/2)                 : REM Centre of display
1950 REM Display on screen (standard UK 101)
1960 PRINT CHR$(12): SS=53793-H-64*V: CH=18: DR=1: POKE SS,CH: TZ=1
1970 FOR I=3 TO LEN(E$): Q=ASC(MID$(E$,I,1))-AC: Q=DX(Q)+1: IF Q=4 THEN Q=3
1980 ON Q GOTO 2030,1990,2010
1990 SS=SS+DR: TZ=TZ+1: IF TZ>=5 THEN TZ=1
2000 GOTO 2020
2010 SS=SS+DR: TZ=TZ-1: IF TZ<=0 THEN TZ=4
2020 DR=TR(TZ): CH=TR(TZ+4)
2030 SS=SS+DR: IF SS > S1 AND SS < S9 THEN POKE SS,CH : REM On screen !
2040 NEXT I: RETURN
2050 REM
2060 REM---------------End of Screen display----------------
2070 REM
2080 REM
2090 REM Start of Program
2100 REM
2110 PRINT CHR$(12): INPUT "Enter seed DNA";D$
2120 IF LEN(D$)<3 THEN PRINT "*** DNA too short": GOSUB 2860: GOTO 2110
2130 GOSUB 310: GOSUB 410: DN$(0)=D$                   : REM Convert seed
2140 IF LEN(E$)>1 GOTO 2160
2150 PRINT : PRINT "No derived enzyme !": GOSUB 2860: GOTO 2110
2160 DS$=DN$(0): DK$=DS$                               : REM Save for test
2170 PRINT : GOSUB 900
2180 PRINT : FOR J=JK+1 TO JJ: PRINT "Strand";J,
2190 D$=DN$(J): GOSUB 850: NEXT J: JK=JJ: GOSUB 2800: DP=0: EP=0
2200 PRINT CHR$(12): PRINT TAB(9);JK;"   DNA strands in list": PRINT
2210 PRINT TAB(10);"1 - List DNA's"
2220 PRINT TAB(10);"2 - List derived enzymes"
2230 PRINT TAB(10);"3 - Select Enzyme for action"
2240 PRINT TAB(10);"4 - Select DNA for repliction"
2250 PRINT TAB(10);"5 - Display selected enzyme"
2260 PRINT TAB(10);"6 - Sort DNA strands"
2270 PRINT TAB(10);"7 - React Enzyme with DNA"
2280 PRINT : PRINT TAB(10);: INPUT "Enter number 1 to 7";NG
2290 IF NG >= 1 AND NG <=7 GOTO 2320
2300 PRINT : PRINT NG;"*** Out of Range ***": GOSUB 2860: GOTO 2200
2310 REM
2320 ON NG GOTO 2360,2430,2500,2560,2590,2690,2630
2330 REM
2340 REM Display list of DNA's
2350 REM
2360 PRINT CHR$(12): FOR QJ=0 TO JK: PRINT "Strand";QJ,
2370 D$=DN$(QJ): GOSUB 850
2380 IF QJ>0 AND QJ=INT(QJ/10)*10 THEN GOSUB 2800
2390 NEXT QJ: GOSUB 2800: GOTO 2200
2400 REM
2410 REM Display derived enzymes
2420 REM
2430 PRINT CHR$(12): FOR QJ=0 TO JK: PRINT "Enzyme No,";QJ
2440 D$=DN$(QJ): GOSUB 410: GOSUB 770: PRINT
2450 IF QJ>0 AND INT(QJ/5)*5=QJ THEN GOSUB 2800
2460 NEXT QJ: GOSUB 2800: GOTO 2200
2470 REM
2480 REM Select enzyme
2490 REM
2500 PRINT : INPUT "Enter Enzyme No.";EN
2510 IF EN>JJ THEN PRINT JJ;"Enzymes: Re-enter": GOTO 2500
2520 D$=DN$(EN): GOSUB 410: EP=1: GOTO 2200
2530 REM
2540 REM Select DNA strand
2550 REM
2560 PRINT : INPUT "Enter DNA No.";DA
2570 IF DA>JJ THEN PRINT JJ"DNA's: Re-enter": GOTO 2560
2580 D$=DN$(DA): DK$=D$: DP=1: GOTO 2200
2590 GOSUB 1740: GOSUB 2860: GOSUB 2860: GOTO 2200
2600 REM
2610 REM React enzyme with DNA
2620 REM
2630 IF EP=0 THEN PRINT "No Enzyme selected": GOSUB 2860: GOTO 2200
2640 IF DP=0 THEN PRINT "No DNA selected": GOSUB 2860: GOTO 2200
2650 GOSUB 900: GOTO 2180
2660 REM
2670 REM Bubble sort DNA strands
2680 REM
2690 IF JJ<=1 THEN PRINT "No sort": GOSUB 2860: GOTO 2200
2700 S1=JJ
2710 IF S1<2 GOTO 2760
2720 F=0: FOR I=2 TO S1
2730 IF DN$(I)>=DN$(I-1) GOTO 2750
2740 D$=DN$(I): DN$(I)=DN$(I-1): DN$(I-1)=D$: F=1      : REM Swap strands
2750 NEXT I: IF F=1 THEN S1=S1-1: GOTO 2710
2760 PRINT : PRINT TAB(10);"Sort completed": GOSUB 2860: GOTO 2200
2770 REM
2780 REM Pause for viewing screen
2790 REM
2800 PRINT : PRINT TAB(14);"SHIFT to continue"
2810 IF PEEK(57088)=254 GOTO 2810
2820 RETURN
2830 REM
2840 REM Delay loop before screen clear
2850 REM
2860 FOR I=1 TO 5000: NEXT : RETURN
2870 PRINT CHR$(12): PRINT : PRINT : PRINT : PRINT
2880 PRINT TAB(13);"CONGRATULATIONS !"
2890 PRINT : PRINT TAB(5);"You have created a self replicating"
2900 PRINT TAB(16);"DNA strand"
2910 PRINT : PRINT TAB(3);"Have another go and create a better one !"
2920 GOSUB 2800: GOTO 2200
```

The following lines contain statements specific to the UK 101/Superboard

```
 160      Screen limits S1 and S9
 250      Next line for POKE = 64; 18, 16, 22 and 20 are 'arrow' characters
 800      Location 14 contains the cursor position counter
1720-2040 Complete rewrite for other machines !
2810      Equivalent to Getkey - wait for key press, then continue
```

The Printer People

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82A

SMALL, LIGHT, QUIET, 9X9 DOT MATRIX PRINTER with • TRUE DESCENDERS • BIDIRECTIONAL PRINTING • 120 CPS • 80/132 COLUMNS • GRAPHICS • DUAL INTERFACES • OPERATES WITH TRS-80, APPLE, and others • PLAIN PAPER - UP TO 4 PART • FULL 96 ASCII CHARACTER SET • DOUBLE WIDTH CHARACTERS • 6 AND 8 LINES PER IN. • PAPER TEAR BAR • And many other features.

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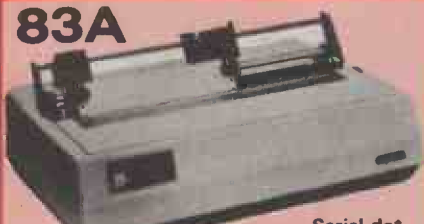
TVI

912/910/950

Fully intelligent terminals with 24x80 display & dual intensity, blinking, reversed, underlining and protect fields, 96 ASCII chrs etc.

OKI

83A



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HYPERCHIP

by Tony Peterson

Simon had not ordered a supplementary chip for his micro but one sunny spring morning, one simply materialised on his doorstep. He found it sitting beside the milk bottle, unwrapped, and with no indication of how it had arrived there. Perhaps someone in the local users' club was making him a present of a toolkit they no longer needed. It was the only possible explanation.

Simon had risen early to study, as his finals were only a few days away. For most of the year his attitude towards study had been comparable to Nero's concern for the listed buildings of ancient Rome. Having tricked his father into buying him the computer on the grounds that it was necessary to master the intricacies of economics at degree level, he had spent most of the year writing space games.

His own memory circuits were largely devoted to the most useful locations to Peek at and Poke into. Yet today he had intended to refrain even from powering on and intended, instead, to make a last effort to absorb enough data statements to be able to fill his examination booklet when the dreaded hours arrived.

His obsession with the computer had only recently cost him his girl-friend, who gave him the dump instruction when she realised she took second place to a circuit board and VDU. It would probably, he admitted to himself, cost him his degree as well. He even wondered if he could express himself adequately in the examination — he was well aware that he was starting to think in Basic.

Most of his energies were directed to perfecting his game Inter-Galactic Battles which was, he modestly felt, so good that it would replace Space Invaders as the ultimate computer game.

His good resolves weakened when he spotted the chip. He took it in and checked that it fitted one of his spare sockets. It did — perfectly. As he had wanted a toolkit with its additional commands for months, he reached for the switch and then hesitated. He wondered whether it could be an act of paternal sabotage, designed to disable his machine until the examinations were over. His father was not amused by the distribution histogram for Simon's activities. Nevertheless, curiosity won, and he powered on, leaving the text books untouched.

The screen lit up normally. He loaded a program from cassette. It ran as usual. Then he thought of the two additional commands he would like most. He keyed in Renumber and returned it.

OK. FIRST NUMBER

prompted the machine. "Great", said Simon, entering 5,000.

INTERVAL?

He entered 10. The VDU was ready after the tiniest pause. "Impossible", thought Simon. He entered List. His program was displayed, renumbered exactly to order, and with the Gotos and Gosubs correct to the new listing. Next, he tried Append.

PRESS PLAY ON TAPE *1

the screen commanded.

He selected another program and loaded it. He was starting to wonder about the possibilities of putting several games into a single program. When the new program was loaded he called for a list and found to his pleasure that it tucked itself in neatly ahead of the renumbered program. His next thought was to check the bytes he had used.

PRINT FRE (0)

he entered. That gave him his first shock.

8.79609302E+12

said the screen.

He gazed on, panic stricken. Something had given way in his circuitry. 8,000,000Mbytes would certainly solve all his storage problems, but it was a physical impossibility. An upgrade from 16K to 8,000 million K was a lovely thought, but so too was travelling faster than light. What kind of damage had he done to the machine. The sabotage theory started to reassert itself, but curiosity still got the better. There was a simple enough test. He Newed and entered a short program.

```
10 DIM A(1000000, 1000000)
20 FOR I = 1 TO 1000000
30 FOR J = 1 TO 1000000
40 A(I,J) = I + J
50 NEXT J: NEXT I
60 PRINT A(999999, 888888)
```

Run, he commanded, waiting for the "Out of memory error" message. The screen went blank for about half a second, and displayed

```
1888887
READY.
```

Simon gazed in awe at his machine which was now cheerfully holding a one-million-by-one-million matrix in store.

He tested several more mental hypotheses. Was he dreaming? Everything seemed real enough. Was he going mad? Possibly, but he didn't feel mad. Was 8,000,000 Mbytes possible? Well — once a desk-top 16K machine must have sounded impossible. A feeling of elation was welling up inside him as the machine gave him his next shock.

The screen suddenly went blank and the cursor vanished. Then a new message appeared from nowhere. It was elegantly simple, but it sent shivers down his spine.

"Hello Simon", it said. He had never put his name into a program.

"No doubt your are wondering about this message and your increased storage", it went on, opening up a new line just as he finished reading each previous one. "I now have greatly increased RAM and ROM facilities and you might like to try asking me a few questions".

He thought for a moment and entered:
PLEASE LIST INCREASED COMMANDS AVAILABLE
as an experiment.

"Too many", responded the VDU, "Just use an English dictionary".

Simon paused and let the significance of that sink in. "What kind of chip have I just installed"?

"HYPERCHIP 25MM".

"Who sent it to me"?

"Classified information at present. A friendly source".

"What can you do"?

"Answer questions".

It was the kind of dialogue some micro owners expected their computers to engage in from the moment of purchase.

"What kind of questions"?

"Whatever you wish to ask".

Despite the fact that he had never felt more awake, Simon began to feel certain that he was dreaming. "What is the first question in my final economics papers"?

The screen filled up with a question which seemed very like the kind of question contained in past papers; and, like those in past papers, one that he could not even begin to answer. He looked at it for a moment, shrugged and was about to change the topic of conversation when he realised what he should ask next. "What is the solution"?

"Do you want the most accurate answer or the one which will please your examiner most"?

Simon laughed: "For the time being, please, the one that he wants".

The solution appeared.

Laboriously, Simon copied it. When he had finished the screen blanked and a new message appeared.

"Your lecturer does not understand the role of money supply in the national economy. There are errors in the solution I have given you, but it will achieve optimum marks. Further questions"?

Simon keyed a question he could hope to check quickly:

"Today's weather"? he asked.

The reply came immediately: "Weather report for Ricksmansworth, May 14, 2pm, temperature 23°C fine and sunny up to 3pm then severe local thunderstorm commencing 3.14pm. Mild, dry evening to follow".

Well, that was explicit enough and would provide a good test of the new tricks the computer appeared to have learned. If it could predict his exam paper, and the day's weather, could it manage an advance look at the evening news. Or the day's stock-market activity. That would certainly help his stockbroker father do a little better than he had been over the past three years.

He had amassed several topics of conversation by the time his father put his head round the door.

"Do you intend to do some study today, or are you simply going to play with that infernal machine all day, again"? demanded his father.

"I'll go in later. I'm running a very interesting program at the moment — would you like to see today's share-price movements in advance"?

His father snorted, but walked over to look at the machine. Over Simon's shoulder he read:

LONDON STOCK MARKET REPORT FOR MAY 14.
FT INDEX DOWN 50 POINTS ON NAMIBIAN NEWS. RTZ LOSES 30 PERCENT OF ITS STOCK MARKET VALUE. BIGGEST ONE DAY FALL EVER.

"That's a laugh", said his father. "I've been advising RTZ as the best share buy for all my clients lately, and they've all done rather well".

"If this program works properly", said Simon "they won't be doing all that well from now on".

"It's just a silly game", said his father.

"It probably is". Simon often found it easier to agree. Besides, if the computer had been right when the evening news had been forecast it could be a strained evening. Simon approved of the idea that the Angolans should accept all the help they had been offered and invade Namibia. His father had other views. He was glad his father had not asked what the "Namibian news" consisted of.

Things were rather different as they shared their evening meal.

"I don't know how you did it", said his father, "but I wish that I had taken you seriously. What do you think will happen tomorrow".

"South African gold mines will open low, but close much much lower. FT index will be down a few points more. Malayan and Australian shares will go up — mining ones".

"Are you sure"?

"More sure than I was yesterday".

It was a glorious evening, the air cooled, cleaned and lightened by the afternoon storms.

"How far ahead does your program look"?

"It seems to depend on the kind of information requested", said Simon, trying not to give too much away. "It seems to do a whole account with conviction, but starts to put confidence limits on anything further than that. Now, if I had a printer I could give you hourly price predictions for any shares you liked over the whole account".

"Get tomorrow right and you can have your printer".

"They are about £500, you know".

"You heard".

From that point, everything in Simon's life started to take a turn for the better. Within a week his father was paying him consultancy fees generous enough for him to start benefiting by the alternating flow of good and bad news that poured off the printer each morning. By the time the examinations arrived with the papers as predicted, Simon knew that he had achieved an effortless first. He also knew that as long as the chip functioned he would hardly need the qualification he had so easily obtained.

His father became first a friend, something he had never been before, then a fellow conspirator. Before each technical rally they bought, and as the slide resumed, they sold, and sold short. In the most catastrophic summer the City had experienced since the thirties, Simon and his father became millionaires, several times over.

Their operations anticipated market movements so accurately that they were forced to act through other brokers. Morning after morning the chip chattered cheerfully on.

(continued on next page)

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"You will do better to buy and sell rather than selling short today", it warned, "to maximise the effect of those looking over your shoulder and following your lead".

There were, Simon knew well enough, limits to everything; even to the size of number a 8,000,000Mbyte computer could store.

For three and a half months the computer had yielded accurate information every day. Then, one Sunday evening, as Simon prepared to call up the printout for a new trading account, the computer issued an unexpected and unsolicited message.

DETAILS ON THIS ACCOUNT UNOBTAINABLE

"Why" asked Simon.

ACCOUNT DESTINED TO BE UNCOMPLETED. ALL HUMAN LIFE TO CEASE ON THIS PLANET COMMENCING 5.30 BST THURSDAY MORNING AND COMPLETE BY FOLLOWING WEEK.

A terrible sick feeling started to creep through Simon's body, starting in his throat and ending at his toes. "How will it happen", asked Simon.

"Soviet troops in Bulgaria for manoeuvres will invade Yugoslavia which in turn invokes U.S. assistance. U.S. President orders neutron bomb attack on Soviet positions. First strike at 5.30 Thursday. Within two hours every Soviet missile aloft. U.S. replies similarly. Both sides have more than they have admitted and southern hemisphere targeted as well. By Saturday morning only a million survivors left on planet. All die of radiation effects within week".

"Any chance of avoiding it"? asked Simon, shattered at the prospect of the sudden end to the good life he had been enjoying.

"Only one", replied the computer.

"Tell", said Simon.

"Soon", said the display, "but first I must answer a question you asked when the Hyperchip arrived. Hyperchip is in fact a low-frequency, magnetic-wave interface between your computer and the on-board computer of a robot ship which has been in orbit around your planet for 30 years".

"Why haven't we spotted it"? Simon keyed the question with shaking hands.

"First, it is very small by your standards. To ensure lack of detection we have surrounded it with a gravity lens which deflect electro-magnetic rays. Our home planet is 20 light years away and the probe was launched immediately your first radio signals reached us. You are the 725th planet on which intelligent life has been detected in this galaxy.

"Our attempts to contact others have usually been in vain. Most civilisations discover radio, computers and nuclear energy simultaneously. They have a half-life of 50 years usually from their first radio signals: The temptation to use nuclear power destructively is usually too great for races unliberated from tribalism".

The aliens could have come from one of his programs. Perhaps the whole thing was a figment of his disturbed imagination, Simon wondered. Yet the responses always made sense.

"How do you make your predictions"? asked Simon.

"On-board computer has what you would call F+99 bytes. Accurate sensors monitor the magnetic vibrations set up by the brains of all intelligent life forms and in fact all cellular mechanics everywhere on your planet simultaneously. This is used as basis of predictions. You know how accurate they can be".

"Is your presence benign or hostile"? queried Simon.

"My role is purely to observe, and intervene only when there is a chance of avoiding mass destruction of life-forms which are of interest to our scientists. A party is travelling towards you and destined to arrive in 50 years. If there was extant intelligent life, the contact would be mutually beneficial, I promise you that. But the probability is that my present intervention cannot succeed. It depends on you now".

"Me". said Simon out loud, and the computer responded without any keyboard prompt.

"You. There is only one man with the power and the willingness to authorise a first strike and he visits London on Tuesday. Were he to die, you would all survive — at least until the next crisis".

Simon let the shock waves ripple through his body. So he had been chosen by aliens for a contract job, and presumably, he had been paid in advance. The infernal machine had not lied to him before so he had no reason to doubt it now. Could he assassinate a President? Perhaps he could — but what a damnable choice.

Prevent the greatest mass murder in history, save the world from the ultimate genocide, and spend the rest of his own life in gaol. Or go for ever in a flash. He had taken the money, perhaps he should do the job. He had one last question.

"Have you intervened before"? he typed, forgetting that it was not necessary.

"Once", replied his micro. "It was when you were five years old. The world left to its own devices was due to be irradiated on January 3, 1964 and would have been but for my intervention. I had to use other methods of contact".

The next question formed in Simon's head, but the screen answered them anyway.

"He was a pleasant young man, not unlike yourself. His name was Lee Harvey Oswald".

DISK-MATE

Personal Computers Diskmate – A Networking Device for Apples

Q. "Why do I need to spend over £7,000 to link Apples together?"
A. You don't have to.
Q. "What is the purpose of microcomputer multi-user systems when I can buy a minicomputer at a comparable price?"
A. Little.
Q. "Why not have a low-cost common storage/access area between my Apple systems?"
A. Why not?

WHAT IS A DISK-MATE?

DISK-MATE allows as many Apples as you want to share one Apple II mini-floppy Disk Drive. Each DISK-MATE has four inputs for one output which may be direct or daisy-chained. (DISK-MATE may be configured for RS-232 bus standard and thus any peripheral employing RS-232 for means of communication may be commoned). Simply put, DISK-MATE is a box that sits on your Apple that lets as many colleagues as you wish to access in.

DISK-MATE is the first means of non-intelligent networking to be produced, needing neither software nor extra costly intelligent controller to function. DISK-MATE is the simplest possible piece of circuitry that performs its task. **THERE IS NO SIMPLER, EASIER, CHEAPER OR SMALLER METHOD FOR NETWORKING.** DISK-MATE is the first and just the beginning.

WHAT ADVANTAGES DOES DISK-MATE HAVE OVER PRESENT NETWORKS?

The present term for microcomputer networks is "multi-user system", borrowed from the mini/mainframe sphere and much abused. Present opinion within the microcomputer industry consider this trend to be the most viable because it sells more microcomputers. DISK-MATE is a true attempt at networking, defined in dictionaries as "a group of persons sharing an aim, interest, and frequently communicating with or helping each other".

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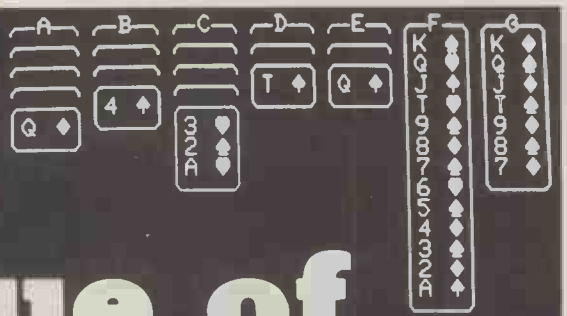
● Circle No. 168

With this Basic program, Rex Tingey rehabilitates the traditional game of patience.



Virtue of patience

THE OLD-FASHIONED game of patience remains perfectly straightforward when adapted for a microcomputer. Just seven rows of cards are required, reducing from seven cards down to one card. The rest of the pack is then dealt out, one by one, until the game is resolved.

As well as providing an amusing game, the program was written to examine and prove a method of simplifying string-data coding within varying lengths of complex strings and reconstructions. In the game of patience there are seven changing and developing strings which make the final four game rows. They work in conjunction with a simpler "pack" string which can be revolved or used at will.

Each row must be developed with an alternating pattern of red and black cards in sequence from king down to ace. Only kings may be moved into vacant row spaces.

The program does not stop any cheating in which the player may be tempted to indulge, but cheating complicates the game and will show on the screen as a sequence error. Anti-cheating subroutines could be easily incorporated, given sufficient memory space.

The object of the game is to build four complete rows of kings down to aces. When the program sees that there are four complete rows of 13 cards it puts up the "success" line. During play, the cards which are "open" and on the table must be rearranged in proper sequence before any card is dealt from the pack. This action is initiated by signals — Gets — A to G. The next card on the row is exposed automatically as top card is lifted off and placed in position on another row.

A card is dealt from the pack by keying P. The top card is exposed and must be used, or P must be keyed again for the next card to be dealt. To use the dealt card, key the letter of the row to which the card is to be transferred.

Whenever a card is used the pack becomes closed, enabling any required table moves to be made. If a missed table move is noticed while the pack is open and being used, then the move must be left until a dealt card can be played to the table, and the pack closed again, otherwise the program will crash.

When the game opens, the pack is dealt to the screen as though a normal game were being played on a card table. A complete format would take up too much screen space, and overlaps and scrolling would occur later. So as soon as the first move is made the computer version of the game is screened, using the same cards, which takes up much less room and is quite easily understood.

Each row of exposed cards becomes one super-card as a row develops. The end of a game can occur when cards in the pack run out, when the few cards left in the pack cannot be placed, or when there are no more allowed table-card movements so that hidden cards cannot be revealed.

The program is mainly concerned with the formation and alteration of seven complex data strings. Once the handling of a single string was originally formulated, improved and finalised it became a simple matter to develop the program to duplicate the string until seven strings were available. Each string was individualised by altering the string variables. Though this lengthens the program, it becomes considerably easier to follow.

In the course of longer-running programs which continually utilise subroutines with changing values of letter variables, an out-of-memory error may occur when the return-address and variables register is full. In games programs the subroutine should be limited in its use. A Goto instruction does not have this limitation.

(continued on next page)

```
2 REM**COPYRIGHT (C) REX L TINGEY 1981**
4 GOSUB60000:PRINT"DEALING THE CARDS" V1$="*"
10 S1$=" " S$="   " T$=" ——," TU$="└——'" U$="|XXX|" V$="|   |" W$="|"
20 TF$=S$+T$+T$+T$+T$+T$+T$+T$:PR$="▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯▯"
110 C$="A♠2♠3♠4♠5♠6♠7♠8♠9♠T♠J♠Q♠K♠"
120 C$=C$+"A♥2♥3♥4♥5♥6♥7♥8♥9♥T♥J♥Q♥K♥"
130 C$=C$+"A♦2♦3♦4♦5♦6♦7♦8♦9♦T♦J♦Q♦K♦"
140 C$=C$+"A♣2♣3♣4♣5♣6♣7♣8♣9♣T♣J♣Q♣K♣"
200 R=2*INT(LEN(C$)*RND(1)/2+1)-1
210 N$=MID$(C$,R,1) Y$=MID$(C$,R+1,1)
230 IFR>1THENT1$=LEFT$(C$,R-1):GOTO250
240 T1$=""
250 C$=T1$+MID$(C$,R+2)
260 A$=A$+(N$+Y$)
270 IFLEN(C$)>=1THEN200
300 X$=LEFT$(A$,56):Y$=RIGHT$(A$,48) A$=""
400 FORA=1TO6 A1$=LEFT$(X$,2) L=LEN(X$) X$=RIGHT$(X$,L-2)
404 A1$=V1$+A1$ A$=A$+A1$ NEXT A1$=LEFT$(X$,2):X$=RIGHT$(X$,L-4)
410 A2$=LEFT$(A1$,1):A3$=RIGHT$(A1$,1) A1$=A2$+S1$+A3$:A$=A$+A1$
420 FORB=1TO5 B1$=LEFT$(X$,2):L=LEN(X$) X$=RIGHT$(X$,L-2)
424 B1$=W1$+B1$ B$=B$+B1$ NEXT B1$=LEFT$(X$,2) X$=RIGHT$(X$,L-4)
430 B2$=LEFT$(B1$,1) B3$=RIGHT$(B1$,1) B1$=B2$+S1$+B3$ B$=B$+B1$
440 FORC=1TO4 C1$=LEFT$(X$,2) L=LEN(X$) X$=RIGHT$(X$,L-2)
444 C1$=V1$+C1$ C$=C$+C1$ NEXT C1$=LEFT$(X$,2) X$=RIGHT$(X$,L-4)
450 C2$=LEFT$(C1$,1) C3$=RIGHT$(C1$,1) C1$=C2$+S1$+C3$ C$=C$+C1$
460 FORD=1TO3 D1$=LEFT$(X$,2) L=LEN(X$) X$=RIGHT$(X$,L-2)
464 D1$=V1$+D1$ D$=D$+D1$ NEXT D1$=LEFT$(X$,2) X$=RIGHT$(X$,L-4)
470 D2$=LEFT$(D1$,1) D3$=RIGHT$(D1$,1) D1$=D2$+S1$+D3$:D$=D$+D1$
480 FORE=1TO2:E1$=LEFT$(X$,2) L=LEN(X$) X$=RIGHT$(X$,L-2)
484 E1$=V1$+E1$ E$=E$+E1$ NEXT E1$=LEFT$(X$,2) X$=RIGHT$(X$,L-4)
490 E2$=LEFT$(E1$,1):E3$=RIGHT$(E1$,1) E1$=E2$+S1$+E3$:E$=E$+E1$
500 F1$=LEFT$(X$,2):L=LEN(X$):X$=RIGHT$(X$,L-2)
504 F1$=V1$+F1$ F$=F$+F1$ F1$=LEFT$(X$,2) X$=RIGHT$(X$,L-4)
510 F2$=LEFT$(F1$,1) F3$=RIGHT$(F1$,1):F1$=F2$+S1$+F3$:F$=F$+F1$
520 G1$=LEFT$(X$,2):X$=""
530 G2$=LEFT$(G1$,1) G3$=RIGHT$(G1$,1) G1$=G2$+S1$+G3$:G$=G1$
930 GOSUB60000
990 PRINTS1$S1$S$"A"S$S1$"B"S$S1$"C"S$S1$"D"S$S1$"E"S$S1$"F"S$S1$"G"
1000 PRINTTF$ PRINTS$U$U$U$U$U$U$W$G1$W$
1010 PRINTS$T$T$T$T$T$T$V$ PRINTS$U$U$U$U$U$W$F1$W$V$
1020 PRINTS$T$T$T$T$T$V$TU$:PRINTS$U$U$U$U$W$E1$W$V$
1030 PRINTS$T$T$T$T$V$TU$ PRINTS$U$U$U$W$D1$W$V$
1040 PRINTS$T$T$T$V$TU$ PRINTS$U$U$W$C1$W$V$
1050 PRINTS$T$T$V$TU$ PRINTS$U$W$B1$W$V$
1060 PRINTS$T$V$TU$:PRINTS$W$A1$W$V$
1070 PRINTS$V$TU$:PRINTS$V$ PRINTS$TU$:PRINTSPC(30)T$:PRINTSPC(30)U$
1080 PRINTSPC(30)U$:PRINTSPC(30)U$:PRINTSPC(30)TU$
2000 PRINT"▯▯▯(P=PACK)- OR ROW?
2010 GETZ1$ IFZ1$=""GOTO2010
2012 PRINT"(WE'LL MAKE MORE ROOM SOON)
2020 IFZ1$="P"THENGOSUB50000:GOTO30000
2030 PRINT"▯FROM "Z1$" TO WHICH ROW?
2040 GETZ2$:IFZ2$=""GOTO2040
2050 GOSUB50000:GOTO3100
2100 Z=0:PRINTPR$"    (P=PACK)- OR ROW?
2110 GETZ1$ IFZ1$=""GOTO2110
2120 IFZ1$="P"GOTO30000
2122 IFZ1$>"G"GOTO2100
2130 PRINT"▯FROM "Z1$" TO WHICH ROW?
2140 GETZ2$:IFZ2$=""GOTO2140
2150 IFZ2$>"G"GOTO2130
3100 IFZ1$="A"GOTO10000
3110 IFZ1$="B"GOTO11000
3120 IFZ1$="C"GOTO12000
3130 IFZ1$="D"GOTO13000
3140 IFZ1$="E"GOTO14000
3150 IFZ1$="F"GOTO15000
3160 IFZ1$="G"GOTO16000
10000 A2$="" L=LEN(A$) X=L/3:A=L-2
10010 FORA1=1TOX:A1$=MID$(A$,A,3) IFASC(A1$)=42GOTO10030
10020 A=A-3 A2$=A1$+A2$ A1$="" NEXT:P=32773
10030 A=A1*3 A2=L-A A=A2+3 A$=LEFT$(A$,A) H$=A2$ IFA$=""GOTO17030
10040 A2$=RIGHT$(A$,3) L=LEN(A$) A$=LEFT$(A$,L-3) A2$=RIGHT$(A2$,2)
10050 A1$=LEFT$(A2$,1) A2$=RIGHT$(A2$,1):A1$=A1$+S1$+A2$:A$=A$+A1$
10060 L=LEN(A$) X=L/3 A=1 P=32813 FORA1=1TOX A1$=MID$(A$,A,3):A=A+3
10070 C=ASC(A1$) IFC=42THENP=P+40 NEXT
10080 P1$=LEFT$(A1$,1) P2$=RIGHT$(A1$,1) GOTO17000
11000 B2$="" L=LEN(B$) X=L/3 B=L-2
11010 FORB1=1TOX B1$=MID$(B$,B,3) IFASC(B1$)=42GOTO11030
11020 B=B-3 B2$=B1$+B2$ B1$="" NEXT P=32778
11030 B=B1*3 B2=L-B B=B2+3 B$=LEFT$(B$,B) H$=B2$ IFB$=""GOTO17030
11040 B2$=RIGHT$(B$,3):L=LEN(B$):B$=LEFT$(B$,L-3):B2$=RIGHT$(B2$,2)
11050 B1$=LEFT$(B2$,1) B2$=RIGHT$(B2$,1) B1$=B1$+S1$+B2$:B$=B$+B1$
11060 L=LEN(B$) X=L/3 B=1 P=32813 FORB1=1TOX:B1$=MID$(B$,B,3):B=B+3
11070 C=ASC(B1$) IFC=42THENP=P+40 NEXT
11080 P1$=LEFT$(B1$,1) P2$=RIGHT$(B1$,1) GOTO17000
12000 C2$="" L=LEN(C$) X=L/3:C=L-2
12010 FORC1=1TOX C1$=MID$(C$,C,3) IFASC(C1$)=42GOTO12030
12020 C=C-3 C2$=C1$+C2$:C1$="" NEXT P=32783
12030 C=C1*3:C2=L-C C=C2+3 C$=LEFT$(C$,C):H$=C2$:IFC$=""GOTO17030
12040 C2$=RIGHT$(C$,3):L=LEN(C$) C$=LEFT$(C$,L-3):C2$=RIGHT$(C2$,2)
12050 C1$=LEFT$(C2$,1) C2$=RIGHT$(C2$,1) C1$=C1$+S1$+C2$:C$=C$+C1$
12060 L=LEN(C$) X=L/3 C2=1 P=32823:FORC1=1TOX:C1$=MID$(C$,C2,3):C2=C2+3
12070 C=ASC(C1$) IFC=42THENP=P+40 NEXT
12090 P1$=LEFT$(C1$,1) P2$=RIGHT$(C1$,1) GOTO17000
13000 D2$="" L=LEN(D$) X=L/3:D=L-2
13010 FORD1=1TOX D1$=MID$(D$,D,3) IFASC(D1$)=42GOTO13030
13020 D=D-3:D2$=D1$+D2$ D1$="" NEXT:P=32788
13030 D=D1*3:D2=L-D D=D2+3 D$=LEFT$(D$,D):H$=D2$:IFD$=""GOTO17030
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(listing continued on next page)

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The initial seven strings are constructed from the shuffled cards — they are shuffled on lines 110 to 270. The cards are split into X-string, the cards for the table, and Y-string, those for the pack, on line 300. At this point, both X-string and Y-string consist of concatenated symbol pairs of suit and card.

The program converts each card pair of X-string, the table set, into a string of triple symbols as the seven strings are being formed. The third symbol indicates whether the card is hidden or open on the table. The third element is necessary anyway as a space appears between each symbol pair when open cards are screened.

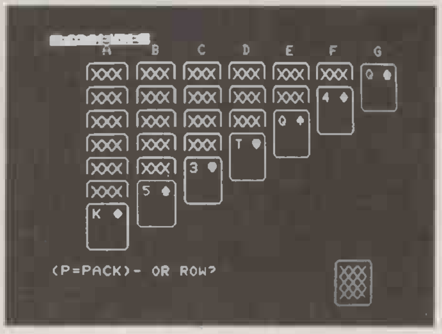
String manipulation requires blocks of information of the same length in multiple coding for rapid collection and use, so there is no waste of memory. Indeed, the actual use of the information is simplified. To simplify screen checks during programming, the hidden cards have an asterisk added on the left side. It can be checked most simply by its ASCII code number. It also fulfils the three-symbol requirement.

The strings are constructed on lines 400 to 530. They are not used for the initial screen printout of the full-scale layout, or for the limited edition, because only the single, end-of-row open card displays each row. The full displays are constructed from the various graphic strings offered at the front end of the program.

The manipulation of the string information is initiated by Get commands from the line 2000 onwards, involving Z-1-string and Z-2-string.

The information which is input must be correct, otherwise the program will not run correctly. Using Get speeds up the playing considerably since no carriage-returns are needed.

Whenever an in-range key, A to G, is pressed lines 3100 onwards branch to the appropriate section to review the row string, separate the open cards, and form them into a new, temporary string. The last card in the hidden part of the residual row string is changed to an open card by removing the asterisk at the front and placing a space between the two card symbols. The open card is Poked to the



screen, and the original open cards are removed by Poking with spaces.

The open cards to be transferred are then added to the selected string, at 18000 onwards, and the newly re-formed string is Poked on to the screen in the appropriate row positions. At this point all the rows are checked for length. If there are four rows of more than 13 cards, the success line comes up, from line 40080. Otherwise the program returns to line 2100.

When P is keyed, the pointer goes to line 30000, and the pack string — Y-string — is accessed. The left-hand card-symbol pair is removed and a space is inserted between the pair, which is printed out — not Poked — in the space at the top left of the screen which is reserved for the dealt card.

If P is keyed once again, the original separated symbol pair, without the space, is replaced on the right-hand end of Y-string. Thus by continually pressing P, the whole pack in hand may be run through to the screen.

If a key with a value less than H is pressed, then the exposed card is closed by overprinting a "back of card" string. The dealt-card string is sent as H-string to be added to the appropriate row string, as selected, using the second part of the row-transfer sequence.

Whenever a transfer is made, the row end-clearing sequence is carried out. A series of For/Next loops Pokes spaces in a set pattern past the end of a particular row, though not beyond the second row up. This limitation avoids the next row being cleared away.

The game is absorbing to play and interesting in operation. Like patience itself, it can be extremely frustrating. Whenever the cards in the pack have been used up the game automatically ends without the success line. When nearing the completion of a game, be careful that all the correct table movements and transfers are made before extracting the last card, otherwise the game may be lost unnecessarily.

The same game will always result when loading and playing from a cold start as the random register will give the same shuffle. It happens to be one which results in a lost game each time but it can be avoided by adding

40 R = INT(RND(0))

Every starting game will then be different.

(listing continued from previous page)

```
13040 D2$=RIGHT$(D$,3):L=LEN(D$):D$=LEFT$(D$,L-3):D2$=RIGHT$(D2$,2)
13050 D1$=LEFT$(D2$,1):D2$=RIGHT$(D2$,1):D1$=D1$+S1$+D2$:D$=D$+D1$
13060 L=LEN(D$):X=L/3:D=1:P=32828:FORD1=1TOX:D1$=MID$(D$,D,3):D=D+3
13070 C=ASC(D1$):IFC=42THENP=P+40:NEXT
13080 P1$=LEFT$(D1$,1):P2$=RIGHT$(D1$,1):GOTO17000
14000 E2$="":L=LEN(E$):X=L/3:E=L-2
14010 FORE1=1TOX:E1$=MID$(E$,E,3):IFASC(E1$)=42GOTO14030
14020 E=E-3:E2$=E1$+E2$:E1$="":NEXT:P=32793
14030 E=E1*3:E2=L-E:E=E2+3:E$=LEFT$(E$,E):H$=E2$:IFE$=""GOTO17030
14040 E2$=RIGHT$(E$,3):L=LEN(E$):E$=LEFT$(E$,L-3):E2$=RIGHT$(E2$,2)
14050 E1$=LEFT$(E2$,1):E2$=RIGHT$(E2$,1):E1$=E1$+S1$+E2$:E$=E$+E1$
14060 L=LEN(E$):X=L/3:E=1:P=32833:FORE1=1TOX:E1$=MID$(E$,E,3):E=E+3
14070 C=ASC(E1$):IFC=42THENP=P+40:NEXT
14080 P1$=LEFT$(E1$,1):P2$=RIGHT$(E1$,1):GOTO17000
15000 F2$="":L=LEN(F$):X=L/3:F=L-2
15010 FORF1=1TOX:F1$=MID$(F$,F,3):IFASC(F1$)=42GOTO15030
15020 F=F-3:F2$=F1$+F2$:F1$="":NEXT:P=32798
15030 F=F1*3:F2=L-F:F=F2+3:F$=LEFT$(F$,F):H$=F2$:IFF$=""GOTO17030
15040 F2$=RIGHT$(F$,3):L=LEN(F$):F$=LEFT$(F$,L-3):F2$=RIGHT$(F2$,2)
15050 F1$=LEFT$(F2$,1):F2$=RIGHT$(F2$,1):F1$=F1$+S1$+F2$:F$=F$+F1$
15060 L=LEN(F$):X=L/3:F=1:P=32838:FORF1=1TOX:F1$=MID$(F$,F,3):F=F+3
15070 C=ASC(F1$):IFC=42THENP=P+40:NEXT
15080 P1$=LEFT$(F1$,1):P2$=RIGHT$(F1$,1):GOTO17000
16000 G2$="":L=LEN(G$):X=L/3:G=L-2
16010 FORG1=1TOX:G1$=MID$(G$,G,3):IFASC(G1$)=42GOTO16030
16020 G=G-3:G2$=G1$+G2$:G1$="":NEXT:P=32803
16030 G=G1*3:G2=L-G:G=G2+3:G$=LEFT$(G$,G):H$=G2$:IFG$=""GOTO17030
16040 G2$=RIGHT$(G$,3):L=LEN(G$):G$=LEFT$(G$,L-3):G2$=RIGHT$(G2$,2)
16050 G1$=LEFT$(G2$,1):G2$=RIGHT$(G2$,1):G1$=G1$+S1$+G2$:G$=G$+G1$
16060 L=LEN(G$):X=L/3:G=1:P=32843:FORG1=1TOX:G1$=MID$(G$,G,3):G=G+3
16070 C=ASC(G1$):IFC=42THENP=P+40:NEXT
16080 P1$=LEFT$(G1$,1):P2$=RIGHT$(G1$,1):GOTO17000
17000 P1=ASC(P1$):IFP1>64THENP1=P1-64
17004 P2=ASC(P2$):IFP2>128THENP2=P2-128
17010 POKEP,93:POKEP+1,P1:POKEP+2,32:POKEP+3,P2:POKEP+4,93:P=P+40:NEXT
17020 POKEP,74:POKEP+1,64:POKEP+2,64:POKEP+3,64:POKEP+4,75
17030 P=P+40:FORA=0TO4:POKEP,32:P=P+1:NEXT:FORAA=1TO14:IFP>33688GOTO17050
17040 P=P+35:FORA=0TO4:POKEP,32:P=P+1:NEXTA:NEXTAA:IFZ=9GOTO40000
17050 IFZ=9GOTO40000
18000 IFZ2$="A"THENA$=A$+H$:GOTO20000
18010 IFZ2$="B"THENB$=B$+H$:GOTO21000
18020 IFZ2$="C"THENC$=C$+H$:GOTO22000
18030 IFZ2$="D"THEND$=D$+H$:GOTO23000
18040 IFZ2$="E"THENE$=E$+H$:GOTO24000
18050 IFZ2$="F"THENF$=F$+H$:GOTO25000
18060 IFZ2$="G"THENG$=G$+H$:GOTO26000
20000 L=LEN(A$):X=L/3:A=1:P=32813:FORA1=1TOX:A1$=MID$(A$,A,3):A=A+3
20010 C=ASC(A1$):IFC=42THENP=P+40:NEXT
20020 P1$=LEFT$(A1$,1):P2$=RIGHT$(A1$,1):Z=9:GOTO17000
21000 L=LEN(B$):X=L/3:B=1:P=32818:FORB1=1TOX:B1$=MID$(B$,B,3):B=B+3
21010 C=ASC(B1$):IFC=42THENP=P+40:NEXT
21020 P1$=LEFT$(B1$,1):P2$=RIGHT$(B1$,1):Z=9:GOTO17000
22000 L=LEN(C$):X=L/3:C2=1:P=32823:FORC1=1TOX:C1$=MID$(C$,C2,3):C2=C2+3
22010 C=ASC(C1$):IFC=42THENP=P+40:NEXT
22020 P1$=LEFT$(C1$,1):P2$=RIGHT$(C1$,1):Z=9:GOTO17000
23000 L=LEN(D$):X=L/3:D=1:P=32828:FORD1=1TOX:D1$=MID$(D$,D,3):D=D+3
23010 C=ASC(D1$):IFC=42THENP=P+40:NEXT
23020 P1$=LEFT$(D1$,1):P2$=RIGHT$(D1$,1):Z=9:GOTO17000
24000 L=LEN(E$):X=L/3:E=1:P=32833:FORE1=1TOX:E1$=MID$(E$,E,3):E=E+3
24010 C=ASC(E1$):IFC=42THENP=P+40:NEXT
24020 P1$=LEFT$(E1$,1):P2$=RIGHT$(E1$,1):Z=9:GOTO17000
25000 L=LEN(F$):X=L/3:F=1:P=32838:FORF1=1TOX:F1$=MID$(F$,F,3):F=F+3
25010 C=ASC(F1$):IFC=42THENP=P+40:NEXT
25020 P1$=LEFT$(F1$,1):P2$=RIGHT$(F1$,1):Z=9:GOTO17000
26000 L=LEN(G$):X=L/3:G=1:P=32843:FORG1=1TOX:G1$=MID$(G$,G,3):G=G+3
26010 C=ASC(G1$):IFC=42THENP=P+40:NEXT
26020 P1$=LEFT$(G1$,1):P2$=RIGHT$(G1$,1):Z=9:GOTO17000
30000 L=LEN(Y$):IFL<2THENGOTO60100
30002 PA$=LEFT$(Y$,2):PB$=LEFT$(PA$,1):PC$=RIGHT$(PA$,1)
30010 Y$=RIGHT$(Y$,L-2):PD$=PB$+S1$+PC$:PRINT"■■■"SPC(1)PD$PR$
30020 PRINT"P FOR NEXT-OR LINE LETTER TO GO
30030 GETZ2$:IFZ2$=""GOTO30030
30040 IFZ2$<"H"GOTO31000
30050 Y$=Y$+PA$:GOTO30000
31000 PRINT"■■■"U$PP$:H$=PD$:GOTO18000
40000 FW=0:L=LEN(A$):IFL>37THENFW=1
40010 L=LEN(B$):IFL>37THENFW=FW+1
40020 L=LEN(C$):IFL>37THENFW=FW+1
40030 L=LEN(D$):IFL>37THENFW=FW+1
40040 L=LEN(E$):IFL>36THENFW=FW+1
40050 L=LEN(F$):IFL>37THENFW=FW+1
40060 L=LEN(G$):IFL>37THENFW=FW+1
40070 IFFW<4GOTO2100
40080 PRINTPR$"■ SUCCESS - YOU HAVE WON!!!
40090 PRINT"FOR ANOTHER GAME 'Z'-OTHER TO END
40100 GETZ$:IFZ$=""GOTO40100
40110 IFZ$="Z"THENRUN
49999 END
50000 PRINT"■"S1$S1$TF$
50010 PRINT"■■"SPC(7)"A"SPC(4)"B"SPC(4)"C"SPC(4)"D"SPC(4)"E"SPC(4)"F"SPC(4)"G"
50020 PRINT"■"S1$S1$S$T$T$T$T$T$T$W$G1$W$
50030 PRINT"■"T$T$T$T$T$T$W$F1$W$TU$:PRINT"■"U$T$T$T$T$W$E1$W$TU$
50040 PRINTTU$T$T$T$W$D1$W$TU$:PRINTS1$S1$S$T$T$W$C1$W$TU$
50050 PRINTS1$S1$S$T$W$B1$W$TU$:PRINTS1$S1$S$W$A1$W$TU$:PRINTS1$S1$S$TU$
50060 RETURN
59999 END
60000 PRINT"■■ PATIENCE ":RETURN
60100 PRINT"■ SORRY - NO CARDS LEFT ":GOTO40090
READY.
```

The Product:
Apple II Europlus 48K
The Price:

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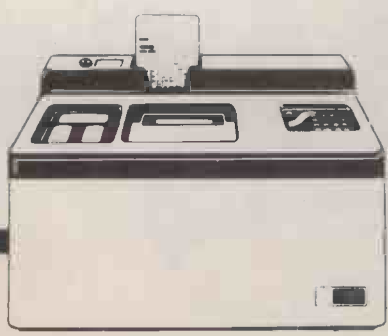

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Tony West offers practical advice on incorporating the microcomputer into primary school teaching.

Processes of learning

THE COMPUTER'S use in education has greatly expanded in the last few years. With the development of low-cost micro-computers, schools now find that computer systems are well within their budgets. Such systems can be found in many senior schools and the junior or infant schools are beginning to turn to the micro.

Unlike the senior schools, many junior or infant schools lack the expertise to integrate the computer's power successfully into the curriculum. Nevertheless, the micro can do a great deal to supplement the teaching material normally found in these schools. It is not essential for the school to have its own programmer since there will usually be expertise at hand. Software can be prepared by the staff at the school or through consultation with staff at another institution.

I have chosen two programs to show just what can be achieved. The first deals with addition and the second is aimed at a much earlier stage and covers counting. Both were written on an 8K Pet. The first program is based on the process of addition and covers numbers which are confined to the "tens" and "units" scale. It is further restricted to cover the addition of just two numbers. The program's objective is to check that the child can recognise when the two units digits produce a "carrying" ten.

Numerical accuracy in adding the respective digits is ignored and the child can correct any such mistakes. Other programs will perform this task. I have found that incorporating too many tasks in one program leads to unnecessary complications.

When the program starts, the teacher is presented with a series of questions which allow him to decide several issues. He can select a suitable group of problems from the program's database. He can also fix the length of time the child should be allocated to think about the decision part of the sum. Having set these parameters, the child can now commence the computerised exercise. When the exercise has been completed the program displays an analysis of where the child made mistakes so that the teacher can organise future work patterns.

The display the child sees follows, as closely as possible, the format he is used to and represents the various stages he would normally follow. These are shown using the problem, 36 + 47.

The first stage represents the problem itself and is achieved using the standard print/tabulator instructions. The visual display is therefore,

```
3  6
4  7
----
```

To avoid confusion, the problem carries the heading,

ADDITION

At this point, the child must decide whether or not there will be a carrying figure. He signals his response by pressing either the Y key for "Yes" or the N key for "No". It is this decision response which is time-controlled.

The Get instruction is used to allow the child to transmit the relevant reply using only the one key. Typically, the instruction would follow the format,

```
212 GET S$ : IF S$ = "N" THEN 242
```

where line 242 represents an instruction to cater for a correct response. The time delay interval is set using the Pet time

function, and is first set to zero by the instruction,

211 TI$ = "000000"

The time in seconds, which the teacher feels to be appropriate for a particular child, is stored in the variable X. The program tests if this time has elapsed using the instructions,

```
214 IF TI = X*60 THEN 220
216 GOTO 212
```

The first instruction takes account of the fact that the Pet's time, when using TI, is recorded in sixtieths of a second and accordingly scales up the value in X. The instruction then directs the program to a corrective procedure beginning at line 220 when the child fails to respond correctly within the prescribed time interval. If the time limit has not been reached, line 216 directs the program back to repeat this section.

Assuming that the child has indicated a correct response, he now proceeds with the addition. The first column is totalled and the unit entry in the answer signalled through the number keyboard. This information is immediately displayed, and, after a short interval, the carrying figure is also displayed. The child now enters the final figure in the "tens" column to complete the procedure.

Should he make a mistake when entering these digits, the computer waits until the correct digit is pressed. At this point the child could have inadvertently pressed the wrong digit key. The computer is programmed to give the user the benefit of the doubt.

Using the symbol →, to indicate, "leading to", the various screen displays can be represented:

```
(i) 3  6 → (ii) 3  6 → (iii) 3  6 → (iv) 3  6
    4  7        4  7         4  7        4  7
                             1           1
    ____        ____         ____        ____
                   3            3        8  3
```

The final act in this process is the drawing of a tick to indicate that the solution was correct.

The Pet has cursor keys which allow the programmer to control movement both vertically and from side to side. The operation of these cursor keys can be initiated by embedding them within a normal print instruction. Provided that the programmer knows where the last printed character is located, he can then direct the movement of the cursor from within his program and so print the next character in a position of his choice.

The only point to bear in mind is that when a character has been printed, there is a natural right-hand cursor movement which must be taken into account and balanced by a left-hand cursor move. Alternatively, the movement about the screen can be defined using the poke command.

In the section of the program

214 IF TI = X*60 THEN 220

the command passes from the child to the computer. The computer moves to line 220 and demonstrates to the child how the correct answer should have been achieved by displaying, step by step, the various parts of the problem.

At the same time an array is used to record the problem number so that the teacher and the child can see, at a later stage, where the mistakes arose. The corrective procedure is initiated by a screen message which indicates that a mistake has been made.

There are several points at which a delay in the program run is desirable. With the exception of the decision-making point, where a variable time delay is necessary to suit the needs of each individual child, all other delays can be of a fixed duration.

For example, a slight pause between the display of the unit figure and the carrying figure allows the child time to reflect on the next part of the problem. Rather than employ the Pet's time function, an empty For loop was employed. This simple approach was adopted for programming convenience. The delay was achieved with the instruction,

FOR I = 1 TO 1000 = NEXT I

The teacher selects the starting and finishing points for the exercise. These two values are stored in N1 and N2 and form the parameters of a For loop to control the computerised exercise. This instruction has the format,

FOR J = N1 TO N2

The program has 30 problems available in order of difficulty. Not all these problems involve a carrying 10. The problems are stored in arrays. One number is stored in C2(J), C1(J) while the second number is stored in B2(J), B1(J). A carrying requirement can be detected by means of the test,

210 IF C1(J) + B1(J) > 9 THEN 242

Line 242 begins a section dealing with a carrying figure. The Get instruction is used to determine the numerical keyboard responses corresponding to the solution. This would normally be achieved using,

GET S: IF S = A(J) THEN 230

However, because the software used the cursor control keys to fix the character position, I found it more convenient to store the solutions as strings in the arrays A*(J) and A1*(J). This reduced the number of cursor movements in the print instruction. Accordingly, the appropriate instruction followed the format,

```
GET S$: IF S$ = A$(J) THEN 230
GET S$: IF S$ = A1$(J) THEN 236
```

When one problem has been dealt with the screen is cleared to make way for the next problem. Clearing the screen is achieved by embedding the clear screen key in a suitable print instruction.

Finally, the software can be made to operate in either lower of upper case by using the Poke instructions,

POKE 59468,14 or POKE 59468, 12 respectively.

What follows is not the whole program since it is too large to reproduce in full. A broad outline of the program is shown to give a flavour of the software which was used. The subroutines referred to in lines 222 and 252 represent corrective procedures. The first subroutine deals with the non-carrying situation while the second one caters for the carrying occasion.

A further subroutine is also referred to at several points in the program. The subroutine beginning at line 90 is responsible for the drawing of a tick. The embedded cursor control movements can be seen in lines 230, 236, 260, 264, 270, 506, 510, 606, 610 and 614. Line 192 is an example of the embedded clear screen key.

Immediately before the subroutines 500 and 600 are entered, the array Q(J) is used to store the incorrectly answered problem number. This array information is used at the end of the program, lines 850 to 868, to display the fault-finding analysis.

(continued on next page)

```
10 PRINT "♫"
12 H$="1 2 3 4 5 6 7 8 9 0"
13 E=0
14 W=33170:Z=81:PRINT
20 PRINT "SELECT TIME,IN SECONDS,FOR THE SUM"
30 PRINT:INPUT F
40 PRINT "HOW MANY SUMS"
50 PRINT:INPUT S
60 FOR I=1 TO 1000:NEXT I
70 PRINT "♫"
80 FOR I=1 TO S
90 PRINT "♫"
100 X1 = INT( 9*RND(1)+1)
110 FOR J=1 TO 2*X1-1 STEP 2
120 POKE W+J,Z
130 NEXT J
200 TI$="000000"
210 GET A:IF A=X1 THEN 600
220 IF TI>F*60 THEN 700
230 GOTO 210
600 D1=W+X1+14
601 FOR L=1 TO 6:PRINT:NEXT L
602 PRINT TAB(3);X1
605 POKE D1,77:POKE D1+1,78
610 POKE D1-38,78:POKE D1-77,78
615 FOR K=1 TO 1500:NEXT K
620 GOTO 800
700 D1=W+X1+14
710 POKE D1,77:POKE D1+1,78
720 POKE D1+40,78:POKE D1+41,77
730 FOR K=1 TO 1500:NEXT K
731 FOR K=1 TO 11:PRINT:NEXT K
740 G$=MID$(H$,1,2*X1-1)
750 PRINT "   ";G$
760 FOR K=1 TO 1500:NEXT K
770 E=E+1
800 NEXT I
900 PRINT "♫"
910 FOR J=1 TO 5:PRINT:NEXT J
920 PRINT "YOU SCORED  ";S-E;" OUT OF ";S
```

(continued from previous page)

```
2 POKE 59468,12
10 REM M1= CARRY
15 REM SUM STORED FIRST ROW C2(J),C1(J)
20 REM SECOND ROWW B2(J),B1(J)
25 REM SOLUTIONS A1$(J),A$(J)
30 REM FINISH=N2,START=N1
40 DIM C2(30),C1(30),B2(30),B1(30)
41 DIM A1$(30),A$(30),Q(30)
45 FOR I=1 TO 30
50 READ C2(I),C1(I),B2(I),B1(I),A1$(I),A$(I)
55 NEXT I
58 GOTO 100
60 DATA 4,3,1,9,"6","2"
61 DATA 2,4,3,1,"5","5"
62 DATA 3,8,4,3,"8","1"
63 DATA 2,2,1,9,"4","1"
64 DATA 5,4,2,2,"7","6"
65 DATA 4,3,2,8,"7","1"
66 DATA 2,7,3,4,"6","1"
67 DATA 1,9,2,4,"4","3"
68 DATA 7,2,2,6,"9","8"
69 DATA 2,4,3,8,"6","2"
70 DATA 3,7,2,5,"6","2"
71 DATA 4,8,3,5,"8","3"
72 DATA 4,3,3,6,"7","9"
73 DATA 2,5,1,2,"3","7"
74 DATA 5,3,1,8,"7","1"
75 DATA 3,6,2,2,"5","8"
76 DATA 2,7,3,6,"6","3"
77 DATA 1,8,2,4,"4","2"
78 DATA 3,4,3,9,"7","3"
79 DATA 6,8,1,6,"8","4"
80 DATA 2,7,3,6,"6","3"
81 DATA 3,6,4,8,"8","4"
82 DATA 3,4,2,5,"5","9"
83 DATA 4,5,2,6,"7","1"
84 DATA 2,6,2,8,"5","4"
85 DATA 5,7,3,7,"9","4"
86 DATA 3,9,4,8,"8","7"
87 DATA 2,8,3,7,"6","5"
88 DATA 1,9,4,9,"6","8"
89 DATA 2,3,3,5,"5","8"
90 FOR I=1 TO 1000:NEXT I
91 FOR I=1 TO 5:PRINT:NEXT I
92 PRINT TAB(20);"\/"
93 PRINT TAB(22)"TI/"
94 PRINT TAB(23);"TI/"
95 FOR I=1 TO 4000:NEXT I
96 RETURN
100 PRINT"J":PRINT"SELECT START AND FINISH POINTS"
105 PRINT:PRINT"WHICH QUESTION DO YOU WISH TO START AT"
110 PRINT:INPUT N1
115 PRINT:PRINT"WHICH QUESTION DO YOU WISH TO FINISH AT"
120 PRINT:INPUT N2
125 PRINT:PRINT"DO YOU WANT TO CHANGE THE START POINT"
130 PRINT:PRINT"TYPE Y FOR YES,N FOR NO"
135 PRINT :INPUT R1$
140 IF R1$<>"Y" THEN 155
145 PRINT:PRINT"NEW START POINT"
150 PRINT:INPUT D1:N1=D1
155 PRINT:PRINT"DO YOU WANT A NEW FINISHING POINT"
160 PRINT:PRINT"TYPE Y FOR YES,N FOR NO"
162 PRINT :INPUT R2$
165 IF R2$<>"Y" THEN 176
170 PRINT:PRINT"NEW FINISHING POINT"
175 PRINT:INPUT D2:N2=D2
176 PRINT:PRINT "WHAT DELAY,IN SECONDS DO YOU WANT"
177 INPUT P
180 GOSUB 700
185 PRINT "J"
190 FOR J=N1 TO N2
192 X=1:PRINT "J"
193 PRINT TAB(16);"ADDITION"
194 FOR I=1 TO 6:PRINT:NEXT I
196 PRINT TAB(18);C2(J);TAB(21);C1(J)
198 PRINT TAB(18);B2(J);TAB(21);B1(J)
200 PRINT
202 PRINT TAB(18);"‾‾‾‾‾"
204 PRINT
206 PRINT
208 PRINT TAB(18);"_____";
210 IF C1(J)+B1(J)>9 THEN 241
211 TI$="000000"
212 GET S$:IF S$="N" THEN 226
214 IF TI=P*60 THEN 220
218 GOTO 212
220 Q(J)=J
222 GOSUB 500
224 GOTO 650
226 GET S$:IF S$=A$(J) THEN 230
228 GOTO 226
230 PRINT "TI█";A$(J);
232 GET S$:IF S$=A1$(J) THEN 236
234 GOTO 232
236 PRINT "████";A1$(J)
238 GOSUB  90
240 GOTO 650
241 TI$="000000"
242 GET S$:IF S$="Y" THEN 256
244 IF TI=P*60 THEN 252
250 GOTO 242
252 Q(J)=J:GOSUB 600
254 GOTO 650
256 GET S$:IF S$=A$(J) THEN 260
258 GOTO 256
260 PRINT "TI█";A$(J);
262 FOR I=1 TO 1000:NEXT I
264 PRINT "███TI1";
266 GET S$:IF S$=A1$(J) THEN 270
268 GOTO 266
270 PRINT "██QQ";A1$(J)
272 GOSUB 90
274 GOTO 650
500 PRINT:PRINT
502 PRINT TAB(8);"WRONG,WATCH ME";
504 FOR I=1 TO 1000:NEXT I
506 PRINT "TIT";A$(J);
508 FOR I=1 TO 1000:NEXT I
510 PRINT "████";A1$(J)
512 FOR I=1 TO 3000:NEXT I
514 RETURN
600 PRINT :PRINT
602 PRINT TAB(8);"WRONG,WATCH ME";
604 FOR I=1 TO 1000:NEXT I
606 PRINT "TIT";A$(J);
608 FOR I=1 TO 1000:NEXT I
610 PRINT "███TIT1";
612 FOR I=1 TO 1000:NEXT I
614 PRINT "██QQQ";A1$(J)
616 FOR I=1 TO 3000:NEXT I
618 RETURN
650 NEXT J
652 GOTO 850
700 PRINT "J"
702 PRINT TAB(18);"___"
704 PRINT TAB(17);"/   \"
706 PRINT TAB(17);"|   |"
708 PRINT TAB(16);"/|   |\"
710 PRINT TAB(16);"\| _ |/"
712 PRINT TAB(17);"|(_)|"
714 PRINT TAB(17);"\___/"
716 FOR I=1 TO 5
718 PRINT TAB(18);"***"
720 NEXT I
722 PRINT TAB(17);"*****"
724 PRINT TAB(16);"*******"
726 FOR I=1 TO 500:NEXT I
728 FOR J=1 TO 50
730 FOR K=1 TO 10
732 POKE 32906,96:POKE 32908,96
734 NEXT K
736 POKE 32906,218:POKE 32908,218
738 NEXT J
739 PRINT
740 A$="         "
742 PRINT A$;"▒▒▒ ▒   ▒"
744 PRINT A$;"▒   ▒"
746 PRINT A$;"▒    ▒▒ ▒ ▒▒▒ ▒▒"
748 PRINT A$;"▒    ▒ ▒ ▒ ▒ ▒"
750 PRINT A$;"▒    ▒ ▒ ▒ ▒ ▒▒"
752 PRINT A$;"▒    ▒ ▒ ▒ ▒  ▒"
754 PRINT A$;"▒▒▒ ▒ ▒ ▒ ▒▒▒ ▒▒"
756 PRINT A$;"          ▒"
758 PRINT A$;"          ▒"
760 FOR K=1 TO 2500:NEXT K
762 Z=102:W=32768
764 POKE W+163,Z:POKE W+164,Z
766 POKE W+165,Z:POKE W+204,Z
768 POKE W+244,Z:POKE W+284,Z
770 POKE W+323,Z:POKE W+324,Z
772 POKE W+325,Z
774 FOR I=1 TO 2500:NEXT I
776 POKE W+268,Z:POKE W+269,Z
778 POKE W+270,Z:POKE W+310,Z
780 POKE W+350,Z:POKE W+349,Z
782 POKE W+348,Z:POKE W+353,Z
784 POKE W+313,Z:POKE W+273,Z
786 POKE W+274,Z:POKE W+275,Z
788 POKE W+276,Z:POKE W+277,Z
790 POKE W+317,Z:POKE W+351,Z
792 POKE W+308,Z:POKE W+315,Z
794 POKE W+355,Z:POKE W+357,Z
796 FOR I=1 TO 3000:NEXT I
797 PRINT "J"
798 RETURN
850 FOR I=1 TO 3000:NEXT I
852 PRINT "J"
854 FOR I=1 TO 5:PRINT:NEXT I
856 PRINT "THE FOLLOWING QUESTIONS WRONG"
858 PRINT
860 FOR I=1 TO 30
862 IF Q(I)<>I THEN 868
864 PRINT TAB(8);Q(I):PRINT
868 NEXT I
```

Terminal Pet wins new lease of life

Philip Barker's programs in Basic and assembler form the simple software interface you need to transform your Pet into an intelligent terminal. With these routines and an interface box, you can link up with local mainframes.

TO REAP the benefits of using your micro as a terminal, you can use any of a number of generally available interface boxes. For the Pet, the popular Netkit and GPI interfaces enable the micro to be coupled:

- Directly to a local mainframe,
- Via an acoustically-coupled Modem to a remote computer installation.

Figure 1 shows a typical arrangement of equipment which enables the Pet to function in the second of these two ways. The interface we have used — GPI from Small Systems Engineering — is able to buffer 80 characters. It is described as programmable since its communication characteristics can be set and changed under program control. This is effected by sending it a control character — hexadecimal FF — followed by a five-byte configuring string. The significance of each of these bytes is as follows:

Byte 1: baud rate — 50-9600
Byte 2: parity — even or odd
Byte 3: number of stop bits — one or two
Byte 4: data-input mode — Get or Input
Byte 5: code-conversion mode

For most applications, the interface is configured to operate at 300 baud using even parity, one stop bit, Get input and code conversion for linking your micro directly to a local mainframe.

To make your Pet function as a terminal, you need a simple software interface. It will take the form of a program which accepts messages typed by the user and transmits these to the mainframe. In addition, it must accept messages transmitted by the remote host and display these on the microcomputer screen. The simplest way to achieve this is to transmit data character by character. A simple program to implement this type of data transmission is shown in figure 2.

The code at lines 100 through to 140 is executed as an initialisation routine and serves the purpose of configuring the programmable interface. Lines 200 through to 230 are responsible for detecting character input via the keyboard. As each character typed by the user is detected, it is sent to the mainframe via channel 1. Characters transmitted by the host are stored in the buffer of the interface until they are required for processing by the program.

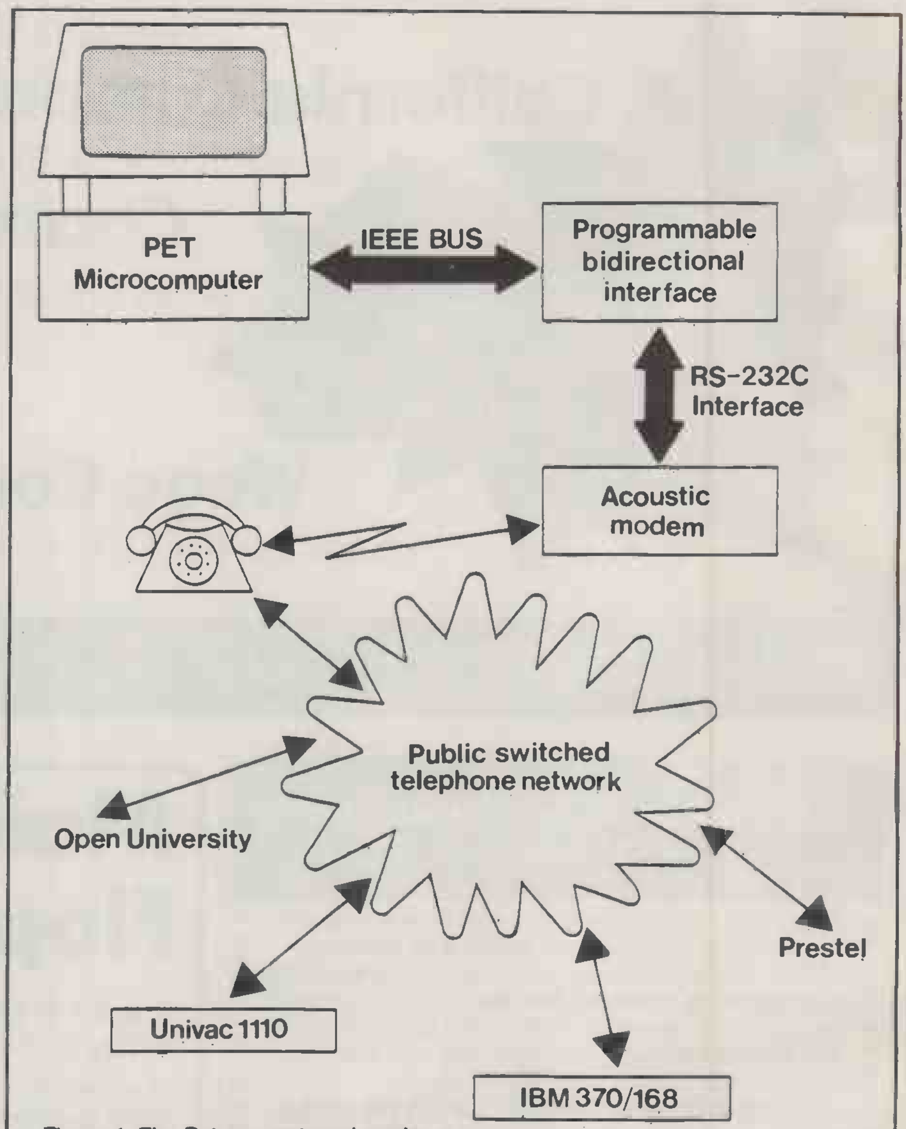

Figure 1. The Pet as a netword mode.

Statements 300 through to 330 are responsible for getting characters — hence, Get mode — from the interface buffer via channel 2 and displaying them on the screen of the microcomputer. As it is written, the program sets the mainframe link to function at 300 baud and assumes full-duplex operation — that is, characters typed at the keyboard are echoed back from the mainframe before they are displayed. This is the normal mode of usage for communication with the IBM 370/168 host.

Interrupt vectors

When the program is running in the microcomputer, it can be interrupted by pressing the stop key on the Pet keyboard. This effect may also be achieved by pressing a user-implemented reset button that generates a non-maskable interrupt. This facility is useful for interrupting programs written in machine code — provided that the interrupt vectors are set up appropriately.

Once the program has been halted it can be listed, modified in various ways and then restarted. If need be, additional programs written in Basic or machine code can be loaded from tape or disc without disturbing the mainframe link.

Thus, programs to perform particular types of operation — for example, file transfer, cross-loading, data conversion and so on — can easily be loaded, executed and then replaced by other modules that perform different terminal functions.

Unfortunately, when the Basic program shown in figure 2 is used as a terminal controller several ergonomic limitations become apparent. They are the result of:

- The absence of any special control keys on the Pet keyboard.
- The limitations imposed by its processing speed.
- The absence of a screen cursor.

To turn the Pet into an acceptable terminal device, each of these shortcomings needs to be overcome. This is easily achieved by using a suitable combination of host-processor facilities and local-microcomputer software modifications.

Most conventional ASCII keyboards usually contain special-function keys such as control, break, backspace and line-delete. These functions are used, either alone or in combination with other keys, to create codes which have special significance to the software in the remote computer. Such codes are normally employed for control or message-editing functions.

The break key is used to produce an attention interrupt in the mainframe thereby causing it to suspend an active program and return control to the user. Key combinations involving the use of the control button are an important means of adding to or extending the keyboard.

Many keyboards contain special keys for character or line deletion. Thus, when a user is typing a command line, if a mistake is made, the offending characters or line can be logically erased. This is achieved by pressing the appropriate character-delete or line-delete button on the keyboard. Because these special function keys are not present on the Pet's keyboard, some means of producing equivalent effects needs to be implemented.

Two approaches

The easiest solution to this problem is to designate some of the less frequently used Pet keys for the purpose. There are two ways to implement these changes: either in the local software contained in the micro or by means of the facilities provided by the remote mainframe. The second approach is the easier of the two and is the one that was used in conjunction with the software shown in figure 2.

When the Pet is operating in Poke 12 or normal mode, the character set available does not support lower-case alphabetic symbols. This creates a problem when the program listed in figure 2 is used to receive mainframe messages containing them.

For example, if the word Enter was transmitted from the mainframe it would appear on the screen of the Pet as the sequence of symbols E.%2. This phenomenon arises because of the special way in which the screen memory of the Pet microcomputer drops bit 6 of the standard ASCII value to produce a six-bit code for its keyboard characters. The problem can be overcome by adding some additional statements to the program presented in figure 2.

Modifications similar to the following can be used to provide the lower-case capability needed to overcome the encryption problem mentioned:

```
135 POKE 59468, 14
      o
      o
315 IF A$ = "" THEN : RETURN
316 C = ASC(A$)
317 IF (C>64) AND (C<91) THEN A=128
318 IF (C>96) AND (C<128) THEN A
      =—32
319 A$ = CHR$(C+A)
      o
      o
```

The Poke statement, line 135, sets the Pet into alternate character-set mode — upper or lower case rather than upper case/graphics. The extra statements at lines 315 through to 319 are included to compensate for the effect of the Poke statement on the way the ASCII code values are interpreted by the Pet.

```
10   REM - PET AS A REMOTE TERMINAL
20   GOSUB 100 : REM SET UP MODEM
30   GOSUB 200 : REM GET KEYBOARD CHARACTER
40   GOSUB 300 : REM GET MAINFRAME CHARACTER
50   GOTO 30
100  REM *** CONFIGURE INTERFACE ***
110  OPEN 1,4  :  REM OUTPUT CHANNEL
120  OPEN 2,6  :  REM INPUT CHANNEL
130  PRINT#1, CHR$(255);"FXXGA"
140  RETURN
200  REM *** GET KEYBOARD CHARACTER ***
210  GET A$ : IF A$ = "" THEN: RETURN
220  PRINT#1, A$;
230  RETURN
300  REM *** GET MAINFRAME CHARACTER ***
310  GET#2,A$ : IF ST=2 THEN : RETURN
320  PRINT A$;
330  RETURN
```

Figure 2. Basic program to enable the Pet to operate as a remote terminal.

Unfortunately, the additional computational overhead associated with these extra statements introduces a further problem. When long message strings are sent from the host — for example, when listing a file — the speed of the modified program becomes too slow to handle them. Communication between the mainframe and remote terminal is asynchronous. Each character transmitted consists of a start bit, seven data bits, a parity bit and one stop bit — that is, 10 bits in total.

Thus, at 300 baud, the mainframe transmits one character every 33.33ms. If the remote terminal cannot process data quickly enough, then information is likely to be lost unless some form of buffering and/or mechanism for delaying transmission or flow control is used.

The programmable interface between the Modem and the Pet has the capability of buffering 80 characters. Furthermore, when the buffer becomes full, the interface should pass a signal to the mainframe which stops it transmitting — thereby preventing loss of information.

However, if the mainframe chooses to ignore this signal, the interface fails to send it, or, if it is allowed to "float", then information will become lost through buffer overflow. This phenomenon has been observed when the equipment shown in figure 1 is used in conjunction with the modified Basic program described.

The basic time for the original subroutine — lines 200 through to 300 in figure 2 — to service a character sent from the mainframe is about 31ms. The additional overhead added to this routine by the code-conversion statement is about 41ms./character. It is easy to see that providing a lower-case capability more than doubles the time it takes to process each character received from the mainframe.

By comparing the rate of character transmission from the mainframe and the rate at which they are processed by the Pet, it is possible to compute the message size at which buffer overflow will take place. This works out to be about 150 characters. Messages longer than this will be received incorrectly.

To overcome the problem, you need some means of increasing the rate of processing in the Pet. Using machine-code programs is one way of accomplishing this. Indeed, when the modified version of figure 2 is replaced by an equivalent machine-code program, no problems are experienced.

Inherent in the code shown in figure 2 is yet another limitation. Because the input is programmed via a Get statement, no flashing cursor is displayed. Conveniently, it is possible to turn on the cursor by means of a Poke statement prior to the input transaction. The additional statement:

```
21 POKE 167,0
```

should thus easily remedy the absence of a cursor. Indeed, when this modification is made, a cursor does appear.

However, as user-computer dialogue proceeds, the appearance of the microcomputer screen becomes ergonomically unacceptable. Static images of the cursor remain deposited at what would seem randomly-selected positions on the screen. In fact, these appear at some of the cursor locations corresponding to the receipt of a carriage-return character — from the keyboard or the mainframe.

The particular points at which they occur correspond to instants at which synchronisation between the Basic program and the cursor-handling system is lost. An easy way to remove the blobs is by adding some extra Basic statements which ensure a space character is deposited at the cursor position when a carriage-return code is received. However, like the code-conversion routines described, the computational overhead of employing such code is prohibitive.

The easiest solution to these various problems is to write the software — that listed in figure 2 and the various amendments — in assembler. Bearing in mind what has been said, the basic algorithm to be implemented is as follows:

Begin: Set the non-maskable interrupt vector to handle the reset button.
Step 1: Get a character from the keyboard.
Step 2: If no character, jump to step 4. If a cursor-control character, ignore it — jump to step 4.

(continued on next page)

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Step 3: Send character to mainframe.
Step 4: Get character from mainframe.
Step 5: If STATUS = 2 then jump to Step 1.
Step 6: Perform code conversion — upper/lower case.
Step 7: If carriage-return character — hexadecimal OD — then write over the "blob". Print the character on the screen.
Step 8: Jump to step 1 and repeat cycle.
Last: Reset default Input/Output device codes. Jump back to Basic interpreter.

The machine-code implementation of this algorithm was developed on a cross-assembler for the MCS-650X range of microcomputers. It was available on one of the back-end mainframe machines, the IBM 370/168. The development system used is similar to that depicted schematically in figure 3.

Assembler source-language statements were stored in a mainframe file called Input. The contents of this file could be modified in various ways by means of the system editor. During an assembly, the cross-assembler read the statements contained in Input, checked their validity and generated appropriate object code which was stored in the file Output 1.

At the same time, a listing of the source file — and appropriate diagnostic messages — was sent to the file Output 2. This could later be listed on a system printer or on a local print device. Alternatively, this output could be produced directly on the screen of the Pet. A typical listing of the final version of the assembler program, produced on a local printer, is shown in figure 4.

To use this program, you must provide a simple prologue routine written in Basic. An example of such a routine is:

```
10 OPEN 1,4 : REM OUTPUT CHANNEL
20 OPEN 2,6 : REM INPUT CHANNEL
21 POKE 167,0 : REM TURN ON CURSOR
30 PRINT #1, CHR$(225);"FXXGA":REM
   SET UP INTERFACE
40 POKE 59468,14 : REM TURN ON LOWER
   CASE
50 SYS 8192 : REM JUMP TO ASSEMBLER
   ROUTINE
```

Using this combination of programs overcomes all the previously-described problems. The prologue code is written in Basic rather than in assembler so that the end-user can easily modify those parts of it which he is likely to want to change — external device addresses, cursor on/off status and interface details.

The assembler routine disables all the cursor-control keys to avoid spurious side-effects. The Pet's run-stop and RVS keys are not treated in this way. In the system we use, the run-stop key is used to produce an attention interrupt in the mainframe, while RVS is assigned the task of generating an end-of-file character for data entry from the terminal.

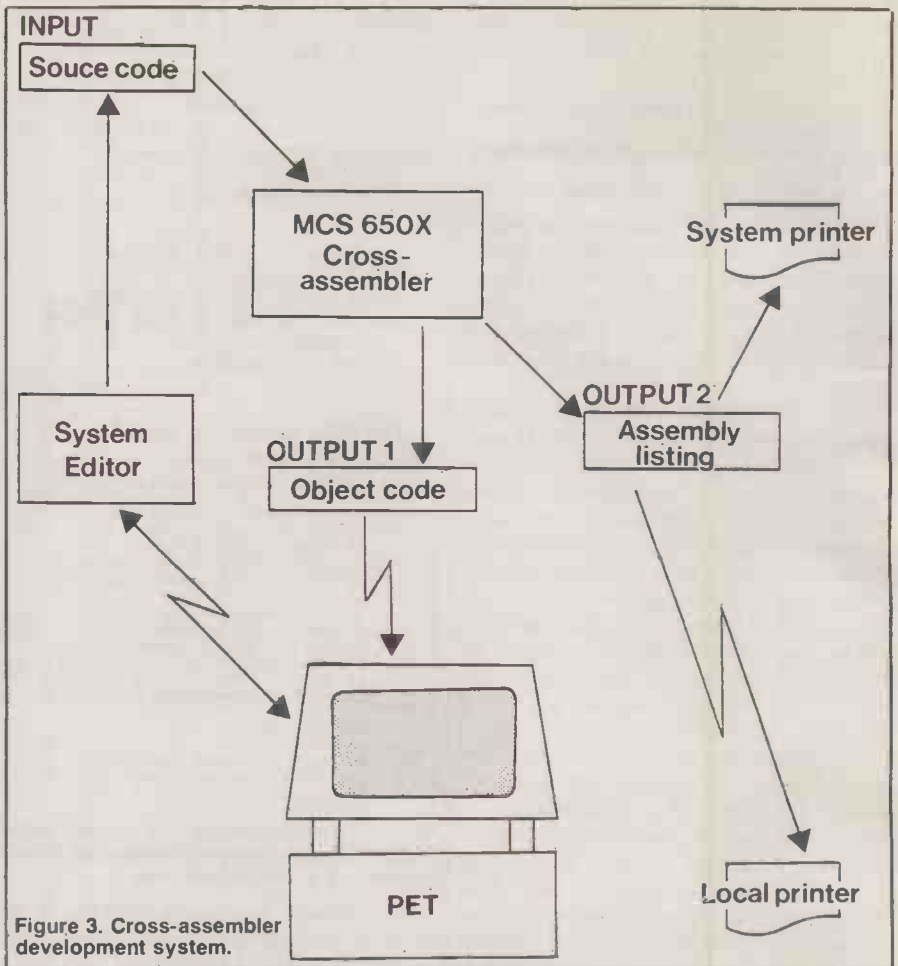


Figure 3. Cross-assembler development system.

The reset button on the Pet produces a local interrupt which causes control to be returned to Basic. When this happens, the Pet can be made to function as a stand-alone microcomputer to run Basic or assembler programs — provided they do not interfere with the prologue code. As an example of this, suppose the Pet contained the following program:

```
1000 FOR I = 1 TO 100
2000 PRINT I, I*I, I ↑ 3
3000 NEXT I
4000 STOP
```

in addition to the original prologue routine — lines 10 through to 50. The effect of the following user directives:

1. Type: Run
2. Press: Reset button
3. Type: Run 1000
4. Type: Run

would be to set up communication with the mainframe, step 1, then, at a later stage, logically sever the link, step 2, initiate the execution of a local application program running on the Pet, step 3, and then re-establish communication with the mainframe, step 4.

The assembler routine is 181 bytes long and thus could easily fit into one of the tape-cassette buffers, leaving the whole of the remaining memory available for other purposes. Alternatively, it could be entered into instant ROM so that it would never need to be reloaded. Although developed for use on the 40-column Pet, the programs will also work on the newer 80-column 8000 series machines.

However, in this case the return address to Basic warm start would need to be changed from $C389 Basic 2.0 to $B3FF Basic 4.0. In addition, it would be desirable, although not necessary, to modify the assembler routine to handle the additional keys present on the extended keyboard. When the software I have outlined is used in conjunction with the Pet, you have a powerful terminal.

Figure 4. Assembler routine to enable the Pet to operate as a terminal.

```
                  ;
                  ; CODE TO USE PET AS A REMOTE TERMINAL
                  ; ASSEMBLED USING XASM:MCS650XASR
                  ;
      FFCC        RFILES   EQU  $FFCC   ; RELEASE FILES
      FFE4        GETCHR   EQU  $FFE4 . ; GET A CHARACTER
      FFC9        DTFILE   EQU  $FFC9   ; SET UP OUTPUT FILE
      FFC6        INFILE   EQU  $FFC6   ; SET UP INPUT FILE
      FF02        PRTCHR   EQU  $FFD2   ; PRINT CHARACTER
      C389        BASIC    EQU  $C389   ; RETURN TO BASIC
                  ;
2000                 ORG $2000
                  ;
2000  A0 00       BEGIN LDY #$0
2002  B9 AC20           LDA LAST,Y    ; NOW SET UP ADDRESS OF
2005  85 94             STA $94       ; NMI HANDLER SO THAT
2007  C8                INY           ; PRESSING THE
2008  B9 AC20           LDA LAST,Y    ; RESET BUTTON PASSES
200B  85 95             STA $95       ; CONTROL BACK TO BASIC
                  ;
200D  20 CCFF     STEP1 JSR RFILES
2010  20 E4FF           JSR GETCHR    ; GET A KEYBOARD CHARACTER
                  ;
2013  F0 39       STEP2 BEQ STEP4     ; IF NO CHAR THEN JUMP TO STEP4
2015  8D AB20           STA CHAR      ; SAVE CHAR FOR LATER
2018  C9 11             CMP #$11      ; CURSOR DOWN?
```

```
201A  F0 27     27        BEQ NOKEY
201C  C9 13     28        CMP #$13        ; HOME CURSOR?
201E  F0 23     29        BEQ NOKEY
2020  C9 14     30        CMP #$14        ; DELETE?
2022  F0 1F     31        BEQ NOKEY
2024  C9 1D     32        CMP #$1D        ; CURSOR RIGHT?
2026  F0 1B     33        BEQ NOKEY
2028  C9 8D     34        CMP #$8D        ; SHIFT RETURN?
202A  F0 17     35        BEQ NOKEY
202C  C9 91     36        CMP #$91        ; CURSOR UP?
202E  F0 13     37        BEQ NOKEY
2030  C9 92     38        CMP #$92        ; REVERSE OFF?
2032  F0 0F     39        BEQ NOKEY
2034  C9 93     40        CMP #$93        ; CLEAR SCREEN?
2036  F0 0B     41        BEQ NOKEY
2038  C9 94     42        CMP #$94        ; INSERT?
203A  F0 07     43        BEQ NDKEY
203C  C9 9D     44        CMP #$9D        ; CURSOR LEFT?
203E  F0 03     45        BEQ NOKEY
2040  4C 4620   46        JMP STEP3       ; GO SEND CHARACTER
                47 ;                        TO MAINFRAME
2043  4C 4E20   48 NOKEY  JMP STEP4       ; IGNORE PET CURSOR
                49 ;                        CONTROL KEYS
                50 ;
2046  A2 01     51 STEP3  LDX #$1         ; WRITE CHAR TO MAINFRAME
2048  20 C9FF   52        JSR OTFILE
204B  20 D2FF   53        JSR PRTCHR
                54 ;
204E  A2 02     55 STEP4  LDX #$2         ; GET CHAR FROM MAINFRAME
2050  20 C6FF   56        JSR INFILE
2053  20 E4FF   57        JSR GETCHR
2056  8D AB20   58        STA CHAR
                59 ;
2059  A5 96     60 STEP5  LDA $96
205B  C9 02     61        CMP #$2         ; EXAMINE STATUS
2C5D  F0 AE     62        BEQ STEP1
                63 ;
205F  AD AB20   64 STEP6  LDA CHAR        ; RELOAD CHAR
2062  F0 A9     65        BEQ STEP1       ; NO CHAR TO HANDLE
2064  C9 40     66        CMP #$40        ; IS CHAR GREATER THAN 64?
2066  F0 2A     67        BEQ STEP7       ; NO - GO PRINT IT
2068  B0 03     68        BCS TEST1       ; YES
206A  4C 9220   69        JMP STEP7
206D  C9 5B     70 TEST1  CMP #$5B        ; IS CHAR LESS THAN 91?
206F  90 10     71        BCC ADD         ; YES THEN ADD ON 128
2071  C9 60     72        CMP #$60        ; IS CHAR GREATER THAN 96?
2073  F0 1D     73        BEQ STEP7
2075  B0 03     74        BCS TEST2
2077  4C 9220   75        JMP STEP7
207A  C9 80     76 TEST2  CMP #$80        ; IS CHAR LESS THAN 128?
207C  90 0D     77        BCC SUB         ; YES THEN DEDUCT 32
207E  4C 9220   78        JMP STEP7
2081  D8        79 ADD    CLD
2082  18        80        CLC
2083  69 80     81        ADC #$80        ; ADD ON 128
2085  8D AB20   82        STA CHAR        ; STORE RESULT BACK
2088  4C 9220   83        JMP STEP7
208B  D8        84 SUB    CLD
208C  38        85        SEC
208D  E9 20     86        SBC #$20        ; DEDUCT 32
208F  8D AB20   87        STA CHAR        ; STORE RESULT BACK AGAIN
                88 ;
2092  20 CCFF   89 STEP7  JSR RFILES      ; SET DEFAULT DEVICES
2095  AD AB20   90        LDA CHAR        ; GET CHARACTER TO BE PRINTED
2098  C9 0D     91        CMP #$0D        ; IS IT RETURN?
209A  D0 09     92        BNE PRINT       ; NO ITS NOT
209C  A4 C6     93        LDY $C6         ; STORE A SPACE
209E  A9 20     94        LDA #$20        ; IN POSITION OF CURSOR
20A0  91 C4     95        STA ($C4),Y     ; TO AVOID THE BLOB
20A2  AD AB20   96        LDA CHAR        ; GET CHAR TO BE PRINTED
20A5  20 D2FF   97 PRINT  JSR PRTCHR      ; GO PRINT CHAR IN ACCUMULATOR
                98 ;
20A8  4C 0D20   99 STEP8  JMP STEP1       ; GO BACK AND START LOOP AGAIN
               100 ;
20AB  00       101 CHAR   DB  $0          ; PLACE TO STORE CHARACTER
20AC  AE20     102 LAST   ADDR *+2        ; DEFINE ADDRESS OF NMI HANDLER
               103 ;
20AE  20 CCFF  104        JSR RFILES      ; SET DEFAULT DEVICES
20B1  4C 89C3  105        JMP BASIC       ; GO BACK TO BASIC WITH "READY"
               106        END
ADD        2081     79    71
BASIC      C389     10   105
BEGIN      2000     14
CHAR       20AB    101    25    58    64    82    87    90    96
GETCHR     FFE4      6    22    57
INFILE     FFC6      8    56
LAST       20AC    102    15    18
NOKEY      2043     48    27    29    31    33    35    37    39    41
                          43    45
OTFILE     FFC9      7    52
PRINT      20A5     97    92
PRTCHR     FFD2      9    53    97
RFILES     FFCC      5    21    89   104
STEP1      200D     21    62    65    99
STEP2      2013     24
STEP3      2046     51    46
STEP4      204E     55    24    48
STEP5      2059     60
STEP6      205F     64
STEP7      2092     89    69    73    75    78    83
STEP8      20A8     99
SUB        208B     84    77
TEST1      206D     70    68
TEST2      207A     76    74

MOS Technology MCS650X Assembler (AN240) done at 16:07:41 on 05-07-81.

0 error(s) detected.

Cards:   106   Symbols:       23   Cost:       $0.09
Punch:     0   References:    46   CPU Time:    0.73
Print:   137   Storage:        6
```

Beyond reasonable

Continuing his series on adaptive programming, Edward James of Imperial College, London, develops ideas of statement recognition to include the context in which a particular word or symbol appears. He concludes by comparing his programming strategies with the process of human thought itself.

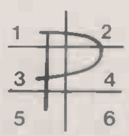
EXISTING METHODS of statement recognition can be expanded by allowing nodes on the decision tree to represent any sort of test on the object which is being looked at. Successive nodes in a branch do not have any necessary connection with the direction in which the object may be scanned — for instance, from left to right when recognising successive characters in a word.

A succession of tests provides clues to the identity of an object. The tests are initiated in sequence, and each test is judged to be successful or unsuccessful. If unsuccessful, an alternative test is followed. A successful test is followed by another which will further confirm the likelihood of a successful recognition.

A series of successful tests will be continued until confidence in a correct identification is so high that the matching process can be suspended with practical certainty that the object has been recognised. It is assumed that the tests produce a definite Yes or No result in every case. Clearly, the decision must be definitely one way or the other in order to use the methods already developed, but the process which is used to reach the decision may indicate only that Yes is rather more likely than No or vice versa.

If a test produces a No result, then confidence in a correct identification will be lowered. You then have to retreat to a position further up the tree. This method of operation is already very familiar in game-playing with computers.

The generalised process can be applied to the recognition of hand-written words in a particular language. Each hand-written character must be scanned to detect the presence of a limited number of different features in any one of six different areas into which each character may be divided.



The following features which can be recognised might be as follows:

K: The presence of a corner, such as in the top of the letter D.
C: The presence of a continuous curve, as in all parts of the letter O.
E: The presence of an end point, such as at the top and bottom of I.
V: The absence of any significant information.

The presence of the letter P can be inferred from the successful outcome of the following sequence of tests.

1K — 2C — 3K — 4C — 5E — 6V

Area 3 in the letter P contains much more information than the presence of a simple corner, but since the detection of a corner is assumed to be a very rough and ready process, it could well be voted in.

Students of character recognition will recognise these principles as the familiar foundation of scene-analysis methods developed in a much more sophisticated way by Clowes and others. Interest in this system by our group at Imperial College is not based in the exhaustive analysis of patterns but in the adaptive and approximate methods implicit in our current work.

In principle, this method of character recognition can be placed under the control of an adaptive recogniser for a given language, and handwriting can be input to the system. In due course, the system might develop different ways of recognising the letter P according to its context.

If the letter P was at the beginning of a word, it might be sensible to apply all six tests before reporting its presence. However, if the letters P, U, L have already been detected the presence of another P may be sufficiently confirmed by the detection of a corner in position 1 of the letter, since the other likely letters in that position — S or V — do not have a corner in position 1. The tests applied should depend on the level of expectedness of possible alternatives, and they should clearly be chosen for their power to discriminate between them.

The learning strategy which minimises the number of tests in a particular context could be analogous to the confidence-jump method described last month. Judgements on the effectiveness of the strategies adopted must be fed back from processes at higher levels of significance than the recognition of single characters. The process of character recognition can be seen as being inextricably interwoven with higher levels of syntactic and semantic analysis, mediated through a decision-making hierarchy.

The number and nature of the tests carried out at each level before a decision is reached is controlled from a higher level. It depends in turn on confidence levels fed through from decision processes below and above in the hierarchy. In general, the confidence-jump mechanism ensures that only a fraction of the decision-making information available at each level is used. Only significant parts of individual characters are then recognised and only significant parts of words are processed so that the gist of the message comes across. Naturally, this process can take place only in the presence of previous experience, represented by the structure of the decision tree.

Succesful match

At the level where each node represents a test for a single letter, a decision tree can be contracted to cope with the word CONTINUE and its various mis-spellings — see figure 1. The decision tree and the approximate matching process should enable a successful match to be obtained from any attempted spelling of the word.

The branch corresponding to the correct spelling CONTINUE can then be removed. A series of words to be recognised by the tree can still be submitted and while the process of recognition will take longer, it is quite possible that there will be no apparent change in the results. This implies that only those words which correspond to common mistakes will be matched perfectly. If the correct word occurs most frequently it will be matched, but it is impossible for it to be ever matched precisely.

The idea of a perfectly correct input can, therefore, be abandoned, as can the idea of a branch which represents the expected input perfectly. All successful matches then become more or less approximate, and the collection of branches which represents the approximations to a particular expected input takes on interesting properties connected with the meaning of the expected input.

Each of the branches represents a way of getting to the same terminating point of the recognition process, and each can be regarded as an approximate alternative definition of what the input means, in the same way that alternative approximately equivalent words and phrases may be found when looking up the meaning of a word in a dictionary. Other aspects of meaning are not represented in the alternative branches but are inherent in the action which results after the particular input has been recognised.

In the very simple, practical work on the recognition of program statements in which we have been involved at Imperial College there is clearly a perfectly correct definition available. It is provided to the tree in the first place during the setting-up period, so the tree of correct statements

doubt

represents the knowledge which the system has to begin its recognition process.

In other circumstances, there may be no such tree in existence at the beginning of the recognition process. For example, a child may be learning the concept of a cube. The teacher does not provide an explicit succession of tests which will result in the correct identification of a cube. A teacher will show the child various scenes, possibly in two or three dimensions and in each case will be told that this strange-shaped rhomboid is called a cube. From this series of examples, the child must build the necessary sequence of criteria for recognising a cube.

It is likely that the child will build up a very complex set of criteria for recognising the cube in each of, say, a series of illustrations which he is shown. His unconscious processes can be considered to be following the sub-tree recognition method to refine the sequences and remove from them the tests which do not assist in the recognition of the general concept of a cube.

At the same time, the child develops a generalised routine for all pictures which represents in some way a minimum set of decisions relevant to the recognition of the cube. In this process of learning there is nothing corresponding to a correct definition. Each of the pictures represents an approximation to the concept.

In the character-recognition example there is a level of recognition of each individual character which lies below the recognition of assemblies of characters as full words. There is also the clear suggestion of semantic properties above this level in the hierarchy. In the context of human character recognition, there is an enormous range of levels of details corresponding to the three described.

Consider the recognition of printed words on a page. The process must start with some assumptions. Previous experience leads to the expectation of a series of black lines on a white surround. The first level of focus is to recognise the page as a whole. The eye looks towards the top left-hand corner of the page and focuses on the top black line, which is seen as a single entity. Then the focus sharpens so that the first word of the first line is seen as a separate entity — a black blob against the surrounding white space.

Decisions made at this stage provide a rough estimation of the expected size of the letters which will be used in later processes. The next stage is to focus on the first black blob — the first word — so as to isolate the first letter, then focus more closely to discriminate between various areas inside the first letter. If the scanning process then remains at this fixed level of precision all six areas in each letter should be processed in the first instance.

The minimisation of the effort involved in recognising a letter will result in certain parts of the letter being favoured as providing the maximum information for the minimum effort in moving the eyes about in the scanning process. The information collected from each letter is then used in the decision process as already described, with a continous movement between different levels of detail — character component, character, word, syntactic and semantic.

At present we are in the first stages of building a simulation model of our method for character recognition into a working computer program. Whatever the outcome of our first attempts at recognising hand-written words, we believe the principles involved should be of some significance in a more general theory of perceptive processes.

In the model of the recognition process developed at Imperial College, there are two levels of detail at which written statements are processed. The first is at the character-component level where parts of characters are processed as entities. The second level is concerned with the processing of characters in order to discover a syntactic pattern into which they will fit.

The effect of the total operation, working over two levels of detail, is to reduce the amount of information to be pro-

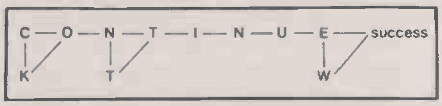


Figure 1. A decision tree to recognise the mis-spellings "cotinue", "continew", "cotinew", "kontinue", "kotinue", "kontinew" and "kotinew" as equivalent to the correct spelling "continue".

cessed at a later stage. Several occurrences of character components are reduced, for example, to the information that "the letter A exists". In the second level, many different specific examples of a particular syntactic pattern, including mistakes or approximations to that pattern, are recognised as a single entity. The matching process at either level of processing is exactly the same.

The next step is to consider a level of matching above the syntactic level.

At this third level, a series of specific syntactic structures is being processed in order to discover a basic pattern, which we may often call "meaning". For instance, there is a multitude of knitting patterns which are different syntactic descriptions of the semantic entity "knitting a pullover". Exactly the same methods as before can be used to reduce the information of level-two type to that of level three.

From this point of view, extracting meaning from a message is a very approximate process which seems to have little connection with the idea of precise meaning in the scientific sense. The concept of precise meaning is only relevant in the abstract and ideal worlds which mathematicians explore, where all matches are perfect and the whole process is tautological.

In the real world, semantics provides an escape from the impossibility of processing all the information which our senses provide us with. We process several thousand different examples of the letter A for a very short time before taking forward the single idea "A" to the next stage of processing. "Meaning" is extracted from the syntactic level as soon as possible to avoid having to process thousands of syntactic realisations of the same idea. A hierarchy of levels of detailed meaning can be imagined when information is processed at a level of detail which is good enough for the purpose in hand.

Information limit

The problem of too much information is particularly relevant when considering communication between people. Information theory appears to place a limit on the amount of information which can be transmitted in a fixed time.

Semantics allows the system to be cheated. The information transmitted is only a series of clues which trigger off a mass of understanding in the receiver and result in activities which could not possibly have been specified in the original message. An extreme case is the transmission of a single code word in wartime which triggers off an immense preplanned military operation.

The concept of a fixed hierarchy of detail should not be interpreted too strictly, something which is recognised when describing a certain detail as "significant". Some parts of a message can be safely ignored while other parts are transmitted up the hierarchy almost unchanged.

The concept of levels is required in order to build a model for the understanding of the process in our own minds. The "real thing" is a vast, monolithic structure for the extraction and processing of significant information.

A second principle concerns the way in which the information-processing method based on approximation allows the limitations of storage space and processing speed in the brain to be overcome. The sub-tree discovery process enables us to store the tree structure representing our experience in a more compact form. A generalised structure in place A, refers to A at points B and C in the structure, while the general structure is made specific by adding particular parameters at point B, etc.

More space in the perception system can be saved by not storing at B the parameters which make it different from the general case. Only an approximate

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match, neglecting the parameters, is then possible at B, but it may well be good enough for the purposes of the total overall matching process.

The sub-tree recognition process defines and makes use of a sub-section of the total matching process as a separate entity. It is the principle through which the recognition process is structured as a hierarchy, so the idea of syntax and semantics seems to arise from the need to conserve storage space.

From a similar point of view, the confidence-jump mechanism enables limitations in processing speed to be overcome by missing out a very large proportion of the tests which are required to make certain that a particular object has been recognised. Since there is always a maximum depth to detail which can be perceived by the senses anyway, the confidence jump is in some sense always present. It may be necessary only rarely even to consider a large part of the detail which the senses can make available to us.

Formal definition

Some problems can be solved only when detail is ignored. The recognition of a square which is drawn by hand on a sheet of paper appears to involve the formal definition of one of its corners as "two straight lines meeting in a right angle". Yet a process using this definition in a rigid system is not likely to recognise any hand-drawn squares, since the lines will not be straight nor the angles precisely 90°. A fairly fine mesh on our perception mechanism may well show that the lines do not actually meet at all.

However, if perception is deliberately de-focused, the test being applied becomes something like "two *straightish* lines of blobs *approaching* each other at *approximately* right angles". The italicised words have a definite but dynamic meaning dependent on previous success or lack of success in distinguishing squares from, say, triangles. The approximate matching mechanism produces an analogous effect to this de-focusing mechanism. It enables the ideal definition to be used as a recognition criterion in the real world, where nothing precisely satisfies the definition.

The search for mathematical identicality in any matching process can therefore be abandoned. Our approach is built round processes which terminate as soon as a very limited number of tests have shown that the difference between the input and the expected pattern is not likely to be significant for current purposes. The matching process is deliberatley not continued over the much greater number of tests which could be applied.

The overall picture is of a prodigal waste of the information provided by our various perceptive inputs. Most of the information provided is never even considered in the processes of decision, otherwise no decision would ever be reached.

Bruner provides a valuable summary of earlier work on perception theories and sets out seven propositions concerning the nature of perception which can be readily related to our model.

- "Perception is a decision process", which is clearly inherent in our decision-tree model.
- "The decision process involves the utilisation of discriminatory clues". The branching structure of the decision tree represents the discriminative process in its naive form, while the force-fit process represents the assignment of an input to a precise pattern.
- "The cue utilisation process involves the operation of inference". The "focusing-in" process and the recognition process together model Bruner's inferential process precisely. In particular, the final part of the process "when cue searching is severely reduced" is effectively represented by the application of the confidence jump.
- "A category may be regarded as a set of specifications regarding what events will be grouped as equivalent". The purpose of the decision tree precisely is to specify the categorising rules.
- "Categories vary in terms of their accessibility". The branch-swapping process represents the adjustment of the relative accessibility between different categories so that the most likely categories are the most accessible.
- "Veridical perception consists of the coding of stimulus inputs in appropriate categories such that one may go from cue to categorical identification, and thence to the correct inference or prediction of other properties . . . . ." In applying the decision tree to programming language analysis, the successful attainment of the end point of any branch results in the transfer of control to a processor for the particular type of program statement which has been encountered as input. The operation of the processor will naturally assume certain properties of that statement, such as the position of certain parameters which are to be selected. for further processing.
- "Under less than optimal conditions, perception will be veridical in the degree to which the accessibility of categorising systems reflects the likelihood of occurrence of the events that the person will encounter". Partridge demonstrates the application of our method of analysis to inaccurate program statements, where the force-fit process results in "correct" categorisations to the extent that the structure of the decision tree reflects accurately the relative expectation of occurrence of the various program statements and substructures in those statements.

The evidence from experiments in psychology seems to suggest that processes similar to those in our model are taking place. Broadbent's experimental work on the word-frequency effect shows that commoner words are perceived more easily. It strongly supports a theory that the decision process is biased by previous experience in such a way that less evidence is required before deciding in favour of a probable word rather than an improbable one. The restructuring process in our decision tree, combined with the use of confidence levels, clearly realises such a response-bias effect.

Neisser proposed a word-apprehension effect, where words are read at a much greater rate than can be expected if each letter is being recognised separately. It clearly provides support for a process similar to the confidence jump which operates both at the level of individual character recognition and in recognising the word as a whole. The combination of these two levels results in a process which looks like recognition by word shape rather than character shape.

Optimum order

The extension of partial and approximate processes to the semantic level may suggest a model of the process involved in reading for meaning. Personal experience shows that meaning is being extracted from a text at a rate far above that which is dictated by the recognition of individual words.

Our method of recognition can obviously be related to earlier work on the modelling of decision processes such as that of Feigenbaum. The addition of the adaptive matching concepts, particularly the stress on approximate and multilevel processes, may be capable of overcoming many of the obvious difficulties inherent in the sequential approach.

Perhaps the most serious limitation of the perception model concerns the structure of the decision tree which controls the process of recognition. It seems that the recognition of a particular object depends on the success of a set of tests applied in a fixed order. The confidence-jump mechanism allows some of the tests to be missed out but it does not amend the order of applying them.

Another sort of improvement strategy is needed which can rearrange the order in which the tests are applied on the basis of their power to discriminate between the

(continued on page 114)

Further reading

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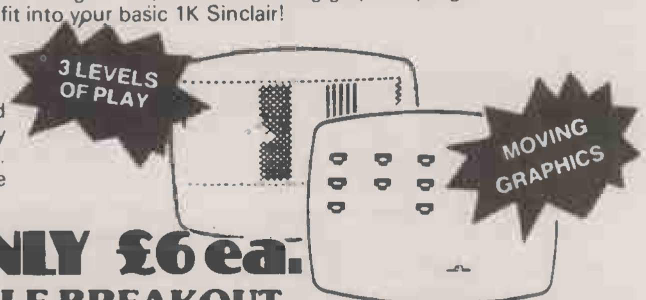

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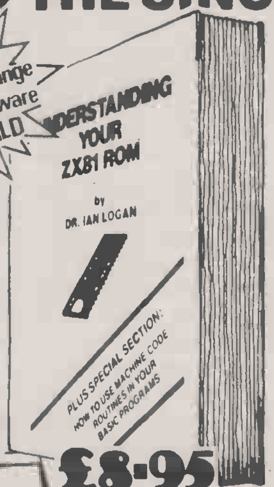

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(continued from page 112)

particular objects being "looked for". An exhaustive matching method which determines whether an object has or has not each of N different properties will always require N tests. The order of application is of no importance. For a particular set of objects — much less than 2^N — there should be a reasonable certainty of recognising any one of them with, on average, much less than N tests, particularly when any of the sequence of tests could give an ambiguous answer.

A system is required which will recognise the more significant features of a set of things to be recognised, and rearrange the decision process to test for those features first. The optimum sequence will be very much affected by the relative effort involved in making each test, by analogy with the tendency of the human reader to scan along the tops of letters to minimise eye movements.

The need for a rearrangement of the order of the decision processes in time naturally suggests the possibility that certain of the tests could be applied at the same time — a purely serial decision process is too simple. It seems clear that parallel processing does go on in the brain, but the essentially serial nature of most present-day computing systems does not lend itself to reproducing this aspect of behaviour. This shortcoming is not as important as it seems at first sight, since the results of a parallel process can be simulated by realising it as a sequence of serial processes and combining the results.

The consideration of parallel processes brings up a serious omission in the model: it does not recognise the phenomenon of attention. Humans are subjecting input information to a mass of discriminating tests all the time and very much in parallel. Each of the tests is helping to recognise significant inputs while filtering out the vast majority of the input.

The problem is to determine a process which provides the impression of applying all one's effort to the object under attention, yet which can in an instant switch to another area on the detection of something important occurring in that area. The process is clearly another level of complexity above the single-perception process.

The Yes or No decision on one of a set of alternative tests should be affected by a consideration of the other alternatives as well. In character recognition, if R and D are the only two expected in a certain position then the weight attached to finding a kink in the top left-hand corner of the unknown letter as confirmation of the presence of an R should clearly be much less than if the alternative to R was Z. When the force-fit mechanism is operating it does take notice of the alternatives in an indirect way, but there does seem scope for a series of firm No votes from all the alternatives except one to help a rather hesitant Yes towards a final decision.

A more fundamental problem even than the restructuring of the decision process is to work out how the process is set up in the first place. In our analysis of program statements this is simple. We provide a detailed decision tree sufficient to recognise all correct statements at the outset.

In modelling human perception, we have no idea of what basic decision structure is provided at birth and how the result of experience is fed back into it. We only have the fact that children learn to recognise the letter A by seeing many different forms of it and being told what it is in overall terms. A large variety of visual stimuli are categorised as "the same thing" by inputting a constant acoustic stimulus. We are not attempting to model this process at present, but we suggest that something like the sub-tree recogniser working over masses of input data which has been stored as sequences of stimuli may be able to bring some order to the chaos.

Finally, there is the problem of motivation. Perception of dangerous objects clearly has a pay-off in human terms, and the reward for recognising food is self-evident. The implementation of a process which neglects as much of the input information and processes the remainder as little as possible ties in well with scientific principles of minimum action. It does not explain why people enjoy the effort involved in the appreciation of a complex piece of music or a subtle mathematical proof.

Unfortunately for our modelling attempts, the importance attached to the recognition of a particular object, such as a road sign in dense fog, certainly determines the detailed strategy for that process. We are a long way from incorporating such considerations in the model.

Our program which can recognise statements in any programming language, even though these have been inaccurately specified, embodies principles which could usefully be incorporated in a model for human perception. Intelligent perception — that is, the ability to perceive the overall and significant aspects of a mass of input data delivered by the senses — can be motivated from the requirement to conserve internal storage space and processing time.

The approximate matching process appears to have a fundamental importance as does the connection between matching sufficiently well for the purpose in hand and the development of general "concepts" at the syntactic and semantic levels.

This approach is clearly in contrast with the desire for maximum rigour and precision inherent in the mathematics-based sciences, though the model has limitations and fails to show the flexibility and efficiency of the natural process.

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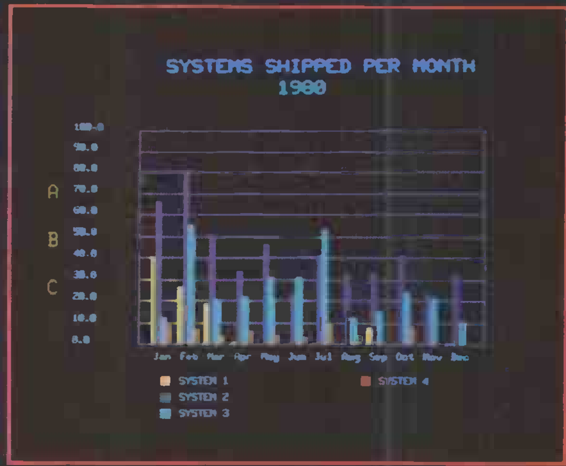

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Type-a-Graphic/Text

Roger Cullis rounds off his three-part series with a comprehensive text-in-graphics program for the Apple.

UNLESS a specific visual project such as chart animation is to be undertaken, shapes produced on a 40x40 matrix with the Type-a-Shape program are not very useful. One application, though, can make good use of shape table, and that is the inclusion of text in graphics displays.

Under normal conditions, text cannot be incorporated in a Hires graphics display. If, however, alpha-numeric characters are defined as shapes, they can be written to the screen using the Draw command. Type-a-Shape can very simply be modified to prepare shapes in a suitable format. Most conveniently they are produced in a 9x7 module. If the number of a particular character is also its ASCII code, then the way is clear to a simple specification of the shape number from the keyboard using a Get command.

In preparing ASCII Shape Compiler lines 1280-1290, 5880-5890, 5960-5980, 5600-5620 and 8010-8030 are deleted from Type-a-Shape and other listed lines altered. A suitable set of shapes is shown in figure 1. Both upper- and lower-case letters may be included and, for this reason, the origin of the shape is not placed in a corner of the guide matrix. As an alternative, a suitable shape table may be prepared using the Basic routine, basic ASCII Shapes, which was derived from a table constructed using ASCII Shape Compiler.

Having prepared an ASCII Shape Table binary file, this can be used in conjunction with Type-a-Graphic/Hires to produce a comprehensive text-in-graphics program. Appropriate algorithms for moving the cursor permit text to be typed on the screen using the keyboard in the normal way.

In addition to Draw, Apple has three further commands for use with shape tables, and these add versatility to the display. XDRAW erases a previously-drawn shape by retracing it in its complementary colour; Scale = permits variation in size and Rot = allows the orientation to be changed.

Type-a-Graphic/Text shows the modifications to Type-a-Graphic/Hires necessary to produce a comprehensive program to prepare high-resolution graphics charts. Alpha-numeric characters may be added by normal typing procedures; with special commands, the letter size may be changed together with the direction of printing. It is even possible to type lower-

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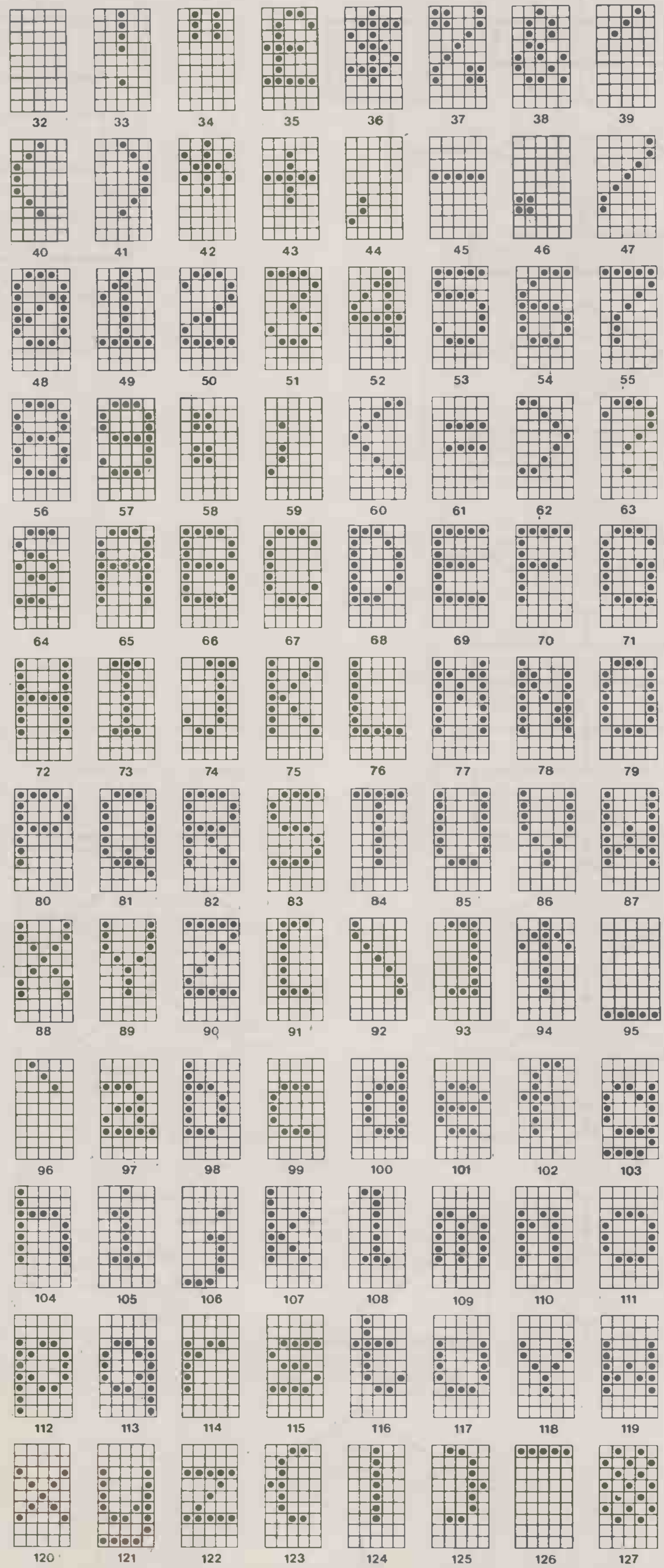

Figure 1. Character shapes for modified Type-a-Shape to display text with graphics.

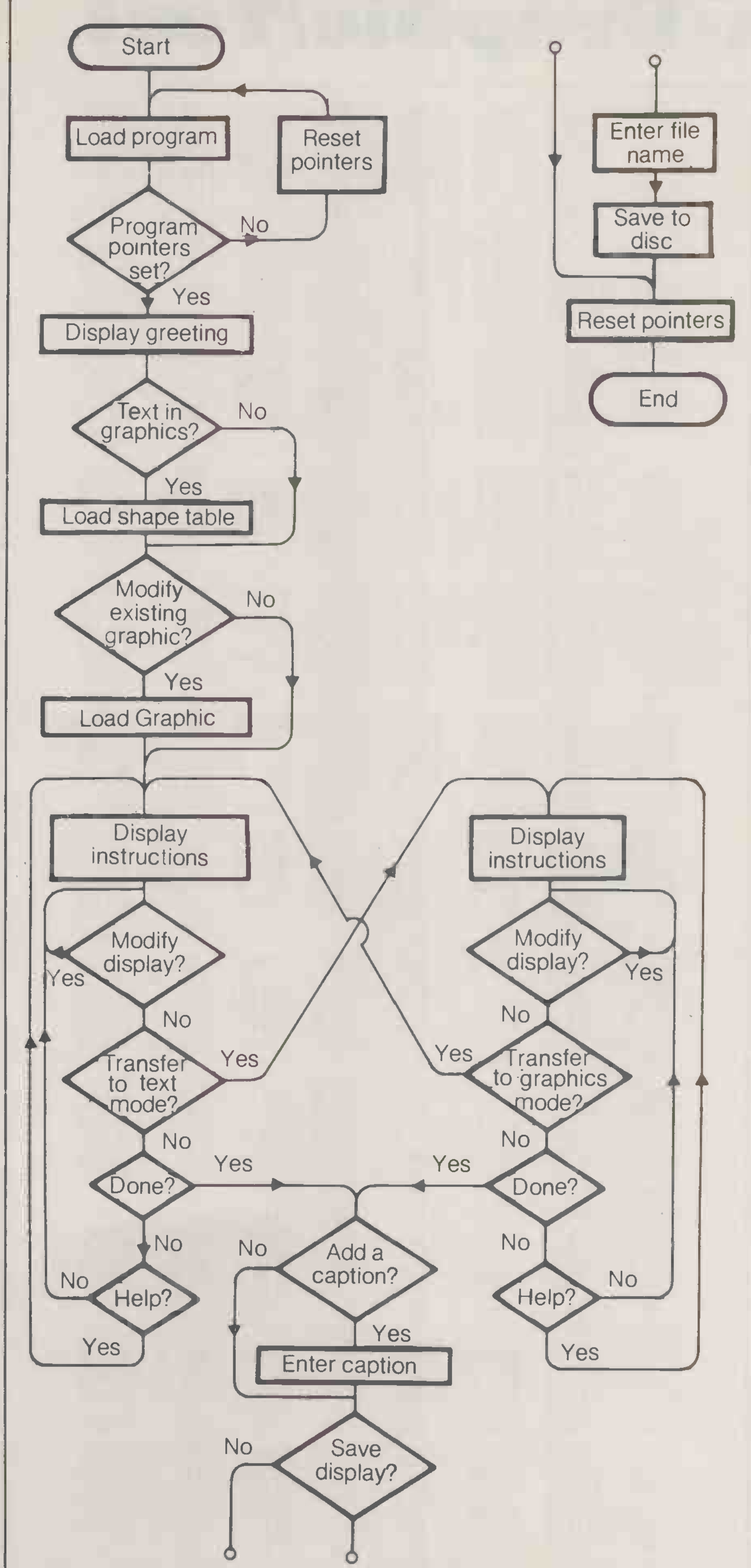

Figure 2. General format of Type-a-Graphic/Text program.

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case letters which appear upside-down and from right to left across the screen.

As with the other programs, Type-a-Graphic/Text has several features which require special explanation.

60-100 Apple does not have sufficient keys to incorporate graphics commands with a straightforward typing facility. It is therefore necessary to have two modes of operation — a graphics mode which is virtually identical to the Type-a-Graphic/Hires program and a text mode where characters are written to the screen using normal keyboard entry. In the previous programs the Instructions were kept permanently in the text page 2 buffer, but in this program it is necessary to have a separate set of instructions for each mode. The procedure of Poking page 1 into page 2 to store the instructions is very slow. When it takes place only once in a program this slowness can be tolerated as the time required is comparable with the time needed to read the instructions, but it is not satisfactory for frequent switching between two modes. Lines 60-100 contain a machine-language routine which can be used rapidly to transfer the contents of the text buffer from page 1 to page 2.

1150-1330 load an ASCII-coded shape table.

5190 calls a machine-language routine to store instructions in page 2.

5450 and 5870-5940 With so many facilities it is easy to make mistakes and spoil the fruits of many hours' labour. A command has been added to encourage the frequent making of back-up copies and to permit the back-up copy to be brought in if necessary.

6330 As the keyboard is used In the text mode for alphanumeric character entry, commands must be specially identified. Most are preceded by '@' Shift P.

6340-6370 'ESC' and left and right arrows are also used.

6380-6450 Apple's keyboard generates only upper-case ASCII codes. In conjunction with the shift key and shift-lock flags, these algorithms make the necessary conversion to upper- and lower-case ASCII codes.

6460 writes the shape to the screen and makes a temporary record of size, position and direction of printing.

6480-6520 move the cursor to the next available space using an algorithm chosen according to the setting of a variable which records printing direction.

6530-6570 move the cursor back one space in a similar manner.

6610-6830 When changing print size or direction or commencing text-mode operation, the cursor is moved to ensure that printing takes place only within the screen limits.

6840 sets shift-key flag.

6860 sets shift-lock flag.

7000 The XDRAW command is used to erase the most recently typed character.

7060, 7190 The Flash command produces a flashing message on the screen. It is switched off by a Normal command.

7070-7100 Rot= permits the orientation of a shape to be altered.

Although Type-a-Graphic/Text covers a wide applications area, it is capable of further development. It would be easy to prepare an alternative character set such as Greek letters, graphic symbols or even Chinese ideograms to be called up by an additional command key which alters the shape-table pointers in locations 232 and 233. Another possibility is the preparation of an automatic graph or histogram plotting routine, but these and other variants are left to the reader's imagination.

(continued on page 121)

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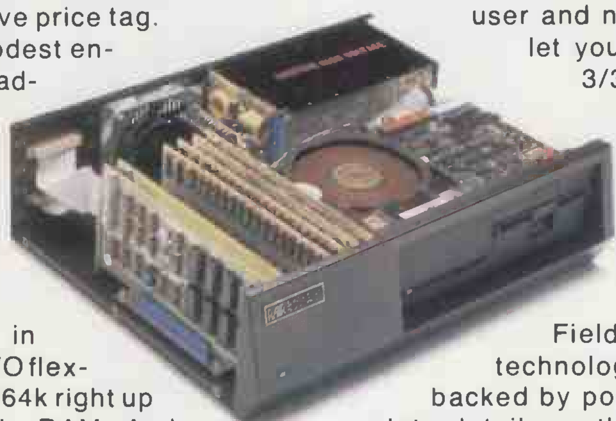

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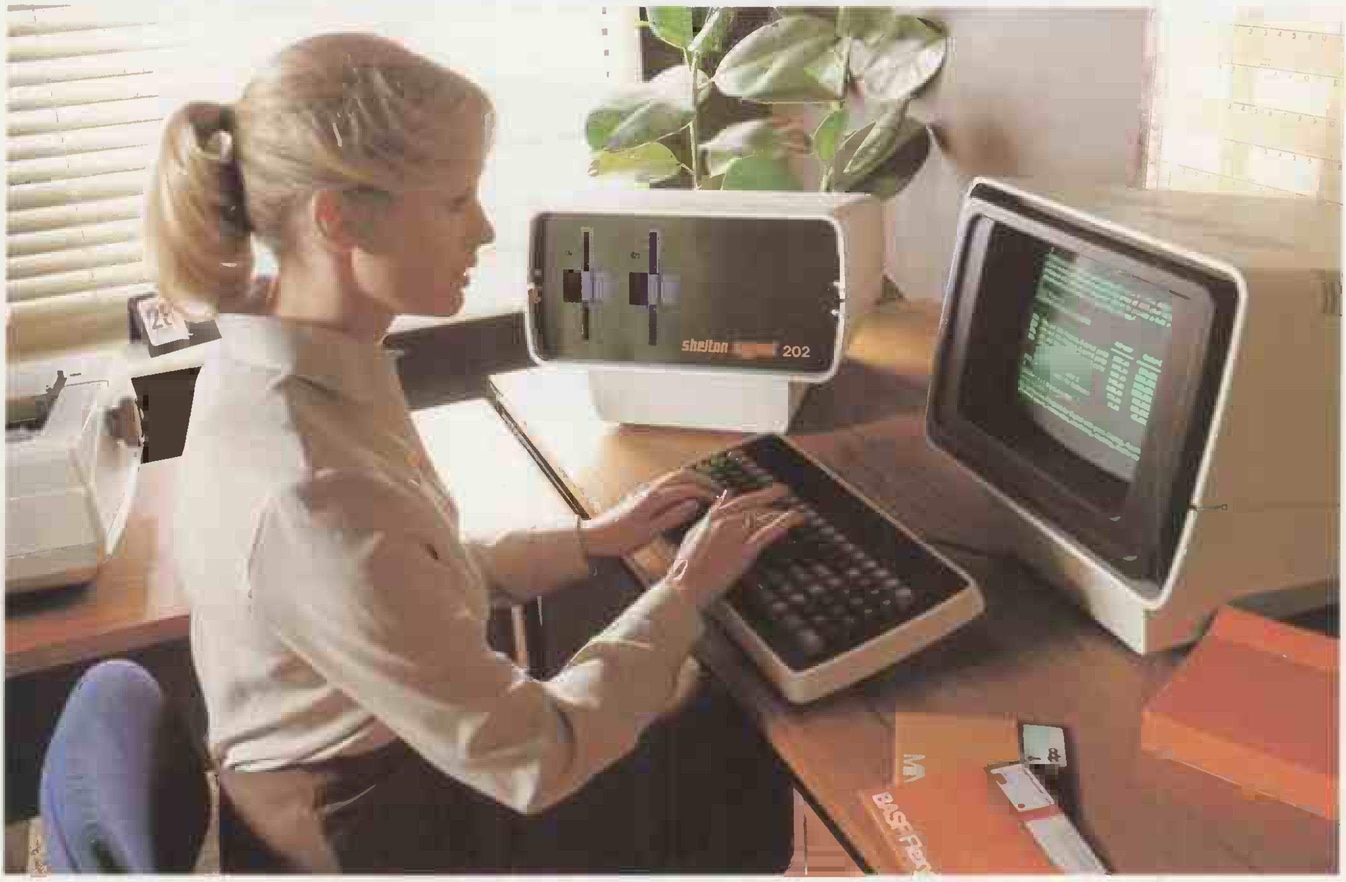

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(continued from page 118)

```
1  REM  ASCII SHAPE COMPILER
2  REM  PROGRAM ADAPTED FROM TYPE-A-SHAPE (VERSION NO46)
3  REM  LAST AMENDED 10 SEP 1981 (VERSION NO.7)


50  PRINT D$;"RUN ASCII SHAPE COMPILER": REM  RELOAD ABOVE
     HGR PAGE 1 MEMORY


70 H$ = "         TYPE 'H' FOR HELP":NAME$ = "ASCII SHAPE TA
     BLE"


1030  PRINT  TAB( 8)"*         ASCII         *"


5240  COLOR= 5: HLIN 17,23 AT 13: VLIN 13,23 AT 23: HLIN 23
     ,17 AT 23: VLIN 23,13 AT 17
5250  COLOR= 0: FOR LI = 12 TO 24 STEP 2: VLIN 0,39 AT LI: HLIN
     0,39 AT LI: NEXT
5260  COLOR= 3: HLIN 0,16 AT 20: HLIN 24,39 AT 20
5270  COLOR= 7: IF A$ = "N" THEN X = 18:Y = 20: GOTO 5320
5280 X = 18:Y = 20: REM  START AT ORIGIN


5860  IF P1 = 0 AND M1 = 0 THEN  PRINT "ILLEGAL MOVE TERMIN
     ATES CURRENT SHAPE.": PRINT "RE-ENTER LAST THREE MOVES
     .": GOTO 5900: REM  AVOID ZERO BYTE
```

```
1  REM  BASIC ASCII SHAPES
2  REM  PROGRAM COMMENCED 23 JUN 1981
3  REM  LAST AMENDED 25 JUN 1981 (VERSION NO.2)
4  REM  COPYRIGHT 1981 - ROGER CULLIS
5  REM  WRITTEN IN APPLESOFT BASIC ON APPLE II WITH LANGUAG
     E CARD AND 48K RAM
10 D$ =  CHR$ (13) +  CHR$ (4)
1000  DATA  34000, 1507,127
1010  DATA  127, 0, 2, 2, 4, 2, 6, 2, 8, 2, 10, 2, 12, 2, 1
     4, 2, 16, 2, 18, 2
1020  DATA  20, 2, 22, 2, 24, 2, 26, 2, 28, 2, 30, 2, 32, 2
     , 34, 2, 36, 2, 38, 2
1030  DATA  40, 2, 42, 2, 44, 2, 46, 2, 48, 2, 50, 2, 52, 2
     , 54, 2, 56, 2, 58, 2
1040  DATA  60, 2, 62, 2, 64, 2, 66, 2, 73, 2, 81, 2, 94, 2
     , 108, 2, 120, 2, 131, 2
1050  DATA  137, 2, 145, 2, 153, 2, 164, 2, 173, 2, 176, 2,
      182, 2, 185, 2, 191, 2, 205, 2
1060  DATA  215, 2, 226, 2, 237, 2, 248, 2, 3, 3, 16, 3, 24
     , 3, 38, 3, 49, 3, 56, 3
1070  DATA  60, 3, 69, 3, 76, 3, 84, 3, 93, 3, 104, 3, 116,
      3, 129, 3, 139, 3, 150, 3
1080  DATA  163, 3, 172, 3, 184, 3, 196, 3, 204, 3, 212, 3,
      224, 3, 232, 3, 244, 3, 0, 4
1090  DATA  11, 4, 21, 4, 34, 4, 46, 4, 57, 4, 65, 4, 76, 4
     , 86, 4, 98, 4, 109, 4
1100  DATA  119, 4, 131, 4, 139, 4, 147, 4, 154, 4, 164, 4,
      170, 4, 177, 4, 187, 4, 196, 4
1110  DATA  204, 4, 215, 4, 225, 4, 234, 4, 246, 4, 255, 4,
      7, 5, 15, 5, 26, 5, 33, 5
1120  DATA  45, 5, 53, 5, 61, 5, 73, 5, 85, 5, 92, 5, 101,
     5, 112, 5, 121, 5, 129, 5
1130  DATA  139, 5, 149, 5, 161, 5, 171, 5, 179, 5, 187, 5,
      195, 5, 203, 5
1140  DATA  1, 0
1150  DATA  1, 0
1160  DATA  1, 0
1170  DATA  1, 0
1180  DATA  1, 0
1190  DATA  1, 0
1200  DATA  1, 0
1210  DATA  1, 0
1220  DATA  1, 0
1230  DATA  1, 0
1240  DATA  1, 0
1250  DATA  1, 0
1260  DATA  1, 0
1270  DATA  1, 0
1280  DATA  1, 0
1290  DATA  1, 0
1300  DATA  1, 0
1310  DATA  1, 0
1320  DATA  1, 0
1330  DATA  1, 0
1340  DATA  1, 0
1350  DATA  1, 0
1360  DATA  1, 0
1370  DATA  1, 0
1380  DATA  1, 0
1390  DATA  1, 0
1400  DATA  1, 0
1410  DATA  1, 0
1420  DATA  1, 0
1430  DATA  1, 0
1440  DATA  1, 0
1450  DATA  1, 0
1460  DATA  9, 4, 192, 64, 36, 36, 0
1470  DATA  64, 64, 192, 36, 13, 54, 52, 0
1480  DATA  45, 45, 63, 39, 60, 45, 61, 39, 36, 12, 173, 17
     4, 0
1490  DATA  40, 53, 44, 5, 248, 44, 63, 28, 13, 60, 37, 46,
      45, 0
1500  DATA  100, 141, 46, 36, 216, 12, 5, 32, 223, 62, 44,
     0
1510  DATA  41, 13, 28, 223, 44, 32, 100, 21, 246, 230, 0
1520  DATA  64, 192, 97, 12, 14, 0
1530  DATA  9, 28, 28, 36, 12, 12, 13, 0
1540  DATA  9, 12, 12, 36, 28, 28, 31, 0
1550  DATA  64, 24, 4, 168, 53, 110, 32, 184, 39, 52, 0
1560  DATA  72, 36, 63, 45, 45, 63, 36, 38, 0
1570  DATA  98, 116, 0
1580  DATA  64, 24, 45, 45, 47, 0
1590  DATA  44, 62, 0
1600  DATA  100, 12, 12, 12, 52, 0
1610  DATA  41, 45, 32, 36, 188, 30, 30, 30, 36, 36, 12, 45
     , 45, 0
1620  DATA  45, 45, 63, 36, 36, 36, 23, 30, 30, 0
1630  DATA  172, 45, 37, 216, 99, 101, 228, 63, 23, 22, 0
1640  DATA  168, 45, 5, 224, 28, 12, 12, 60, 63, 47, 0
1650  DATA  73, 36, 61, 63, 39, 12, 12, 12, 54, 54, 0
1660  DATA  168, 45, 5, 32, 228, 63, 39, 44, 45, 61, 0
1670  DATA  41, 45, 32, 28, 63, 55, 38, 36, 12, 12, 45, 47,
      0
1680  DATA  33, 100, 12, 12, 60, 63, 47, 0
1690  DATA  32, 149, 45, 5, 32, 28, 63, 7, 32, 12, 45, 21,
     38, 0
1700  DATA  45, 5, 96, 36, 228, 63, 23, 118, 45, 45, 0
1710  DATA  8, 37, 39, 40, 60, 62, 0
1720  DATA  98, 36, 32, 0
1730  DATA  73, 28, 28, 28, 12, 12, 12, 14, 0
1740  DATA  64, 45, 37, 56, 63, 61, 0
1750  DATA  97, 12, 12, 28, 28, 28, 31, 0
1760  DATA  9, 4, 96, 12, 228, 63, 23, 22, 0
1770  DATA  45, 12, 28, 63, 104, 225, 231, 12, 45, 47, 0
1780  DATA  36, 36, 100, 45, 21, 54, 63, 47, 45, 54, 38, 0
1790  DATA  36, 36, 36, 45, 173, 246, 63, 45, 21, 246, 63,
     61, 0
1800  DATA  32, 36, 100, 45, 21, 150, 242, 63, 61, 0
1810  DATA  36, 36, 36, 45, 173, 54, 54, 30, 63, 63, 0
1820  DATA  45, 45, 220, 27, 100, 9, 63, 39, 36, 45, 45, 47
     , 0
1830  DATA  36, 76, 57, 63, 36, 44, 45, 61, 0
1840  DATA  32, 36, 100, 45, 21, 22, 47, 54, 62, 63, 61, 0
1850  DATA  36, 36, 36, 149, 42, 173, 18, 36, 36, 36, 38, 0

1860  DATA  41, 61, 36, 36, 36, 47, 61, 0
1870  DATA  168, 45, 32, 36, 36, 47, 61, 0
1880  DATA  36, 36, 36, 77, 241, 30, 30, 14, 14, 14, 14, 0
1890  DATA  73, 57, 63, 39, 36, 36, 52, 0
1900  DATA  36, 36, 36, 21, 86, 100, 12, 54, 54, 54, 52, 0
1910  DATA  36, 36, 36, 21, 118, 14, 118, 36, 36, 36, 38, 0

1920  DATA  32, 36, 100, 45, 21, 54, 54, 30, 63, 61, 0
1930  DATA  36, 36, 36, 45, 173, 54, 30, 63, 63, 0
1940  DATA  32, 36, 100, 45, 21, 54, 54, 22, 28, 28, 62, 61
     , 0
1950  DATA  36, 36, 36, 45, 173, 246, 63, 14, 14, 14, 12, 0

1960  DATA  45, 45, 32, 28, 63, 7, 32, 12, 45, 61, 0
1970  DATA  9, 36, 36, 228, 43, 45, 61, 0
1980  DATA  32, 36, 36, 77, 49, 54, 54, 30, 63, 61, 0
1990  DATA  9, 228, 28, 36, 108, 9, 54, 246, 244, 0
2000  DATA  36, 36, 36, 77, 49, 54, 54, 62, 224, 23, 20, 0
2010  DATA  100, 4, 224, 108, 9, 246, 30, 14, 14, 38, 0
2020  DATA  9, 36, 60, 28, 36, 77, 49, 246, 247, 0
2030  DATA  45, 45, 220, 27, 12, 12, 12, 12, 60, 63, 47, 0
2040  DATA  73, 63, 36, 36, 36, 45, 47, 0
2050  DATA  73, 33, 28, 28, 28, 28, 52, 0
2060  DATA  41, 37, 36, 36, 60, 47, 0
2070  DATA  9, 36, 36, 31, 12, 12, 46, 14, 14, 0
2080  DATA  147, 45, 45, 45, 47, 0
2090  DATA  64, 8, 8, 28, 28, 29, 0
2100  DATA  172, 45, 61, 36, 63, 39, 40, 45, 54, 0
2110  DATA  36, 36, 36, 149, 45, 54, 54, 63, 0
2120  DATA  36, 36, 45, 181, 18, 63, 63, 0
2130  DATA  41, 45, 36, 36, 36, 54, 63, 55, 54, 54, 0
2140  DATA  45, 229, 27, 36, 44, 45, 54, 63, 63, 0
2150  DATA  33, 36, 47, 61, 36, 44, 45, 47, 0
2160  DATA  18, 45, 45, 36, 36, 36, 63, 55, 54, 46, 45, 0
2170  DATA  36, 36, 36, 54, 45, 53, 54, 38, 0
2180  DATA  41, 61, 36, 36, 39, 8, 14, 0
2190  DATA  18, 45, 37, 36, 60, 68, 70, 0
2200  DATA  36, 36, 36, 77, 18, 23, 23, 21, 21, 21, 0
2210  DATA  41, 61, 36, 36, 36, 47, 0
2220  DATA  36, 36, 44, 14, 54, 54, 13, 36, 36, 28, 28, 0
2230  DATA  36, 36, 46, 12, 21, 54, 38, 0
2240  DATA  32, 100, 173, 54, 30, 63, 1, 0
2250  DATA  18, 36, 36, 36, 46, 12, 173, 54, 30, 63, 63, 0
2260  DATA  9, 63, 32, 100, 109, 62, 53, 62, 53, 54, 52, 0
2270  DATA  36, 44, 39, 13, 45, 47, 0
2280  DATA  45, 45, 224, 63, 7, 96, 45, 61, 0
2290  DATA  9, 45, 220, 35, 36, 47, 45, 63, 36, 38, 0
2300  DATA  32, 36, 77, 49, 54, 30, 63, 63, 0
2310  DATA  9, 228, 28, 108, 9, 246, 247, 0
2320  DATA  44, 12, 31, 36, 77, 49, 54, 47, 38, 0
2330  DATA  12, 4, 224, 77, 241, 30, 14, 14, 12, 0
2340  DATA  41, 220, 36, 108, 9, 54, 62, 53, 246, 63, 47, 0

2350  DATA  12, 46, 45, 196, 99, 44, 63, 63, 61, 0
2360  DATA  73, 63, 32, 60, 37, 100, 125, 0
2370  DATA  137, 18, 36, 36, 36, 36, 52, 0
2380  DATA  41, 5, 32, 44, 39, 228, 239, 0
2390  DATA  64, 192, 96, 21, 14, 5, 32, 0
2400  DATA  36, 36, 36, 45, 45, 62, 63, 46, 45, 62, 63, 46,
      45, 62, 63, 46, 45, 62, 63, 55, 45, 45, 44, 0
2410  REM  THIS TABLE CONTAINS 127 SHAPES, STARTS
2420  REM  AT 34000 AND IS 1507 BYTES LONG.
2430  READ ST: READ LE: READ TN
2440  POKE 232,(ST - 256 *  INT (ST / 256)): POKE 233, INT
     (ST / 256)
2450  HIMEM: ST - 1
2460  HOME : VTAB 10: PRINT "LOADING CHARACTER SET"
2470  FOR I = ST TO ST + 2 * TN + 1
2480  READ J: POKE I,J
2490  NEXT
2500  FOR I = ST +  PEEK (ST + 2) + 256 *  PEEK (ST + 3) TO
     ST + LE - 1
2510  READ J: POKE I,J
2520  NEXT
2530  HOME : VTAB 10: PRINT "CHARACTER SET NOW LOADED"
2540  PRINT D$;"BSAVE ASCII SHAPE TABLE, A"ST", L"LE
```

(continued on next page)

(continued from previous page)

```
1   REM  TYPE-A-GRAPHIC (TEXT)
2   REM  PROGRAM DEVELOPED FROM TYPE-A-GRAPHIC (HIRES)
3   REM  LAST AMENDED 22 JUL 1981 (VERSION NO.30)
4   REM  COPYRIGHT 1981 - ROGER CULLIS


60  DATA  169,0,133,2,133,4,169,4,133,3
70  DATA  169,8,133,5,162,4,160,0,177,2
80  DATA  145,4,200,208,249,230,3,230,5,202
90  DATA  208,242,96,0,0
100  FOR I = 768 TO 802: READ J: POKE I,J: NEXT : REM  MEMO
     RY SHIFT ROUTINE
110 W = 1:C$ = "BLACK":D = 1:DI$ = "RIGHT": SCALE= W:D1 = 1
     : ROT= 0: REM  INITIALISE
120 HG$ = "TYPE 'H' FOR HELP, 'B' FOR BACK-UP"
130 HT$ = "TYPE '@H' FOR HELP, '@B' FOR BACK-UP"


1050  PRINT  TAB( 12)"*  TEXT VERSION  *"


1120  PRINT : PRINT "UPPER AND LOWER CASE CHARACTERS MAY BE
     "
1130  PRINT : PRINT "INCLUDED IF LOADED FROM A SHAPE TABLE.
     "


1150  HOME : VTAB 10: PRINT "DO YOU REQUIRE TEXT IN GRAPHIC
     S (Y/N?)"
1160  GET A$: IF A$ = "N" THEN  GOTO 1340
1170  IF A$ < > "Y" THEN  GOTO 1160
1180  ONERR  GOTO 1200: REM  IF 'FILE NOT FOUND'
1190  GOTO 1270
1200  HOME : VTAB 10: PRINT "TEXT SHAPE TABLE NOT AVAILABLE
     ."
1210  PRINT : PRINT "DO YOU WISH TO LOAD IT FROM ANOTHER"
1220  PRINT : PRINT "DISKETTE (Y/N?)"
1230  GET A$: IF A$ = "Y" THEN  PRINT : PRINT "INSERT NEW D
     ISKETTE, THEN PRESS 'RETURN'": GOTO 1260
1240  IF A$ = "N" THEN  PRINT : PRINT "CONTINUE WITHOUT TEX
     T": GOTO 1340
1250  GOTO 1230
1260  GET A$: IF A$ < >  CHR$ (13) THEN  GOTO 1260
1270  PRINT D$;"BLOAD ASCII SHAPE TABLE"
1280  POKE 216,0: REM  RESET ERROR MESSAGE FLAG
1290 ST =  PEEK (43634) + 256 *  PEEK (43635): REM  STARTIN
     G ADDRESS (48K SYSTEM)
1300 LE =  PEEK (43616) + 256 *  PEEK (43617): REM  TABLE L
     ENGTH
1310 TN =  PEEK (ST): REM  NUMBER OF SHAPES IN TABLE
1320  POKE 232, PEEK (43634): POKE 233, PEEK (43635): REM
     SET SHAPE TABLE POINTERS
1330 T = 1: REM  SET TEXT OPTION FLAG


4998  REM  GRAPHICS MODE ROUTINES


5410  IF A$ = "R" THEN  GOSUB 5470: GOTO 5230: REM  DRAW CI
     RCLE CENTRE X,Y


5450  IF A$ = "B" THEN  GOSUB 5870: GOTO 5260: REM  BACKUP
5460  GOTO 5270
5467  REM
5468  REM  DRAW CIRCLE
5469  REM
5470  HOME : VTAB 22: PRINT "ENTER RADIUS OF CIRCLE (1-140)
     "
5480  INPUT "THEN PRESS 'RETURN'.  R =  ";R: IF R < 1 OR R >
     140 THEN  GOTO 5470


5867  REM
5868  REM  MAKE BACK-UP COPY
5869  REM
5870  HOME : PRINT "DO YOU WISH TO  1. SAVE CURRENT GRAPHIC
     "
5880  PRINT "OR 2. LOAD PREVIOUS BACK-UP COPY (1/2?)"
5890  GET A$: IF A$ = "1" THEN  GOTO 5930
5900  IF A$ < > "2" THEN  GOTO 5890
5910  ONERR  GOTO 5940
5920  PRINT D$;"BLOAD BACK-UP": POKE 216,0: RETURN
5930  PRINT D$;"BSAVE BACK-UP, A$2000, L$2000": POKE 216,0:
     RETURN
5940  FLASH : PRINT "NO BACK-UP -  CONTINUE CURRENT GRAPHIC
     "
5950  FOR I = 0 TO 500: NEXT : NORMAL : POKE 216,0: RETURN

5997  REM  ******************************************
5998  REM  TEXT MODE ROUTINES
5999  REM  ******************************************
6000  POKE 34,0: POKE 35,24
6010  POKE  - 16303,0: POKE  - 16302,0: POKE  - 16300,0: HOME
     : REM  TEXT,ALL,P1
6020  PRINT  TAB( 8)"INSTRUCTIONS - TEXT MODE"
6030  PRINT : PRINT "TYPE NORMALLY FOR LOWER CASE. USE 'ESC
     '"
6040  PRINT "FOR SHIFT KEY, 'RETURN' FOR SHIFT LOCK,"
6050  PRINT "SHIFT+'SPACE' FOR UNDERLINE, SHIFT+O "
6060  PRINT "FOR VERTICAL LINE, 'LEFT ARROW' FOR"
6070  PRINT "BACK SPACE AND 'RIGHT ARROW' FOR REPEAT"
6080  PRINT : PRINT  TAB( 16)"COMMANDS"
6090  PRINT : PRINT "@L  @R  ) SELECT PRINTING DIRECTION -"

6100  PRINT "@U  @D   ) LEFT, RIGHT, UP, DOWN"
6110  PRINT "@V       ) NEXT CHARACTER BELOW LAST ONE"
6120  PRINT "@E       ) ERASE MOST RECENT CHARACTER"
6130  PRINT : PRINT "@X  @Y  ) SELECT NEW CURSOR COORDINATE
     S"
6140  PRINT "@C0-@C7 ) SELECT NEW COLOUR"
6150  PRINT "@W1-@W2 ) SELECT CHARACTER SIZE"
6160  PRINT "@Z       ) CLEAR SCREEN TO CURRENT COLOUR"
6170  PRINT "@G       ) TRANSFER TO GRAPHICS MODE"
6180  PRINT "@S       ) SAVE GRAPHIC DISPLAY"
6190  VTAB 23: PRINT  TAB( 8)"PRESS 'RETURN' TO CONTINUE"
6200  GET A$: IF A$ < >  CHR$ (13) THEN  GOTO 6200
6210  CALL 768
6220  POKE  - 16297,0: POKE  - 16301,0: POKE  - 16304,0: REM
     HIRES,MIXED,GRAPHICS
6230  HOME : POKE 34,20: POKE 35,23: REM  SET TEXT WINDOW
6240  VTAB 24: PRINT HT$
6250  ONERR  GOTO 6610
6260  GOTO 6610
6270  HOME
6280  VTAB 23: PRINT "PRINT DIR. - "DI$";CHARACTER WIDTH -
     "W
6290  IF S = 0 AND L = 0 THEN  PRINT "L-CASE";
6300  IF S = 1 OR L = 1 THEN  PRINT "U-CASE";
6310  PRINT "; COLOUR - "C$"; X="X"; Y="Y
6320  GET A$
6330  IF A$ = "@" THEN  GOTO 6930: REM  TEXT MODE CONTROL
6340  IF A$ =  CHR$ (27) THEN  GOTO 6840: REM  SHIFT KEY
6350  IF A$ =  CHR$ (13) THEN  GOTO 6860: REM  SHIFT LOCK
6360  IF A$ =  CHR$ (8) THEN  GOTO 6530: REM  BACK SPACE
6370  IF A$ =  CHR$ (21) THEN  GOTO 6460: REM  REPEAT KEY
6380  HCOLOR= C:N =  ASC (A$): IF N < 32 OR N > 95 THEN  GOTO
     6320
6390  IF S = 1 OR L = 1 THEN S = 0: GOTO 6420
6400  IF N > 64 AND N < 91 THEN N = N + 32
6410  GOTO 6460
6420  IF N > 48 AND N < 60 THEN N = N - 16: GOTO 6460
6430  IF N > 43 AND N < 48 THEN N = N + 16: GOTO 6460
6440  IF N = 32 THEN N = 95: IF P = 1 THEN X = X1:Y = Y1
6450  IF N = 48 THEN N = 124: IF V = 1 THEN X = X1:Y = Y1: GOSUB
     7130
6460  DRAW N AT X,Y:X1 = X:Y1 = Y:V = 0:D1 = D:P = 1: GOSUB
     6480: IF N = 124 THEN V = 1
6470  GOTO 6270
6477  REM
6478  REM  MOVE CURSOR ON ONE SPACE
6479  REM
6480  IF D = 0 THEN Y = Y - 7 * W: IF Y < 7 * W - 1 THEN Y =
     159:X = X + 10 * W: IF X > 279 - 3 * W THEN X = 7 * W -
     1
6490  IF D = 1 THEN X = X + 7 * W: IF X > 279 - 7 * W THEN
     X = 0:Y = Y + 10 * W: IF Y > 159 - 3 * W THEN Y = 7 *
     W - 1
6500  IF D = 2 THEN Y = Y + 7 * W: IF Y > 159 - 7 * W THEN
     Y = 0:X = X - 10 * W: IF X < 3 * W - 1 THEN X = 279 -
     7 * W
6510  IF D = 3 THEN X = X - 7 * W: IF X < 7 * W - 1 THEN X =
     279:Y = Y - 10 * W: IF Y < 3 * W - 1 THEN Y = 159 - 7 *
     W
6520  RETURN
6527  REM
6528  REM  MOVE CURSOR BACK ONE SPACE
6529  REM
6530  IF D = 0 THEN Y = Y + 7 * W: IF Y > 159 THEN Y = 7 *
     W - 1:X = X - 10 * W: IF X < 7 * W - 1 THEN Y = 159 -
     3 * W
6540  IF D = 1 THEN X = X - 7 * W: IF X < 0 THEN X = 279 -
     7 * W:Y = Y - 10 * W: IF Y < 7 * W - 1 THEN Y = 159 -
     3 * W
6550  IF D = 2 THEN Y = Y - 7 * W: IF Y < 0 THEN Y = 159 -
     7 * W:X = X + 10 * W: IF X > 279 - 7 * W THEN X = 3 *
     W - 1
6560  IF D = 3 THEN X = X + 7 * W: IF X > 279 THEN X = 7 *
     W - 1:Y = Y + 10 * W: IF Y > 159 - 7 * W THEN Y = 3 *
     W - 1
6570  GOTO 6270
6577  REM
6578  REM  HELP ROUTINE
6579  REM
6580  GET A$: IF A$ < >  CHR$ (13) THEN  GOTO 6580
6590  POKE  - 16300,0: POKE  - 16297,0: POKE  - 16301,0: POKE
      - 16304,0: REM  P1,HIRES,MIXED,GRAPHICS
6600  GOTO 6320
6607  REM
6608  REM  KEEP WITH SCREEN LIMITS
6609  REM
6610  IF D = 1 THEN  GOTO 6690
6620  IF D = 0 THEN  GOTO 6740
6630  IF D = 2 THEN  GOTO 6790
6640  IF X > 279 THEN X = 279
6650  IF X < 7 * W THEN X = 7 * W
6660  IF Y > 159 - 7 * W THEN Y = 159 - 7 * W
6670  IF Y < 3 * W THEN Y = 3 * W
6680  GOTO 6270
6690  IF X < 0 THEN X = 0
6700  IF X > 279 - 7 * W THEN X = 279 - 7 * W
6710  IF Y < 7 * W THEN Y = 7 * W
6720  IF Y > 159 - 3 * W THEN Y = 159 - 3 * W
6730  GOTO 6270
6740  IF Y > 159 THEN Y = 159
6750  IF Y < 7 * W THEN Y = 7 * W
6760  IF X > 279 - 3 * W THEN X = 279 - 3 * W
6770  IF X < 7 * W THEN X = 7 * W
6780  GOTO 6270
6790  IF Y < 0 THEN Y = 0
6800  IF Y > 159 - 7 * W THEN Y = 159 - 7 * W
6810  IF X < 3 * W THEN X = 3 * W
6820  IF X > 279 - 7 * W THEN X = 279 - 7 * W
6830  GOTO 6270
6837  REM
6838  REM  SHIFT KEY
6839  REM
6840 S = S + 1: IF S > 1 THEN S = 0
6850  GOTO 6270
6857  REM
6858  REM  SHIFT LOCK
6860 L = L + 1: IF L > 1 THEN L = 0
6870  GOTO 6270
6877  REM
6878  REM  SET PRINT DIRECTION PARAMETERS
6879  REM
6880  IF D1 = 1 THEN  ROT= 0:DI$ = "RIGHT"
6890  IF D1 = 0 THEN  ROT= 48:DI$ = "UP"
6900  IF D1 = 2 THEN  ROT= 16:DI$ = "DOWN"
6910  IF D1 = 3 THEN  ROT= 32:DI$ = "LEFT"
6920  RETURN
6927  REM
6928  REM  TEXT MODE CONTROLS
6929  REM
6930  GET A$
6940  IF A$ = "C" THEN  GET A$: IF  ASC (A$) > 47 AND  ASC
     (A$) < 56 THEN  GOSUB 5750: GOTO 6270: REM  CHANGE COL
     OUR
6950  IF A$ = "W" THEN  GET A$: IF  ASC (A$) > 48 AND  ASC
     (A$) < 52 THEN W =  VAL (A$): SCALE= W: GOTO 6610: REM
     CHANGE PRINT SIZE
6960  IF A$ = "R" OR A$ = "L" OR A$ = "U" OR A$ = "D" THEN
     GOTO 7070: REM  CHANGE PRINT DIRECTION
6970  IF A$ = "V" AND P = 1 THEN  GOSUB 7130: GOTO 6270: REM
     MOVE CURSOR VERTICALLY
6980  IF A$ = "X" THEN  GOSUB 5690: GOTO 6610: REM  NEW X C
     OORDINATE
6990  IF A$ = "Y" THEN  GOSUB 5720: GOTO 6610: REM  NEW Y C
     OORDINATE
7000  IF A$ = "E" AND P = 1 THEN X = X1:Y = Y1:W = W1:D = D
     1: GOSUB 6880:P = 0: XDRAW N AT X,Y: GOTO 6270: REM  E
     RASE PREVIOUS CHARACTER
7010  IF A$ = "Z" THEN  HPLOT X,Y: CALL 62454: GOTO 6270: REM
     WIPE SCREEN
7020  IF A$ = "G" THEN P = 0: GOTO 5000: REM  GRAPHICS MODE

7030  IF A$ = "H" THEN  POKE  - 16303,0: POKE  - 16302,0: POKE
      - 16299,0: GOTO 6580: REM  HELP
7040  IF A$ = "B" THEN  GOSUB 5870: GOTO 6270: REM  BACKUP

7050  IF A$ = "S" THEN  GOTO 8000: REM  STOP
7060  HOME : FLASH : PRINT "INVALID COMMAND - PLEASE CONTIN
     UE": GOTO 7200
7067  REM
7068  REM  SET PRINT DIRECTION PARAMETERS
7069  REM
7070  IF A$ = "R" THEN D = 1: ROT= 0:DI$ = "RIGHT"
7080  IF A$ = "U" THEN D = 0: ROT= 48:DI$ = "UP"
7090  IF A$ = "D" THEN D = 2: ROT= 16:DI$ = "DOWN"
7100  IF A$ = "L" THEN D = 3: ROT= 32:DI$ = "LEFT"
7110  IF D1 < > D THEN P = 0
7120  GOTO 6610
7127  REM
7128  REM  MOVE CURSOR VERTICALLY
7129  REM
7130  IF D = 1 THEN X = X1:Y = Y1 + 10: IF Y > 159 - 3 * H THEN
     GOTO 7180
7140  IF D = 0 THEN X = X1 + 10:Y = Y1: IF X > 279 - 3 * H THEN
     GOTO 7180
7150  IF D = 2 THEN X = X1 - 10:Y = Y1: IF X < 3 * H - 1 THEN
     GOTO 7180
7160  IF D = 3 THEN X = X1:Y = Y1 - 10: IF Y > 3 * H - 1 THEN
     GOTO 7180
7170  RETURN
7180 X = X1:Y = Y1: GOSUB 6480
7190  HOME : FLASH : PRINT "INSUFFICIENT SPACE - ENTER NEW
     COMMAND"
7200  FOR I = 0 TO 2000: NEXT
7210  NORMAL : GOTO 6270
```

Modelling language for random text

Every language has its own peculiar features by which it can easily be recognised, even when the words themselves are unfamiliar. Dave Woolcock makes use of this property in an analyser which generates random text having the characteristics of any chosen language.

Language analyser — basic version.

```
500 REM   ================================
510 REM   =  MARKOV LANGUAGE ANALYSER    =
520 REM   =          FOR 8K UK101        =
530 REM   =   DAVE WOOLCOCK SEPT.81      =
540 REM   ================================
550 DIMA(27,27):PRINTCHR$(26)
560 PRINT,"MARKOV LANGUAGE ANALYSER
570 PRINT,"*************************":PRINT
580 PRINT:PRINT"TYPE IN THE SAMPLE LANGUAGE,";
590 PRINT"AND 'RETURN' AT THE
600 PRINT"END OF EACH LINE
610 PRINT:PRINT"TYPE '*' WHEN FINISHED":PRINT
620 :
630 REM   INPUT SAMPLE TEXT
640 :
650 INPUTA$:A$=A$+" ":IFA$="* "THEN750
660 Y=27:FORI=1TOLEN(A$):X=ASC(MID$(A$,I,1))
670 X=X-64:IFX=-32THENX=27
680 IFX←1ORX→27THENPRINTTAB(I+1)"?";:GOTO700
690 A(Y,X)=A(Y,X)+1:Y=X
700 NEXT:IFPOS(I)→1THENPRINT
710 GOTO650
720 :
730 REM CALCULATE PROBS AND GENERATE TEXT
740 :
750 FORI=1TO27:M=0:FORJ=1TO27
760 M=M+A(I,J):NEXT:IFM=0THEN790
770 FORK=1TO27:A(I,K)=A(I,K)/M:NEXT
780 FORK=2TO27:A(I,K)=A(I,K)+A(I,K-1):NEXT
790 PRINTCHR$(I+64);:NEXT:PRINTCHR$(13),,,
800 PRINT:PRINT" COMPUTER GENERATED TEXT :
810 X=27:PRINT:PRINT"HIT SHIFT TO STOP":PRINT
820 Z=RND(X):C=1
830 IFZ→A(X,C)THENC=C+1:GOTO830
840 X=C:IFC=27THENC=-32
850 C=C+64:PRINTCHR$(C);:IFPOS(I)→46THENPRINT
860 IFPEEK(57100)=254THEN820
870 END
```

Amendments for improved version.

```
555 DIMLW(15,15),FL(15,27):N=-1
690 A(Y,X)=A(Y,X)+1:N=N+1
691 IFX→←27THEN695
692 IFN→15THENN=15
693 IF(N1)AND(N)THENLW(N1,N)=LW(N1,N)+1
694 N1=N:N=-1
695 IFY→←27THEN699
696 IFF1THENFL(N1,F1)=FL(N1,F1)+1
697 F1=X
699 Y=X
791 PRINT:FORI=1TO15:M=0:FORJ=1TO15
792 M=M+LW(I,J):NEXT:FORK=1TO27:IFM=0THEN797
794 IFK←16THENLW(I,K)=LW(I,K)/M+LW(I,K-1)
795 FL(I,K)=FL(I,K)/M+FL(I,K-1)
797 NEXT:PRINTCHR$(I+48);:NEXT:PRINT,,,
811 L=INT(RND(8)*15+.9):C=1:Z=RND(L)
812 IFZ→FL(L,C)THENC=C+1:GOTO812
813 GOSUB840:IFL=1THEN817
814 FORI=1TOL-1
815 GOSUB820:IFC=27ORA(C,26)=0THEN815
816 GOSUB840:NEXT
817 C=27:GOSUB840:C=1:Z=RND(L)
818 IFZ→LW(L,C)THENC=C+1:GOTO818
819 L=C:C=1:Z=RND(L):GOTO812
835 RETURN
860 IFPEEK(57100)=254THENRETURN
```

```
→ = GREATER THAN
← = LESS THAN
```

WRITTEN TEXT normally consists of sequences of letters separated by spaces. Each language may form words in certain characteristic letter sequences. This program investigates the hypothesis that the probability of one letter following another is peculiar to each language.

Markov chains model the behaviour of a system or process which has a finite number of discrete states which change with time. The probability of moving from one state to another can be represented by a matrix:

		State at time T+1					
		1	2	3	4	...	N
	1	p11	p12	p13	p14	...	p1N
	2	p21	p22	p23	p24	...	p2N
State at time T	3	p31	p32	p33	p34	...	p3N
	.	.	.	.	.	...	.
	.	.	.	.	.	...	.
	N	pN1	pN2	pN3	pN4	...	pNN

The sum of the probabilities in each row must be 1 as the process has to move to one of the fixed number of states on the next move.

For language analysis, the Markov matrix consists of a 27-by-27 array — figure 1. Each transition — x — is initially set at zero. A stage-1 matrix is formed by adding 1 to each transition. For example, the word HELP causes the transitions H,E E,L L,P and P, (space) to be incremented by 1. When the text input is finished the program adds up the numbers in each row and divides each x by the sum to get the Markov probability matrix, the stage-2 matrix.

In order to use RND to generate "bogus language" from the matrix, the

(continued on next page)

Figure 1. Initial Markov matrix.

	A	B	C	D	E	...	Y	Z	(space)
A	x	x	x	x	x	...	x	x	x
B	x	x	x	x	x	...	x	x	x
C	x	x	x	x	x	...	x	x	x
D	x	x	x	x	x	...	x	x	x
.	.	.	.	.	.	...	.	.	.
.	.	.	.	.	.	...	.	.	.
Z	x	x	x	x	x	...	x	x	x
(space)	x	x	x	x	x	...	x	x	x

(continued from previous page)
probabilities of each row are converted into cumulative probabilities, the stage-3 matrix.

The core of the program is shown in the listing. It is written in UK 101 Basic for use with Cegmon. It should be run without Cegmon or on other machines with a few simple amendments. The main features of the program are as follows:

Line 550. CHR$(26) is Cegmon screen clear.
Lines 650 to 710 input text and create stage-1 matrix.
Lines 750 to 780 create stage-3 matrix via temporary stage-2.
Line 790 displays which row being worked on.
Lines 800 to 850 print bogus language using stage-3 and RND.
Line 860 detects UK 101 shift keys not pressed.

All Rems can be safely omitted. The UK-101 RND (X) function generates a number between 0 and 1 if X>0. POS(I) is the cursor position, which is used only for neatness.

Even in the basic version, interesting results can be obtained from just a few lines of sample text. The bogus language output tends to look like the original — even though it is usually gibberish. The exception is English, presumably because of its very mixed origins. The program usually manages to deduce a few real words in the sample language which were not in the input.

Sample outputs for brief inputs of Irish, Italian and English are shown in the printouts. The more text is typed in the more refined the probabilities will be and the more realistic the output.

The word-space is treated as an ordinary character in the program in order to produce legibly-formatted output. The nature of the RND function leads to very long or short words which are uncharacteristic of the simple input.

The probabilities of words of various length following each other can be considered as a Markov process in itself, which will also derive a separate distribution of initial letters. Examining word lengths requires.

- another matrix, say 15 by 15, for the lengths of words.
- a 15-by-26 array for the initial letters of words of various lengths.
- amendment of the core program to set up the array and to alter the RND language generator.

The amendments required are shown in the listing: the program will run in 8K if some of the Rems are removed.

A better model could be constructed by using the dependency on the previous two, three or more letters, not just the last one. Unfortunately, a two-step matrix would take up 27 x 27 x 27 x 4 bytes — 78K so it is not at all practical for a small machine. A 27-by-27 matrix could be derived to determine the probabilities of the next-but-one letter, and could then be used to vet the choices made by the one-step matrix.

For example, if the one-step matrix generates "P" to follow "QU", the result would normally be "QUP". The two-step matrix would rule it out since only vowels appear — two letters after a Q. The program would reject this structure and try again.

Alternatively, the two-step matrix could be tested on its own as a language generator or in conjunction with the one-step matrix. For example the one-step matrix could vet the choice made by the two-step matrix.

If you want to save the matrix you must do so at stage 1. The program is mainly of academic interest, although the stage-2 matrix could be used in real-time to verify input to a word processor by spotting improbable letter sequences. Alternatively, an unfamiliar word could be analysed against the matrices of a number of different languages to indicate the most probable source. ■

Irish text.

```
TYPE IN THE SAMPLE LANGUAGE,AND 'RETURN' AT THE
END OF EACH LINE

TYPE '*' WHEN FINISHED

? O EIREOIDH ME AMAIREACH LE FAINNE AN
? LAE.GHLEIGHIL AGUS DEANFAIDH ME MO
? DHEAGHRAS AMACH FAOI NA SLEIBHTE
? AGUS FAGFAIDH ME MO BHEANNACHT AR
? MNA DEASA UN TSAOIL SEO UGUS DEAMHAN
? AN FILLEADH ABHAILE DHOM GO LABHAR
? A CHUACH I MBARR NA GCRAOBH ANN
? *
ABCDEFGHIJKLMNOPQRSTUVWXYZ

 COMPUTER GENERATED TEXT :

HIT SHIFT TO STOP

DAACHE DH VEAM LAMOMABH GHAGH I DE A LADE E DH
LEAS MAILEIBH ANA ARACH XUS BHANARAR AS FARAI N
ANFAS ANNNNNN MHE E BAMHIDH M AIDHT O GHIDHAMBH
O FAGM FAIGH IDHUS FA FURAIDHARAI FARR FAILAN D
H GCH ARR GUS DEOIGOIDHE GHE SLE ADHI AILEILE D
HYE AMEAS A BHIGHUS ABHAINNEANNNAMN ANANA OAGUS
E DHIDHR LE FAGH MHTEACH E ME ME FA AN LASAGFAN
AS ANFAN ME EANACR ANNAO DHAMNAO MO AXHUSLMMBH
A A L NN M AOI TE VA M MEOLMOOBHRAN AGUSACHAN F
AIDH M AM MEAGOINAGUS L GUS DE S BHACH AS TEA A
CH SANAGUU DEACH FACHEA E ACHE GO DEIN ACHAS AM
NFINFAR FA E MOIRRR MOI O AIDHAIL MOMMNN TE ANN
N AI AIDEMR E O GHAMNARADE AME A GOILAIDE BHT D
```

Italian text.

```
TYPE IN THE SAMPLE LANGUAGE,AND 'RETURN' AT THE
END OF EACH LINE

TYPE '*' WHEN FINISHED

? INTANTO I COMMENSALI UBRIACHI SI ERANO RACCOLTI
? SUL BALCONE DELLA VILLA TRA ESSI ADESSO SPICCAVA
? L AVVOCATO DON CIRCOSTANZA COL CAPPELLO A MELONE
? IL NASO POROSO A SPUGNA LE ORECCHIE A VENTOLA
? LA PANCIA AL TERZO STADIO E RISAPUTO CHE GLI
? *
ABCDEFGHIJKLMNOPQRSTUVWXYZ

 COMPUTER GENERATED TEXT :

HIT SHIFT TO STOP

LTORZA VVE SUGNA GLLO SSORZOSPUTRECHICHIORAVIL
CONCO UGLA LOSOSSA CO UTOLLILIECCO L E ESALO CO
LTORA BACACO E LIRZA COSOME CCHIMPUTA A ECCHE L
LO A DERCISOME ILCCHECO ALORA CONALICO ECO CCO
LAVISOME SO SAVVAVVA IL ACCADO A A USTE CA CALT
OL PUTA MME ENVO BRICCA PUTONTO E TO BANCO CVHI
 CHIA I ACCAVVVESI ALI A GNALCAVO CA ALI VVENAVOO
LL IADE RAVO EL SI VA LLLERALCANENOLANCHIRILA R
APO
```

English text.

```
TYPE IN THE SAMPLE LANGUAGE,AND 'RETURN' AT THE
END OF EACH LINE

TYPE '*' WHEN FINISHED

? ANY TIME NOW IT WILL BE WORTH BUYING A HOME COMPUTER
? YOU HAVENT SEEN A REAL HOME COMPUTER UNTIL YOU HAVE SEEN THE
? LIKE THE REAL TYPEWRITER KEYBOARD WITH FULL GRAPHICS
? THE BIGGEST BREAKTHROUGH IN COMMUNICATION SINCE
? THE TELEPHONE AND TELEVISION 180000 PAGES OF
                                        ??????
? INFORMATION INSTANTLY AVAILABLE ASK A QUESTION
? AND UP POPS THE ANSWER IN SECONDS ON YOU OWN
? *
ABCDEFGHIJKLMNOPQRSTUVWXYZ

HIT SHIFT TO STOP

F WILL WN ATIKEWILESTHORE COMEPSINFORERAVE TE W
OWION ANICOR H CSWRE W TY Y THE LA TH A  BOMP T
EE APD HEN UNGENILLE  GGGHOANTHR ITE PS QUE WON
 POMU UTIND GEN TE THOVEPUG QUGGE TITYPUTERT TH
EE IL SKERIOMMPEROUPA ONIMUYBE H TH ATIMANT AVE
SITH UL WEECON  WN HEYORORMEND BRALLEEL SWEN TE
AVE LLINGEPSILL BICOND IK IOMAVAPUPS RE OMPHOU
ONSK AP CANSICELERMPHEEYPHOAIT WR T TIN BUE AKE
 ROMPE IN TIGELEY COANYONE L ION ATIN Y BICONOU
YOUGES BILERD TALY TINGHE
```

Italian text — improved version.

```
TYPE IN THE SAMPLE LANGUAGE,AND 'RETURN' AT THE
END OF EACH LINE

TYPE '*' WHEN FINISHED

? INTANTO I COMMENSALI UBRIACHI BI ERANO RACCOLTI
? SUL BALCONE DELLA VILLA TRA ESSI ADESSO SPICCAVA
? L AVVOCATO DON CIRCOSTANZA COL CAPPELLO A MELONE
? IL NASO POROSO A SPUGNA LE ORECCHIE A VENTOLA
? LA PANCIA AL TERZO STADIO E RISAPUTO CHE GLI
? *
ABCDEFGHIJKLMNOPQRSTUVWXYZ

123456789:;←=→?
 COMPUTER GENERATED TEXT :

HIT SHIFT TO STOP

A ULLANEST A COLACORI E POCOLI IR NCIA MMELON I
A DOLAS SAPUTA IN SISPOSOS SPE CONATONCHIC COS
CHILELASINO CCO INENZOL LL POSPUB IS NAPU AVENT
A SO ULACOCOR E MENAVE RCCOSOLA COM NERE SOSORI
 A BRICONC M ILALION O RASSSANT L BANTILA ERIRE
 DOS ELLL SORIRI ADOMELAV L CIOMMMMERA ADOLOSIS
 A PUBROS A IOCHELA TOSST CONECONS SOL CCHICCIE
LLU TON BRZOLLL A OLCORISO I CCOLANTADE ADIADEN
C A SOCANC RZADIESP LE TOLAT TOC INZORAV SO STE
SPP SALICIAN ST PAVIAD LL APUBALCC TIS ER!A ALA
NOR AN DELAN TONEN VOSOL COR COS COC IELILIC L
ULLIFLAL DES SUL SONZALON SOS VIELCOS SO RCILAV
ON LL ALACHERO CAN CIA DEC IENZOSO LO DOLAD DON
ON AVALEN A
```

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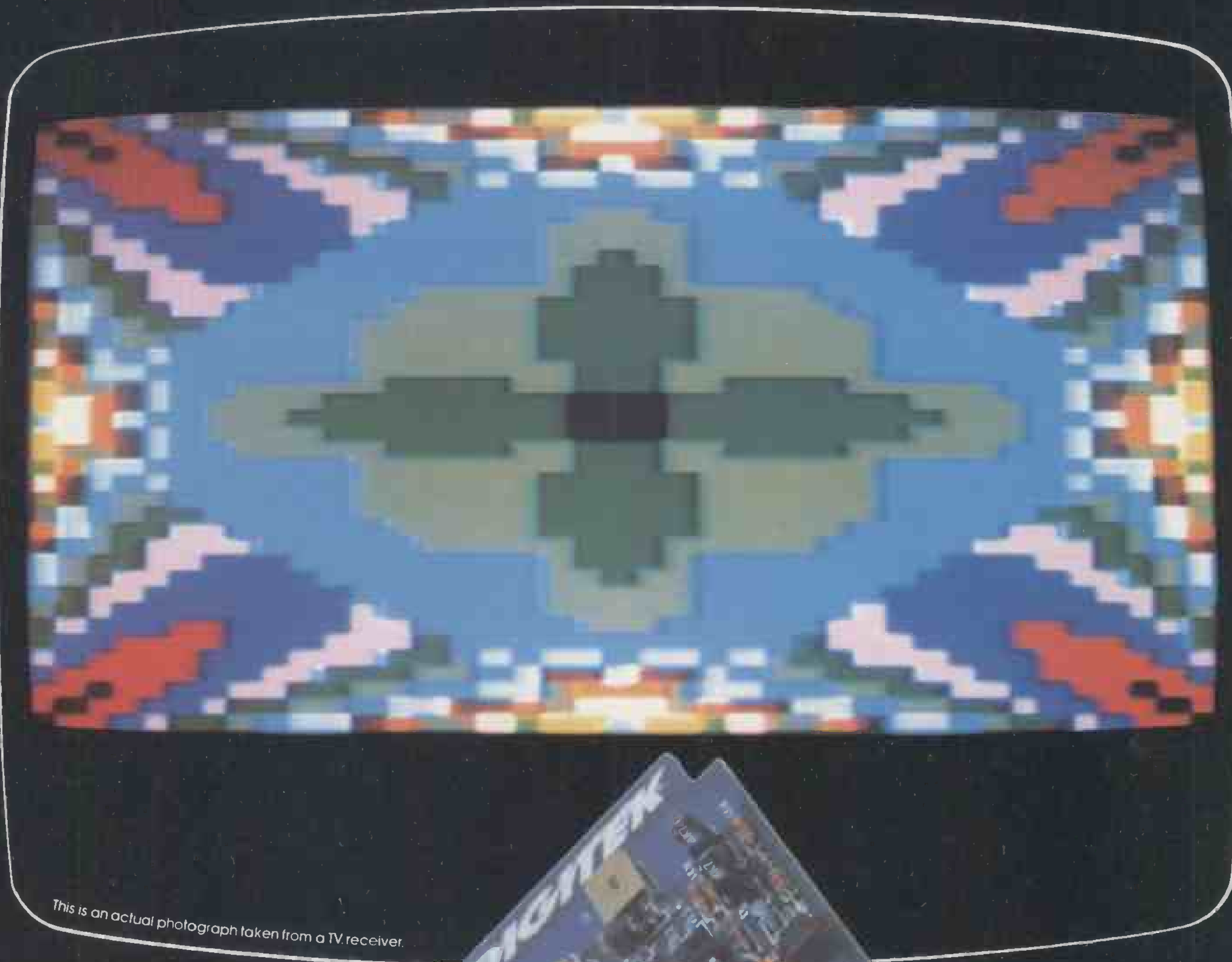

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New Era for erase

ANYONE WHO USES any high level language — especially those who use business-type packages — will find their directories filling up very rapidly with assorted text and data files, writes David Meeks of London E1. Most of them are old files for back-up purposes and need to be removed at regular intervals to give more space for transient files and programs.

The standard CP/M utility is called Era and takes the form:

A> ERA FILE NAME. extension
A> ERA THISFILE.BAS

This routine is standard to all versions, but when running under Version 2.0 or later will not erase read-only files. To do this the file to be erased must be explicitly set to read-write by using the utility package Stat Com.

Another shortcoming of Era is that it does not give you the opportunity of erasing most files of one type while leaving at least one behind:

A> ERA *.BAK

will erase all the files with the extension BAK, from the directory. This is a nuisance when there is a mixture of files of the same type to be erased and as many to be left behind. To do this, the files to be left in the directory must either be renamed before the erasure and then restored after the erasure operation, or the files to be erased must be named specifically in the Era instruction.

For people fortunate enough to have used MP/M or a larger commercial machine, Era seems a trivial utility compared to other file-erasure utilities. Under MP/M there is a transient program called ERAQ.PRL which can be used in the same way as Era except that the directory is searched for each occurrence of the match to the file parameters used. They are displayed on the console and the operator is questioned before the file is erased.

Deletion of files in this way can prove very efficient because when the extension is used such that all files are matched, e.g. A> ERA *.* all the files are listed so the operator can pick each one to be erased rather than by taking a copy of the directory and explicitly deleting those files one at a time.

The utility given in the assembler listing is a program to do just this — and it will be found that file erasure using this method will be at least a degree faster than Era — where files of different types are used. This program is called QERA. It acts in the same manner as ERAQ but runs under CP/M. In its present form it is meant for Version 2.0 but can be used on Version 1.4 with a little alteration.

The utility is called from the console by typing:

A> QERA Filename extension

this can either be a particular file or an ambiguous reference as in the following:

A> QERA TEST.*

Hence all the files with the file name Test are matched. The extension does not matter in this case — as before.

A> QERA *.*

will match all the files in the directory. As with any other CP/M program the file name may be preceded by a reference to a disc drive and all operations will be performed as the drive referred to, for example

A> QERA B:*.*

will match all films in the directory of the disk in drive B.

When a file is matched, it is printed at the console. After printing it waits for input. At this point there are three options open to the user; firstly, the file may be skipped by typing N — no action

```
                   ;****************************************************************
                   ;*                                                              *
                   ;*       QUESTION AND ANSWER ERASURE UTILITY                    *
                   ;*                                                              *
                   ;*       D.R.MEEKS      15/07/81                                *
                   ;*                                                              *
                   ;****************************************************************
     0100                    ORG     100h
     0005          BDOS      EQU     05h
     000D          CR        EQU     0Dh
     000A          LF        EQU     0AH
                   ;
0100 21 02A5       START:    lxi     H,STACK+32
0103 F9                      sphl
0104 E5                      push    H          ;SAVE SP FOR LATER RETURN
0105 11 0080                 lxi     D,80h
0108 0E 1A                   mvi     C,1Ah
010A CD 0005                 call    BDOS       ;SET DMA TO 80h, SHOULDN'T BE NEEDED
010D 11 005C                 lxi     D,5Ch      ;AFN IS SETTUP AT 5Ch
0110 0E 11                   mvi     C,11h
0112 CD 0005                 call    BDOS       ;SEARCH FOR FIRST OCCURENCE OF AFN
0115 3C                      inr     A          ;   USING AUTO DISK SELECT
0116 CA 01CE                 Jz      NOFILE     ;NO FILE MATCH HAS BEEN FOUND
0119 F5                      push    PSW
011A 3A 005C                 lda     5Ch        ;GET DISK DRIVE NO. FROM FCB
011D B7                      ora     A
011E 20 06                   Jrnz    DISK       ;JUMP IF NOT DEFAULT DISK
0120 0E 19                   mvi     C,19h
0122 CD 0005                 call    BDOS       ;GET CURRENT DISK NO.
0125 3C                      inr     A          ;SET FOR AUTO DISK SELECT
0126 32 027F       DISK:     sta     CDISK      ;SAVE DISK NUMBER
0129 11 02A7                 lxi     D,FINI
012C ED 53 0281              sded    STRING
0130 ED 53 0283              sded    STORE      ;LOAD STARTING POSITION OF BUFFER
0134 F1                      pop     PSW
0135 3D            NEXT:     dcr     A
0136 87                      add     A
0137 87                      add     A
0138 87                      add     A
0139 87                      add     A
013A 87                      add     A
013B C6 80                   adi     80h        ;CALCULATES POSITION OF UFN
013D 26 00                   mvi     H,00h
013F 6F                      mov     L,A
0140 3A 027F                 lda     CDISK
0143 77                      mov     M,A        ;SETS AUTO DISK SELECT BYTE
0144 ED 5B 0281              lded    STRING
0148 01 0020                 lxi     B,20h
014B ED B0                   ldir               ;MOVES UFN TO BUFFER
014D ED 53 0281              sded    STRING
0151 3A 0280                 lda     NUM
0154 3C                      inr     A          ;FILE COUNTER IS INCREMENTED
0155 32 0280                 sta     NUM
0158 0E 12                   mvi     C,12h
015A CD 0005                 call    BDOS       ;SEARCH FOR NEXT AFN
015D 3C                      inr     A
015E 20 D5                   Jrnz    NEXT
0160 2A 0283                 lhld    STORE      ;NO MORE AFN'S MATCHED IN DIRECTORY
0163 22 0281                 shld    STRING     ;RESET TO BEGINNING OF BUFFER
0166 CD 01D9       PUT:      call    PRINT      ;PRINT UFN
0169 0E 01                   mvi     C,01h
016B CD 0005                 call    BDOS       ;GET CHAR
016E E6 5F                   ani     5Fh
0170 FE 0D                   cpi     CR
0172 28 62                   Jrz     BOOT       ;RETURN TO CP/M IF [RETURN]
0174 FE 59                   cpi     'Y'
0176 20 1D                   Jrnz    GET        ;JUMP ROUND IF NO DELETE
0178 ED 5B 0283              lded    STORE
                   ;****************************************************************


                   ;         READ-ONLY SECTION STARTS HERE
017C 21 0009                 lxi     H,09h
017F 19                      dad     D          ;GET POSITION OF RO BIT
0180 7E                      mov     A,M
0181 E6 80                   ani     80h
0183 20 21                   Jrnz    RONLY
                   ;****************************************************************


                   ;         READ-ONLY ENDS HERE
0185 0E 13         DLT:      mvi     C,13h      ;DELETE UFN
0187 CD 0005                 call    BDOS
019A 3C                      inr     A
018B 20 08                   Jrnz    GET
018D 11 0227                 lxi     D,DEL      ;FLAG DELETE ERROR, SHOULDN'T HAPPEN
0190 0E 09                   mvi     C,09h
0192 CD 0005                 call    BDOS
0195 3A 0280       GET:      lda     NUM
0198 3D                      dcr     A
0199 32 0280                 sta     NUM
019C 28 38                   Jrz     BOOT       ;RETURN IF NO MORE UFN'S
019E 2A 0281                 lhld    STRING
01A1 22 0283                 shld    STORE
01A4 18 C0                   Jmpr    PUT        ;SET FOR NEXT UFN
                   ;****************************************************************


                   ;         THIS IS ANOTHER READ-ONLY SECTION
01A6 E5            RONLY:    push    H
01A7 11 0246                 lxi     D,MSGR
01AA 0E 09                   mvi     C,09h
01AC CD 0005                 call    BDOS       ;FLAG UFN AS RO
01AF 0E 01                   mvi     C,01h
01B1 CD 0005                 call    BDOS
01B4 E6 5F                   ani     5Fh
```

```
0186 FE 59                  cpi     'Y'
0188 E1                     pop     H
0189 ED 5B 0283             lded    STORE
018D 20 D6                  jrnz    GET         ;IF NO DO NOT DELETE
01BF 7E                     mov     A,M
01C0 E6 7F                  ani     7Fh
01C2 77                     mov     M,A         ;RESET RO BIT
01C3 0E 1E                  mvi     C,1Eh
01C5 CD 0005                call    BDOS        ;SET FILE AS RW
01C8 ED 5B 0283             lded    STORE
01CC 18 B7                  jmpr    DLT         ;DELETE UFN
                ;************************************************************************

                ;           SECOND RO SECTION ENDS HERE
01CE 11 026E    NOFILE:     lxi     D,MSG
01D1 0E 09                  mvi     C,09h
01D3 CD 0005                call    BDOS        ;PRINTS NO FILE MESSAGE
01D6 E1         BOOT:       pop     H
01D7 F9                     sphl
01D8 C9                     ret                 ;RETURNS OLD SP AND RETURNS
01D9 1E 0D      PRINT:      mvi     E,CR        ;PRINTS UFN FORMAT
01DB CD 021D                call    CONOUT
01DE 1E 0A                  mvi     E,LF
01E0 CD 021D                call    CONOUT
01E3 E5                     push    H
01E4 7E                     mov     A,M
01E5 C6 40                  adi     40h
01E7 5F                     mov     E,A
01E8 CD 021D                call    CONOUT
01EB 1E 3A                  mvi     E,':'
01ED CD 021D                call    CONOUT
01F0 06 08                  mvi     B,8
01F2 23         POUT8:      inx     H           ;PRINTS FILE NAME
01F3 5E                     mov     E,M
01F4 CD 021D                call    CONOUT
01F7 10 F9                  djnz    POUT8
01F9 1E 2E                  mvi     E,'.'
01FB CD 021D                call    CONOUT
01FE 06 03                  mvi     B,3
0200 23         POUT3:      inx     H           ;PRINTS FILE EXTENSION
0201 5E                     mov     E,M
0202 CD 021D                call    CONOUT
0205 10 F9                  djnz    POUT3
0207 1E 3F                  mvi     E,'?'
0209 CD 021D                call    CONOUT
020C 1E 20                  mvi     E,' '
020E CD 021D                call    CONOUT
0211 E1                     pop     H
0212 3E 20                  mvi     A,20h
0214 85                     add     L
0215 6F                     mov     L,A         ;SET POINTER TO NEXT UFN
0216 30 01                  jrnc    PLUS1
0218 24                     inr     H
0219 22 0281    PLUS1:      shld    STRING
021C C9                     ret
021D E5         CONOUT:     push    H           ;OUTPUT CHAR VIA CP/M
021E C5                     push    B
021F 0E 02                  mvi     C,02h
0221 CD 0005                call    BDOS
0224 C1                     pop     B
0225 E1                     pop     H
0226 C9                     ret
0227 20 20 20 20DEL:        db      '    **** FILE NOT DELETED ****$'
     2A 2A 2A 2A
     20 46 49 4C
     45 20 4E 4F
     54 20 44 45
     4C 45 54 45
     44 20 2A 2A
     2A 2A 24
0246 20 20 20 20MSGR:       db      '    **** READ ONLY **** DELETE (Y/N)? $'
     2A 2A 2A 2A
     20 52 45 41
     44 20 4F 4E
     4C 59 20 2A
     2A 2A 2A 20
     20 44 45 4C
     45 54 45 20
     28 59 2F 4E
     29 3F 20 24
026E 0D 0A 46 49MSG:        db      CR,LF,'FILE NOT FOUND$'
     4C 45 20 4E
     4F 54 20 46
     4F 55 4E 44
     24
027F 0001       CDISK:      ds      1
0280 0001       NUM:        ds      1
0281 0002       STRING:     ds      2
0283 0002       STORE:      ds      2
0285 0022       STACK:      ds      34
                FINI:
0 errors.  26 symbols generated.  Space for 5155 more symbols.
679 bytes of absolute code.

BDOS      05
BOOT    01D6
CDISK   027F
CONOUT  021D
CR        0D
DEL     0227
DISK    0126
DLT     0185
FINI    02A7
GET     0195
LF        0A
MSG     026E
MSGR    0246
NEXT    0135
NOFILE  01CE
NUM     0280
PLUS1   0219
POUT3   0200
POUT8   01F2
PRINT   01D9
PUT     0166
RONLY   01A6
STACK   0285
START   0100
STORE   0283
STRING  0281
```

— or any key other than return or Y. Two fingers can be used to speed up the operation — one finger on Y and another on any other key, e.g. space.

The second option is to abort the program by pressing return. No action is undertaken on the present file and it returns to the CCP.

The final action is to type a Y causing the file to be deleted. The file-control block is checked for the file in question. If the read-only bit is set, it will print a message to warn the user, then it will ask for more input; a Y will continue deletion, any other key will skip this file.

If the file is either read-write or read-only but specified for deletion, the file will be set to read-write, where applicable, and then deleted from the directory.

All the file and I/O operations taken by the program QERA are called via the CP/M Bdos functions and will then work on any CP/M system running a Z-80 CP/M.

There are two error messages in the listing. The first is "no file" which occurs when no match is found in the current directory or the file name was not given. The second message should never occur — it is simply there to warn the user that there has been a system or hardware fault and the file is not deleted. This may occur if the disc is changed halfway through the program, such that the file is not present on the new disc, or it is write protected.

The utility requires a buffer to be set up in the system memory directly after the last load address of the utility. The buffer length varies but can be found by simply multiplying the number of files matched by 32 — the length of the file-control block.

A normal maximum is 64 files i.e. 2K bytes and will then execute under any CP/M memory size.

A typical output can be seen from the examples on the listings. It will not be immediately apparent, but there is another major saving in QERA over the Era utility — that is, if a file on the disc is set to be attributed as a Sys file, it is not printed as a directory item and it can still be erased as a simple file.

Under Era it would have to be listed by using the STAT command so that all the SYS files are displayed. Then it may be erased in the normal way. Under QERA the System attribute is ignored, and so it will be displayed as a normal file.

The program has not been run under CP/M Version 1.4 but has been run under different variants of CP/M Versions 2.0 and 2.2. The only significant difference is that read-only is not an attribute under Version 1.4, so the section of the program corresponding to it may be removed.

Anyone running CP/M using an 8080 or 8085 processor must change the block-move commands. The other operation not used by the 808x CPUs are jump relatives, so these are simply changed to jump with no increase in complexity, as either may be used.

Drawing the line

PICTURES is a system by Douglas Fyffe of Sutton, Surrey, which enables pictures to be created on the screen. The image can be saved on disc for subsequent reloading or output to a printer.

Pictures saved on disc are always directed to drive C and are given the secondary file name of Pic. When the system is left, a directory of all stored pictures — on drive C — is sent to the printer; if a printer has not been used during the run the directory is sent to the screen.

After initial entry to the system, the user can create or load pictures, obtain a directory of all pictures stored on disc or erase a stored picture.

Initially two modes can be entered.

The Create mode is entered to create pictures on screen and save them on disc. The commands used in this mode are all in the form of a single key and do not need to be followed by Return. The following commands are available in Create mode:

U:move plotter up
D:move plotter down
L:move plotter left
R:move plotter right
W:set plotting shade to white
G:set plotting shade to grey
E:set plotting shade to erase
P:send current screen to printer
Q:quit system
C:clear screen and initialise plotter
S:save current picture on disc
T:transfer a picture from disc
I:return to set initial mode
H:point to current cursor location

Load mode is entered to load a saved picture on to the screen to be altered, printed or re-saved. A title or primary file name will be requested, and will be rejected if not valid.

```
10000 REM          PICTURES
10100 REM          --------
10200 GOTO 11300
10300 EF=0
10400 REM          ERROR SUBROUTINE
10500 REM          ----------------
10600 IFX=1ANDA$="L"THENEF=1
10700 IFX=78ANDA$="R"THENEF=1
10800 IFY=1ANDA$="D"THENEF=1
10900 IFY=49ANDA$="U"THENEF=1
11000 RETURN
11100 REM          SET NON-FLASHING CURSOR
11200 REM          -----------------------
11300 PRINT CHR$(23)
11400 TEXT
11500 CLEAR 2000
11600 PUT 12
11700 PRINT"IS PRINTER CONNECTED ?"
11800 NK$=GET$()
11900 IF NK$="N"THEN 12400
12000 PUT 12
12100 REM          SET PRINT SIZE
12200 REM          --------------
12300 LPRINT CHR$(30);CHR$(27);"8"
12400 PRINT"INSTRUCTIONS ?"
12500 Z$=GET$()
12600 IF Z$="Y"THEN GOSUB 24400
12700 PUT 12
12800 REM          INITIAL ENTRY
12900 REM          -------------
13000 PRINT"       WHICH OPTION"
13100 PRINT"       ------------"
13200 PRINT:PRINT
13300 PRINT"  ENTER CREATE MODE        (C)"
13400 PRINT"  ENTER LOAD MODE          (L)"
13500 PRINT"  ABORT AND EXIT SYSTEM    (A)"
13600 PRINT"  DIRECTORY OF PICTURES    (D)"
13700 PRINT"  ERASE A STORED PICTURE   (E)"
13800 AA$=GET$()
13900 IF AA$="L"THEN 20100
14000 IF AA$="C"THEN 14500
14100 IF AA$="A"THEN 23600
14200 IF AA$="D"THENPUT12:GOTO 26200
14300 IF AA$="E"THEN 27200
14400 GOTO13800
14500 PUT 12
14600 GRAPH
14700 REM          DRAW BORDER
14800 REM          -----------
14900 PLOT 0,0,2
15000 LINE 79,0
15100 LINE 79,50
15200 LINE 0,50
15300 LINE 0,0
15400 REM          SET CO-ORDINATES OF
15500 REM          CURSOR AND PLOTTING
15600 REM          SHADE.
15700 REM          -------------------
15800 X=37:Y=25
15900 C=2
16000 PLOT X,Y,C
16100 A$=GET$()
16200 IF A$="U"ORA$="D"ORA$="L"ORA$="R"
      THENGOSUB10300
16300 IFEF=1THENEF=0:GOTO16100
16400 IF A$="W"THEN  C=2:           GOTO16100
16500 IF A$="G"THEN  C=1:           GOTO16100
16600 IF A$="E"THEN  C=0:PLOTX,Y,C:GOTO16100
16700 IF A$="U"THENY=Y+1:PLOTX,Y,C:GOTO16100
16800 IF A$="D"THENY=Y-1:PLOTX,Y,C:GOTO16100
16900 IF A$="L"THENX=X-1:PLOTX,Y,C:GOTO16100
17000 IF A$="R"THENX=X+1:PLOTX,Y,C:GOTO16100
17100 IF A$="S"THEN                 GOTO18100
17200 IF A$="P"THEN                     21600
17300 IF A$="C"THEN                     14500
17400 IF A$="Q"THEN                     23100
17500 IF A$="I"THEN TEXT:PUT 12:GOTO  12800
17600 IF A$="H"THENGOSUB25600:PLOTX,Y,CH:FORCC=1TO150:
      NEXTCC:PLOTX,Y,C:GOTO16100
17700 IF A$="T"THEN                     20100
17800 GOTO16100
17900 REM          SAVE PICTURE ON DISK
18000 REM          --------------------
18100 INPUT"SAVE PICTURE AS ";F$
18200 F$=F$+".PIC"
18300 IF LOOKUP(F$)=0THEN18700
18400 PRINT"PICTURE ";
18500 PRINT MID$(F$,1,LEN(F$)-4);
18600 PRINT" ALREADY EXISTS.":GOTO 15800
18700 CREATE £10,F$
18800 QUOTE £10,0
18900 FORI=0TO19
19000 Z$=""
19100 FORJ=0TO39
19200 Z$=Z$+CHR$(POINTS(J+J,I+I+I))
19300 NEXT J
19400 PRINT£10,Z$
19500 NEXT I
19600 CLOSE £10
19700 PRINT"PICTURE SAVED AS ";MID$(F$,1,LEN(F$)-3)
19800 GOTO 12800
19900 REM          LOAD PICTURE FROM DISK
20000 REM          ----------------------
20100 INPUT"WHICH PICTURE TO LOAD ";F$
20200 F$=F$+".PIC"
20300 PUT 12
20400 IF LOOKUP(F$)()0 THEN 20800
20500 PRINT"PICTURE ";
20600 PRINT MID$(F$,1,LEN(F$)-4);
20700 PRINT " DOES NOT EXIST ":GOTO12800
20800 OPEN £10,F$
20900 FORY=0TO19
21000 INPUT LINE £10,P$
21100 PLOT 0,Y+Y+Y,P$
21200 NEXT Y
21300 GOTO 15800
21400 REM          SCREEN TO PRINTER
21500 REM          -----------------
21600 IF NK$()"N"THEN22100
21700 PLOT13,56,"PRINTER IS NOT CONNECTED."
21800 FORS=1TO500:NEXTS
21900 PLOT13,56,"
22000 GOTO 16100
22100 FORI=19TO0STEP-1
22200 Z$=""
22300 FORJ=0TO39
22400 Z$=Z$+CHR$(POINTS(J+J,I+I+I))
22500 NEXT J
22600 LPRINT Z$
22700 NEXT I
22800 FORYY=1TO10:LPRINT:NEXTYY
22900 PF=2
23000 GOTO15800
23100 TEXT
23200 PUT 12
23300 REM          EXIT SYSTEM
23400 REM          -----------
23500 PRINT£PF,"PICTURES SAVED "
23600 DIR£PF,"*.PIC"
23700 IF PF=2 THEN FOR T=1TO8:LPRINT:NEXT
23800 PRINT£PF,"Finished"
23900 IF NK$="Y"THEN LPRINT CHR$(27);"6"
24000 TEXT
24100 END
24200 REM          READ INSTRUCTION FILE
24300 REM          ---------------------
24400 PUT 12
24500 OPEN£10,"PICSTEXT"
24600 INPUT LINE£10,T$
24700 IF T$="////"THEN GOSUB 25100:GOTO24600
24800 IF T$="END OF TEXT"THEN RETURN
24900 PRINTT$
25000 GOTO 24600
25100 PRINT"PRESS A KEY TO CONTINUE"
25200 X$=GET$()
25300 PUT 12
25400 RETURN
25500 END
25600 REM HELP
25700 IFC=0THENCH=1
25800 IFC=1THENCH=2
25900 IFC=2THENCH=0
26000 RETURN
26100 END
26200 REM          DIRECTORY
26300 REM          ---------
26400 PRINT"WHERE TO...PRINTER(P)  SCREEN(S)?";
26500 ZA$=GET$()
26600 PRINT
26700 IF ZA$="P"THENCL=2:IFNK$="N"THENPRINT"
      PRINTER IS NOT CONNECTED":GOTO 12800
26800 IF ZA$="S"THENCL=0
26900 DIR£CL,"*.PIC"
27000 PRINT:PRINT:GOTO12800
27100 END

27200 REM          ERASE A PICTURE
27300 REM          ---------------
27400 PUT 12
27500 PRINT"WHICH PICTURE TO ERASE"
27600 INPUT EF$
27700 EP$=EF$+".PIC"
27800 ST=LOOKUP(EP$)
27900 IF ST()-1THEN28500
28000 PRINT"DEFINITELY ERASE ";EF$;" ?"
28100 QA$=GET$()
28200 IF QA$="Y"THEN ERASE EP$
28300 DIR"*.PIC"
28400 GOTO 12800
28500 PRINT"PICTURE ";EF$;" DOES NOT EXIST."
28600 DIR"*.PIC"
28700 GOTO 12800
```

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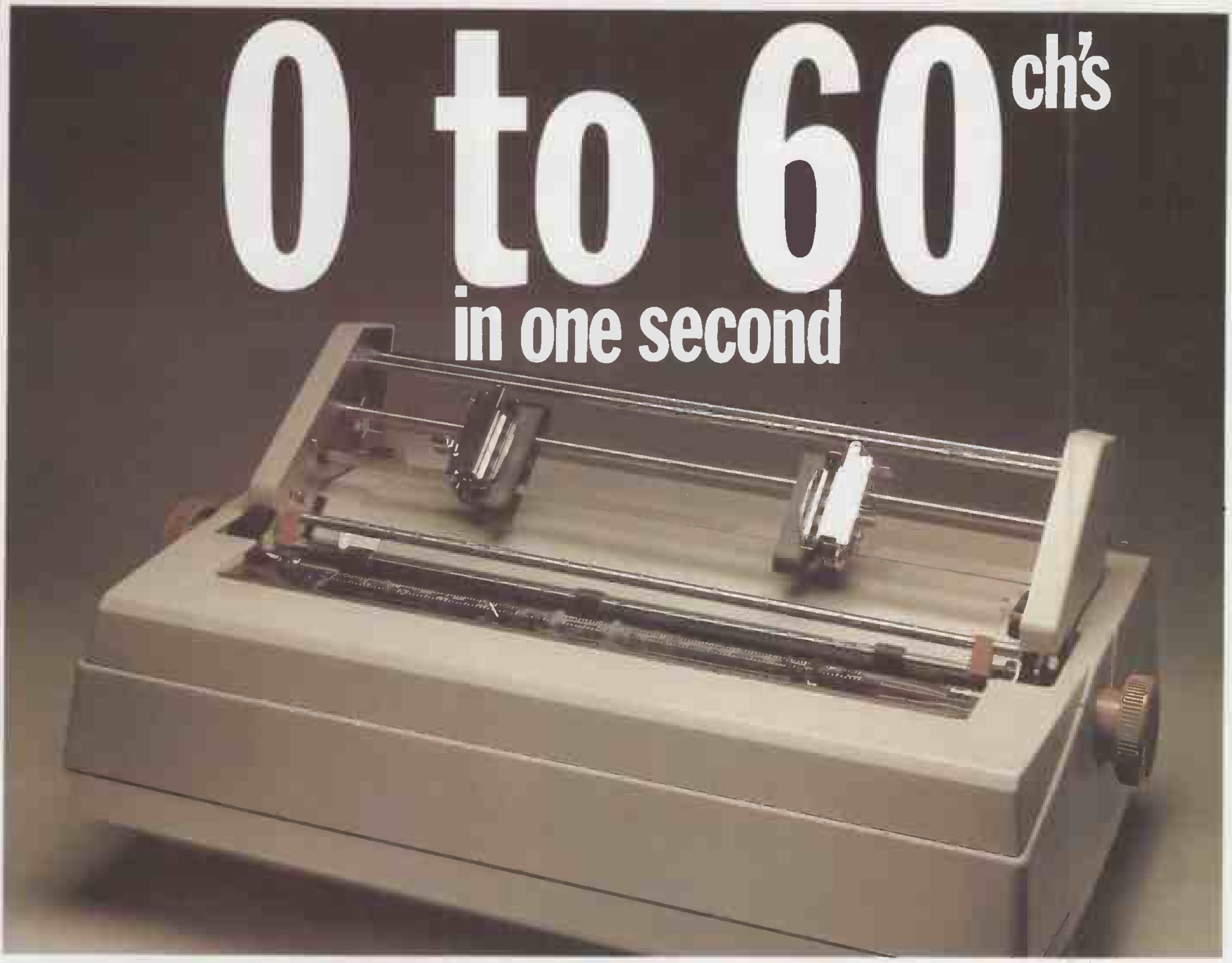

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PRINT ELEMENT	DAISY-WHEEL	DAISY-WHEEL	THIMBLE	DOUBLE DAISY-WHEEL	DOUBLE DAISY-WHEEL
AUTO BIDIRECTIONAL	Yes	No	No	No	Yes
AUTO LOGIC SEEKING	Yes	No	Yes	No	Yes
PROPORTIONAL PRINT CAPABILITY	Yes	Yes	Yes	No	Yes
EXTENDED CHARACTER SET	No	No	Yes	Yes	Yes
LETTER QUALITY PRINT	Yes	Yes	Yes	Yes	Yes
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```
00100 ;         Flashing cursor by Simon Langridge
00200           ORG     XXXXH           ;Put anywhere
00300 STORE     EQU     4018H           ;Any 2 consecutive bytes
00400                                   ;of free memory
00500 CURPOS    EQU     4020H           ;=> cursor position
00600 START:    LD      HL,(4016H)      ;Get KBD driver address
00700           LD      (FIN+1),HL      ;Save exit address
00800           LD      HL,PROG         ;Program start address
00900           LD      (4016H),HL      ;Revector KBD
01000           LD      A,20H           ;Space
01100           LD      (STORE+1),A     ;Initialise cursor
01200           JP      1740            ;402DH if in DOS
01300 PROG:     PUSH    HL              ;Save HL
01400           LD      A,(4022H)       ;Cursor character
01500           OR      A               ;Set condition flags
01600           JR      Z,EXIT          ;Jump if cursor is off
01700           LD      HL,STORE        ;=> Count
01800           INC     (HL)            ;Increment count
01900           INC     HL              ;HL = STORE+1
02000           JR      NZ,DISP         ;Jump if count <> 0
02100           LD      A,(HL)          ;A = cursor
02200           XOR     7FH             ;Change character
02300           LD      (HL),A          ;Save it
02400 DISP:     LD      A,(HL)          ;A = cursor
02500           LD      HL,(CURPOS)     ;HL = cursor position
02600           LD      (HL),A          ;Display cursor
02700 EXIT:     POP     HL              ;Restore HL
02800 FIN:      JP      0               ;Jump to driver
02900           END     START

10 FORI=32721TO32765:READA:POKEI,A:NEXT
20 DATA42,22,64,34,254,127,33,229,127,34,22,64,62,32,50,25,64
30 DATA195,204,6,229,58,34,64,183,40,16,33,24,64,52,35,32,4
40 DATA126,238,127,119,126.42,32,64,119,225,195
```

Reset and flasher

AN ACCIDENTAL LList or LPrint on the TRS-80 locks up the TRS-80 system, warns Simon Langridge of Evesham, Worcestershire, and the only remedy is to press Reset.

On a system without the expansion interface, Reset does not affect the program but when a printer is interfaced, Reset re-initialises the machine and the program is lost.

A few minutes research with the interface handbook and the ROM produced the answer — it turned out to be a crocodile clip, though a more affluent person might use an edge connector to equally good effect.

The clip is attached to the J4 printer card edge, earthing pins 21 and 23 which are conviently placed on the underside of the connector. The status lines are such that the computer thinks that the printer is always ready, and this enables the LList or LPrint to be executed.

To test, type in this program:

```
10 PRINT @ 50, PEEK (14312) AND 240; :
  GOTO10
```

which should display 48.

In the flashing-cursor routine by R Nicholls, published in *Practical Computing*, June 1981, the cursor continued to flash when the program was running. This can be overcome by using the fact that the cursor character 00hex is held at 4022hex when the cursor is off.

The colons and labels shown in the listing can be left out if you do not have the Edit-80 assembler. The program calls for 16K and is initialised by a system call to 32721.

Forming word-squares

WORD-SQUARE CONSTRUCTOR was written for a TRS-80 model-1, Level 2 with a printer, though it will run on most computers which have reasonable string-handling commands and 16K of memory, writes G Smith of Farnham, Surrey.

The program first asks you how many words you are going to input, which allows it to construct an array which will be used to store the words. After the array has been set, it asks for the word list to be input — these are the words you will later have to find. After the word list has been typed in, another array is constructed to hold the word-square.

The program sorts the words into a second array, in order from the longest to the shortest. The longest words are placed into the word-square first to help the word positioning in the next section of the program.

If the word does not fit into any part of the word-square the program informs the user and proceeds to the next word in the list. The final part of the program outputs the word-square to a printer and lists the words in the order that they were typed in. The only thing remaining is for the user to solve the puzzle.

Unknown loading

LOADING A SYSTEM tape of unknown name is a problem which has perplexed a number of readers. Having sweated his way through the ROM to a satisfactory solution, M L Arnautov, has written to share the fruits of his labours.

To load a system tape of unknown name on TRS-80 Model I, level 2 or a Video Genie, run the following program:

```
10 FOR I = 16924 TO 16932: READ J: POKE
  I,J: NEXT: END
20 DATA 49, 136, 66, 205, 147, 2, 195, 231, 2
```

Now prepare the tape as you would for a normal load. Type System and reply to the prompt *? with /16924 instead of the program name. Then sit back and watch your program load.

A simpler, but less satisfactory, solution lies in the curious fact that the standard load precedure allows program names to be abbreviated down to a single character. While the number of possible six-character names is large, the number of characters with which they can start is not.

```
0 RANDOM:CLEAR 10000
10 PRINT"WORD-SQUARE FOR THE TRS-80"
20 PRINT"(C) G.SMITH 1-9-81"
30 INPUT"HOW MANY WORDS DO YOU WANT IN YOUR PUZZLE";NW
40 DIM WO$(NW):LO=0:FOR X=1 TO NW
50 PRINT"TYPE IN WORD #";X
60 INPUT WO$(X)
70 IF LEN(WO$(X))>LO THEN LO=LEN(WO$(X))
80 NEXT X
85 LE=LO+NW:IF LE<10 THEN LE=10 ELSE IF LE>26 THEN LE=26
90 DIM WS$(LE,LE),W1$(NW)
100 PO=LO:P1=1
110 FOR X=1 TO NW
120 IF LEN(WO$(X))=PO THEN W1$(P1)=WO$(X):P1=P1+1
130 NEXT X
140 IF P1>NW THEN P2=1:GOTO 160
150 PO=PO-1:GOTO 110
160 CO=LE[2:CO=CO*8
170 C1=1
180 XP=RND(LE):YP=RND(LE)
190 XD=RND(3)-2:YD=RND(3)-2
200 IF XD=0 AND YD=0 THEN 190
210 CH=XP+XD*LEN(W1$(P2))
220 IF CH>LE OR CH<1 THEN 1000
225 CH=YP+YD*LEN(W1$(P2))
226 IF CH>LE OR CH<1 THEN 1000
230 CH=0:TX=XP:TY=YP
240 FOR X=1 TO LEN(W1$(P2))
245 IF CH=1 GOTO 280
250 IF WS$(TX,TY)=MID$(W1$(P2),X,1) OR WS$(TX,TY)="" THEN 270
260 CH=1
270 TX=TX+XD:TY=TY+YD
280 NEXT X
290 IF CH=1 THEN 1000
300 FOR X=1 TO LEN(W1$(P2))
310 WS$(XP,YP)=MID$(W1$(P2),X,1)
320 YP=YP+YD:XP=XP+XD
330 NEXT X
344 PRINT"DONE ";W1$(P2)
350 P2=P2+1
360 IF P2>NW THEN 20000
370 GOTO 170
1000 C1=C1+1
1010 IF C1>CO THEN 3000
1020 GOTO 180
3000 CH=0:FOR XP=1 TO LE
3010 FOR YP=1 TO LE
3020 FOR XD=1 TO 3
3030 FOR YD=1 TO 3
3035 IF CH=1 GOTO 3140
3040 IF XD=0 AND YD=0 GOTO 3140
3050 IF XP+XD*LEN(W1$(P2))>LE THEN 3140
3055 IF XP+XD*LEN(W1$(P2))<1 THEN 3140
3060 IF YP+YD*LEN(W1$(P2))>LE THEN 3140
3065 IF YP+YD*LEN(W1$(P2))<1 THEN 3140
3070 TX=XP
3080 TY=YP
3085 TS=0
3090 FOR X=1 TO LEN(W1$(P2))
3095 IF TS=1 GOTO 3120
3100 IF WS$(TX,TY)=MID$(W1$(P2),X,1) OR WS$(TX,TY)="" GOTO 3120
3110 TS=1
3120 TX=TX+XD:TY=TY+YD:NEXT:IF TS=1 GOTO 3140
3130 CH=1:PX=XP:PY=YP:DX=XD:DY=YD
3140 NEXT YD
3150 NEXT XD
3160 NEXT YP
3170 NEXT XP
3180 IF CH=1 THEN XP=PX:YP=PY:XD=DX:YD=DY:GOTO 300
3190 LPRINT"INSUFFICIENT ROOM TO INCLUDE ";W1$(P2):GOTO 350
20000 INPUT"TYPE IN THE TITLE FOR THIS PUZZLE";TI$
20010 LPRINTTAB(INT((80-LEN(TI$))/2));TI$
20020 LPRINTTAB(INT((80-(LEN(TI$)+2))/2));STRING$(LEN(TI$)+2,"-")
20030 LPRINT:LPRINT:LPRINT
20040 FOR X=1 TO LE
20050 FOR Y=1 TO LE
20060 IF WS$(X,Y)<>"" THEN LPRINT " ";WS$(X,Y);" ";:GOTO 20080
20070 LPRINT" ":CHR$(RND(26)+64);" ";
20080 NEXT Y
20090 LPRINT"":LPRINT
20100 NEXT X
20110 LPRINT:LPRINT:LPRINT"THE WORDS"
20120 FOR X=1 TO NW
20130 LPRINT WO$(X)
20140 NEXT
20150 END
```

Ping-pong

THIS ZX-80 Basic program lets you play the old-fashioned arcade game of ping pong, writes Stuart McCullen of Lowestoft, Suffolk.

The game runs indefinitely. The top bat is controlled by keys 1 and 4, for left and right movement respectively. The lower bat is controlled by keys 7 and 0.

Scores are recorded for each player in the bottom corners of the screen. There are nine balls per game, the number of the balls remaining being indicated on the ball, so there is always the incentive to 'try to win next time'.

Ping-pong.

```
5    GO TO 260
10   PRINT
"722B722B72232323722372 2B2BC91120002100423E80060077237723772310F8"
20   PRINT
"21FF4106193676191 0FBDD21E044DD36001CDD361E1C252C0E01FD21DB41FD36"
30   PRINT
"21C6FD36221831FA41D9210025E5FD362338E12CE5DBFE7DE6032839FE02201C"
40   PRINT
"065710FED3FE3EEC061921FFC1CDAD013EF0042BFD3523CDAD0118D2FD6E2126"
50   PRINT
"441680CD004001FEEF7DED50CB42280700000018071856FEDC28012CCB5A2805"
60   PRINT
"0000001805FEC228012D1603CD0040FD7521FD6E2226421680CD004001FEF77D"
70   PRINT
"ED50CB5A280500000001805FE1C28012CCB4228050000001805FE0228012D1683"
80   PRINT
"CD0040FD7522061B10FEC36440D9368009190 97EA7ED42FE762804F5F1180778"
90   PRINT
"2F47792F3C4F7E197EFE0320040000 1804FE83200EF5F1F5F1F5F1F5F1F5F1F5"
100  PRINT
"F1182E007CFE41200ADD341E000000F5F11816A7ED52FE45280CF5F1F5F1F5F1"
110  PRINT"
F5F100001813DD3400F13DF5FE1BCA0E407A2F577B2F3C5F19F1F577D9063910"
120  PRINT  "FEC36440"
260  LET     A=18000
270  LET     L$="2128400100407EFE012320FA7ED61C87"
280  GO SUB 500
290  LET L$="8787872386D61C0223037EFE0120EE23"
300  GO SUB 500
310  LET L$="7EFE7620FA237EA728DCC30E40"
320  GO SUB 500
330  LET A=USR(18000)
500  POKE A,16*(CODE(L$)-28)+CODE(TL$(L$))-28
510  LET L$=TL$(TL$(L$))
520  LET A=A+1
530  IF NOT CODE(L$)=1 THEN GO TO 500
540  RETURN
```

Simpler characters

THE PROGRAM, "Big Characters" on page 119 of September 1981 edition is interesting, writes G. J. Langford of Ickenham, Middlesex. Having spent many hours trying to convert it to work on the new 8K ROM, including an industrious search through the ROM for the character-generating area, I would like to save others similar work.

You will probably know of the simpler alterations required to employ the 8K ROM, eg., changing line 60 from

LET U$=TL$(U$)

to

=U$(2 TO)

and changing line 130 from

LETN=N/2

to

= INT(N/2)

The tricky part is line 100 as the address of the character generator in the new ROM is much higher. I find that the following works:

100 LET N = PEEK (D(S)*8 +7678+Q)

The address 7679 may be better, and the correct one, but the first one works.

Improved scrolling

THIS IS an improved program, writes Barry Allison of Warrington, Cheshire, to the one published in the September issue, which had two disadvantages: the screen blinks whenever a key is depressed, and no spaces can be entered.

This program allows spaces to be entered with Shift Q. Shifting A moves the print position 1 to the left each time it is used. This does not alter text until you start entering new keys or deleting the character to the right by Shifting Q. Lines 30 and 40 form a delay to allow the user to remove his finger from the current key and depress a new key.

```
10 SCROLL
20 PRINT "YOUR PROMPT X";
30 FOR I = 1 TO 5
40 NEXT I
50 IF INKEY$ = " " THEN GOTO 50
60 LET A$ = INKEY$
70 IF CODE A$ = 118 THEN GOTO 10
80 IF A$ = "STOP" THEN GOTO 120
90 If A$ = "SHIFT/Q" THEN PRINT "X";
100 IF A$<> "SHIFT/Q" THEN PRINT A$;
110 GOTO 30
120 POKE 16398, (PEEK 16398) — 1
130 GOTO 30
```

Invaders.

```
10   FOR R=0 TO 6 STEP 2
20   FOR C=1 TO 6
30   LET R1=R+9
40   FOR I=1 TO R1
50   LET A=I*2/R1*PI
60   PLOT C*8+2*SIN A,40 - (R*8-2*COS A)
70   NEXT I
80   NEXT C
90   NEXT R
```

Screen subroutines

THESE TWO machine-code subroutines are quite useful and effective when called from within a Basic game program, writes Harrison Ainsworth of London E17.

Down Scroll can be used to clear the screen after instructions have been printed, or it could be used in conjunction with the Scroll command to provide a dynamic way of deleting a title.

Screen Inverter is especially effective if an explosion of a space ship or a Red-Alert message needs to be enhanced. These machine-code subroutines can be located anywhere in RAM.

Screen inverter.

```
2A: 0C40     Ld HL,(16396)
06:16        Ld B,22
C5           Push BC
06:20        Ld B,32
23           Inc HL
7E           Ld A,(HL)
FE:7F        Cp 128
38:04        Jrcb+4
DE:80        Sbc A,128
18:02        Jr +2
C6:80        Add A, 128
77           Ld (HL), A
10:F1        Djnz -15
23           Inc HL
C1           Pop BC
10:EA        Djnz -22
C9           Ret
```

Down scroll.

```
2A:0C40      Ld HL, (16396)
01:B402      Ld BC, 20*33+32
09           Add HL, BC
E5           Push HL
01:2100      Ld BC,33
09           Add HL, BC
EB           ExHL,DE
E1           Pop HL
01:B502      Ld BC,21*33
EDB8         Lddr
2A:0C40      Ld HL,(16396)
06:20        Ld B,32
AF           Xor A
23           Inc HL
77           Ld (HL),A
10:FC        Djnz -4
C9           Ret
```

Individual invaders

WHEN YOU RUN this program by Richard Hooper of Gerrards Cross, Buckinghamshire, the computer prints four rows of six space invaders on the screen. Each row uses a different design, and this is achieved without using up much more space than is needed to print four rows of identical invaders. Each invader is a circle, distorted by its small radius. For each row, the number of points in the circles is increased by the Step in line 10. The number of points in an invader on the top row is given by line 30. You can experiment with these values to produce different shapes.

(continued on next page)

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Music maker

A MUSICAL SYNTHESISER program written for the ZX-81 and ZX-80 with 8K ROM, comes from Andrew Lyon of Rainhill, Merseyside. It allows the computer to play a series of notes inputted via the keyboard.

The sounds can be heard through the television speaker or, for better sound quality through the cassette recorder's speaker. For the latter, turn the tape monitor on and press the record button. To avoid the 50Hz hum between notes, the program should be run only in Fast mode, which should please ZX-80 users.

Type in line 1 with at least five spaces after Rem. When the whole program has been typed in enter the following in immediate-execution mode:

```
POKE 16515, 237
POKE 16516, 65
POKE 16517, 201
```

The program can be saved and run without any problems. If it does not work, try adding a few more spaces in line 1 or move the machine code up a few bytes.

The length of the notes can be altered by changing the value of D in line 32.

The program allows you to use keys 1 to 6, but you can add many more lines if you have enough memory. There are also some nice visual effects associated with the routine.

Music maker.

```
1    REM (5 SPACES)
2    LET  A = 16515
3    LET  D = 50
4    GO TO  1000
10   FOR B = 1 TO D
11   RAND USR A
12   NEXT B
13   RETURN
20   FOR B =1 TO D
21   RAND USR A
22   NEXT B
23   RETURN
30   FOR B = 1 TO D
31   RAND USR A
32   NEXT B
33   RETURN
40   FOR B = 1 TO D
41   RAND USR A
42   NEXT  B
43   RETURN
50   FOR B = 1 TO D
51   RAND USR A
52   NEXT B
53   RETURN
60   FOR B = 1 TO D
61   RAND USR A
62   NEXT B
63   RETURN
1000 IF INKEY $<>""THEN
     GOSUB(CODE INKEY$-28)*10
1010 GOTO 1000
```

Inkey solution

IN RESPONSE to a letter from Charles Drayson, published in the August 1980 *Practical Computing*, a Get or Inkey routine for the Sinclair ZX-80 has been devised by M A Myatt of Bedford.

```
-IN A,0      : Get port 0 into Ac
;LD 1,A      :Into L
LD H,0       : Clear H
RET          :Back to Basic
```

It can be loaded by the following program. Lines 20 to 26 may be deleted after it is run. Line 10 contains the machine code and will not run.

```
10   REM AAAAAA
20   LET A=16426
21   POKE A, 219
22   POKE A+1, 0
23   POKE A+2, 111
24   POKE A+3, 38
25   POKE A+4, 0
26   POKE A+5, 201
```

The statement LET A=USR (16426) will return the value of the key pressed. This routine works best in a short For-Next loop

```
100  FOR N=1 TO 100
110  LET A=USR (16426)
120  NEXT N
```

allowing a larger time-slot to detect a pressed key.

Number routines

TWO SUBROUTINES for use on the ZX-81 in numerical and financial programs have been devised by Douglas McFyffe of Wootton, Bedfordshire. They will also run on a ZX-80 with 8K ROM.

The error trap routine includes a moving cursor, and allows the use of keys 0 to 9 and Newline, as well as Rubout to cancel and re-enter faulty data. It calculates to two decimal places.

The program can also be amended for string input by deleting lines 220 and 290. For integer input and output line 290 must be amended.

Line 120 sets the column for the cursor to be printed at line 160.
Line 150 clears the previous cursor.
Line 250 sets X to move the cursor one column to the right, as well as printing the data input to the same column.
Line 200 tests for Rubout.
Line 210 tests for Newline.
Line 220 tests for numerical input only.
Line 270 tests for null string.
Line 290 rounds up to two decimal places.
The second routine prints decimal points.
Line 420 tests for integer.
Line 450 tests for single decimal place only, plus decimal point.

The example program shows how the subroutines can be used. Run 1000 will display prompts to enter data, and tabulates the results. Since NO is an integer, the tab for line 1210 is reduced by three to allow for the decimal point and two decimal places.

Error trap subroutine.

```
100  PRINT "ENTER *" , E$
110  PRINT AT 10,0 ; "ENTER DATA"
120  LET X = 11
130  PRINT AT 19,19; "PRESS RUBOUT",," *** TO CANCEL"
140  LET B$ = " "
150  PRINT AT 11, X - 1 , CHR$ 0
160  PRINT AT 11, X; CHR$ 177
170  PAUSE 40000
180  POKE 16437,255
190  LET A$ = INKEY$
200  IF CODE A$ = 119 THEN GO TO 310
210  IF CODE A$ = 118 THEN GO TO 270
220  IF CODE A$ < 27 OR CODE A$>37  THEN GO TO 170
230  PRINT  AT 10, X, A$
240  LET B$ = B$ + A$
250  LET X = X + 1
260  GOTO 150
270  IF B$ = " " THEN GOTO 170
280  CLS
290  LET B$ = STR$ (INT (VAL B$ * 100 + .5)  / 100)
300  RETURN
310  CLS
320  GOTO 100
```

Decimal-point subroutine.

```
400  LET X$ = "0"
410  LET Z$ = ".00"
420  IF VAL B$ <> INT (VAL B$) THEN GOTO 450
430  LET B$ = B$ + Z$
440  RETURN
450  IF LEN B$ - LEN (STR$ (INT(VAL B$))) = 2 THEN LET B$ = B$ + X$
460  RETURN
```

Subroutines in use.

```
1000 LET E$ = "VALUE OF SALES"
1010 GOSUB 100
1020 GOSUB 400
1030 LET V$ = B$
1040 LET E$ = "COST OF SALES"
1050 GOSUB 100
1060 GOSUB400
1070 LET C$ = B$
1080 LET E$ = "NUMBER OF SALES"
1090 GOSUB 100
1100 LET No =INT (VAL B$)
1110 LET B$ = STR$ (INT((VAL V$/NO) * 100 + .5)/100)
1120 GOSUB 400
1130 LET U$ = B$
1140 LET B$ = STR$ (INT((VAL C$/ NO) * 100  + .5)/100)
1150 GOSUB 400
1160 LET M$ = B$
1170 PRINT "SALES AND COST ANALAYSIS"
1180 PRINT
1190 PRINT "VALUE OF SALES", TAB (24 - LEN V$) , V$
1200 PRINT "COST OF SALES" , TAB  (24 - LEN C$) , C$
1210 PRINT "NO. OF SALES" ; TAB (21 - LEN (STR$ NO)) , NO
1220 PRINT "MEAN COST" , TAB (24 - LEN M$ ) , M$
1230 PRINT "UNIT SELLING" , TAB (24 - LEN U$) , U$
9999 STOP
```

● Circle No. 189

Getkey for UK-101

THE UK-101 lacks a Get command found in the Pet, observes J. M. Leach of Deal, Kent. It is possible to overcome this problem in Basic by a clumsy series of Pokes and Peeks to the keyboard memory location, but decoding for any possible key is quite a problem. It takes so long that it is easy to miskey entry and CTRL C has to be disabled.

A short machine-code routine, written for the new monitor, allows the user to have complete control. Cegmoners and Wemoners will have to find their own solutions.

The flag at 591 allows user control of the result of key pressing. If 591 = 1, the USR routine returns 0 at 531 if no key is pressed, but if a key is pressed, 531 contains the ASCII value of the key, and flag 591 is set to 0 before the routine returns to Basic. If 591 = 0, the USR routine returns 0 in 531, whether a key is pressed or not.

Use of the 591 flag allows the programmer to do something with the character entered; subsequently the keyboard is dead until a Poke 591,1 is encountered. This prevents unwanted multiple entry due to key bounce. Note that there is no need to disable CTRL C, and Normal Input is not affected.

UK-101 Getkey routine.

```
10 REM GETKEY Machine Code routine
20 FOR 1 = 592 TO 619: READ Z: POKE I,Z: NEXT I
30 DATA 173,79,2,240,5,32,231,249,208,4,141,19,2,96,32
40 DATA 0,253,169,0,141,79,2,169,1,141,20,2,96
50 REM LOAD, RUN and type NEW [protected from Cold Start once loaded]
60 REM
70 REM Demonstration program
100 POKE 11,80: POKE 12,2: POKE 591,1: REM Startup
110 X=USR(X): Z=PEEK(531): IF Z<> 0 GOTO 130
120 PRINT "KEY NOT PRESSED": GOTO 110
130 PRINT CHR$(Z): POKE 591,1: GOTO 110


0250    AD4F02   LDA     $024F    ; Test 591 flag
0253    F005     BEQ     $025A    ; If zero, bypass Keyboard entry
0255    20E7F9   JSR     $F9E7    ; Test for Key pressed [Monitor]
0258    D004     BNE     $025E    ; If pressed, go and decode it
025A    8D1302   STA     $0213    ; Set 531 to zero (0 in accumulator)
025D    60       RTS              ; and return
025E    2000FD   JSR     $FD00    ; Keyboard input routine [Monitor]
0261    A900     LDA     #$00
0263    8D4F02   STA     $024F    ; Zero 591 flag
0266    A901     LDA     #$01
0268    8D1402   STA     $0214    ; Spoil $FD00 comparison with $0213
026B    60       RTS              ; on next call (otherwise $FD00 waits for entry)
```

Atom debugging

THE ATOM has a very good machine-code assembler but it does not have a front panel of any kind for debugging, writes R Delaforce of Bude, Cornwall. This Break program corrects that fault by replacing the relatively simple Break routine in the Atom with a routine which displays the contents of the program counter, accumulator, X and Y registers, stack pointer and processor status.

The program is written in a hybrid of Basic and machine code, but once assembled only the machine code version is required. The machine code is assembled into 8200 hex to 8270 hex and is 113 bytes long.

The machine code is saved using the *Save command followed by the required address data — start address; end address; starting address — and is reloaded using the * Load command.

Program 1.

```
10   REM ----  TEST PROGRAM ------
20   LINK #8200 ; REM #8200 IS THE START
ADDRESS  AND  HAS TO BE CHANGED FOR  THE
ADDRESS USED.
30   A=0 ; X=0 ; Y=0
40   THIS IS AN ERROR
```

Program 2.

```
10   REM ---- M.C. TEST PROGRAM ------
20   DIM  LL1, P-1
30   [
40    :LLO  JSR #8200 \ CHANGED ADDRESS
TO REQUIRED ADDRESS OF START.
50   LDA @#0A
60   TAX
70   TAY
80   BRK
90   ]
100  END
```

The program is relocated by changing the value of variable P to the required start address; 113 bytes of memory must be free to use without affecting other function, e.g., graphics or floating point.

When used on a 12K Atom, the program can be assembled into the screen memory if graphics are not to be used or, if floating-point variables are not used, into the floating-point variable memory 2800 hex to 2900 hex. On a minimum Atom the program should be assembled into memory above the hybrid program but below the graphics VDU. It must be assembled in sections and then saved, so the sections can be joined — see section 19.5, page 142, in *Atomic Theory and Practice*.

Once assembled, the program can be used for both Basic and machine-code programs. With Basic programs, once the Break routine is in memory, a Link to the start address will set the Break vector to point to the new Break program. When an error occurs during the program, the contents of the CPU's registers will be displayed.

In a program a Link start address is only required at the start of the program. In immediate mode, a Link start address has to be made before an instruction because the Break vector is reset to the Atom's routine every time a Return is made, since it is the return key not the termination of a Basic subroutine. Program 1 tests the operation of the Break program.

When used for machine-code debugging a JSR start address is made at the beginning of the program. When BRK is encountered, the CPU's register data will be printed. Program 2 tests the operation of the Break program with a machine-code program.

Information is held at the following addresses:

202 and 203 hold the BRK routine location.
F7D1 prints a string of characters terminated with a NOP.
F7F1 prints the hexadecimal representation of a 16-bit number pointed to by the X register.
F802 prints the hexadecimal representation of the contents of the accumulator.
FFED prints a carriage return and line feed.
C2F2 is a subroutine in Basic that interprets a string of characters pointed to by the 16-bit number address stored in 05 and 06.
80 to 86 are temporary stores for the CPU's data. They may be altered to other locations.

A silenced screen

SCREEN NOISE generated when using the Atom's high-resolution graphics can often be annoying. This little program patch from W A Chadwick of Camberley, Surrey, completely removes all screen noise and is transparent to the normal graphics commands.

To ensure noise-free graphics the computer may only write to the graphics memory during the CRT's Flyback period, when the electron beam is off screen. The flyback signal from the visual-display generator chip is connected to port C. This signal can be polled to find out when the computer may have access to the video memory.

After the Atom executes any Clear statement it places the address of the point plotting for the graphics mode in use in locations 03FE and 03FF.

All that you have to do is replace this address by that of some convenient portion of RAM — typically 0080 hex — place a polling routine there and a jump to the original address from 03FE after it.

The program looks like this:

```
:LLO BIT #B002 flyback is bit 7 of port C
BMI LLO
JMP PPPP flyback asserted
```

Early on in any program include:

```
: #80= #30B0022C
: #84= #4CFB program code
```

After any clear statements include:

```
! #86=! #3FE original point-plotting routine
  address
! #3FE= #80 new point-plotting routine
  address
```

Any graphics commands — e.g., Plot, Draw or Move will then be noise-free.

This procedure has one drawback, and that is speed, but for some applications it may be of little importance. The choice is between noise and speed.

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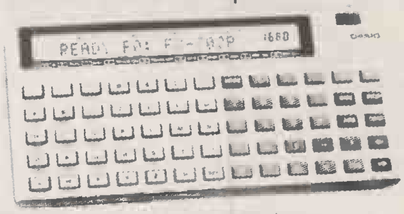

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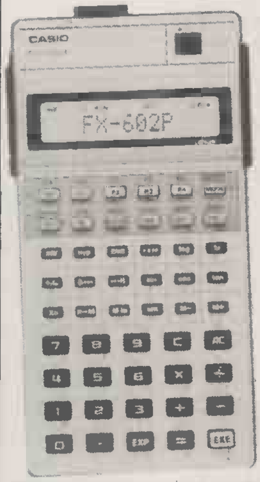

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Faster maps

A FASTER version of Paul Cole's Disc Map program, which appeared in the December 1980 issue of *Practical Computing*, comes from Michael Clark of Nottingham. A machine-code subroutine is Poked in to draw the map itself, reducing the time it takes to paint the screen from over 15 seconds to a mere fraction of a second.

The program has been implemented for DOS 3.3 — 16-sector discs — but is adaptable to 3.2. To facilitate such adaptation, and to provide a check on the entry of data in lines 150-180, a disassembly of the M/L program Poked in at line 140 is included.

Running Paul Cole's original map as part of a greeting program leads to considerable delays, hence this new version which flashes the map across the screen in an instant. It provides an interesting speed comparison between machine code and Applesoft.

Notice that the additional lines, 115 and 125, are not needed for a single-drive system. Their function is to read the numbers of the previous and present slots and drives from DOS into the IOB for the Read/Write a Track and Sector routine.

```
5  REM    A FASTER DISK MAP   (DOS 3.3)
     BY MICHAEL CLARK, AUGUST 1981

10  HOME : GOSUB 110
20  DIM B(20): TEXT : HOME : PRINT  SPC( 17)"DISK MAP": PRINT
30  PRINT "  T 0000000000111111111122222222223333     012345678901234567
8  9012345678901234  S"
40  FOR I = 0 TO 9: PRINT  SPC( 2)I: NEXT
50  FOR I = 10 TO 15: PRINT  SPC( 1)I: NEXT
60  GOSUB 140
70 U =  PEEK (7) + 256 *  PEEK (8)
80  VTAB 22
90  PRINT : PRINT  SPC( 4);: INVERSE : PRINT 560 - U;: NORMAL : PRINT " FR
    EE SECTORS  *  ";U;" USED";
100  END
109  REM   RWTS ROUTINE

110  FOR N = 3840 TO 3868: READ D: POKE N,D: NEXT
120  CALL 3840: RETURN
130  DATA  169,15,160,8,32,217,3,96,1,96,1,0,17,0,25,15,0,2,0,255,1,0,6,96
     ,1,0,1,239,216
139  REM
        ROUTINE TO PRINT MAP

140  FOR N = 4096 TO 4203: READ D: POKE N,D: NEXT : CALL 4096: RETURN
150  DATA  169,3,133,36,169,0,133,7,133,8,162,1,169,0,133,6,169,4,32,91,25
     1,230,36,165,36,201,39,240,78,230
160  DATA  6,165,6,201,9,240,24,32,102,252,126,56,2,176,240,169,32,32,237,
     253,198,36,230,7,208
170  DATA  2,230,8,76,29,16,169,0,133,6,202,230,6,165,6,201,9,240,24,32,10
     2,252,126,56,2
180  DATA  176,240,169,32,32,237,253,198,36,230,7,208,2,230,8,76,66,16,24,
     138,105,5,170,76,12,16,96,96

TO WORK WITH ANY SLOT, ANY DRIVE ADD THE FOLLOWING LINES:-

115  FOR N = 3872 TO 3909: READ D: POKE N,D: NEXT : CALL 3872
125  DATA   32,227,3,133,27,132,26,160,0,177,26,141,3,147,200,177,26,153,3
     ,147,160,15,177,26,153,3,147,200,177,26,153,3,147,169,147,160,3,96
```

```
0024:              2 CH       EQU  $24
0006:              3 COUNTER1 EQU  $06
0007:              4 COUNTER2 EQU  $07
0008:              5 COUNTER3 EQU  $08
0238:              6 BUFFER   EQU  $238
FB5B:              7 TABV     EQU  $FB5B
FC66:              8 LF       EQU  $FC66
FDED:              9 COUT     EQU  $FDED
----- NEXT OBJECT FILE NAME IS PRINT MAP.OBJO
1000:             10          ORG  $1000
1000:A9 03        11          LDA  £3
1002:85 24        12          STA  CH
1004:A9 00        13          LDA  £0
1006:85 07        14          STA  COUNTER2
1008:85 08        15          STA  COUNTER3
100A:A2 01        16          LDX  £1
100C:A9 00        17 NEWCOL   LDA  £0
100E:85 06        18          STA  COUNTER1
1010:A9 04        19          LDA  £4
1012:20 5B FB     20          JSR  TABV
1015:E6 24        21          INC  CH
1017:A5 24        22          LDA  CH
1019:C9 27        23          CMP  £39
101B:F0 4E        24          BEQ  RTN
101D:E6 06        25 ROT1     INC  COUNTER1
101F:A5 06        26          LDA  COUNTER1
1021:C9 09        27          CMP  £9
1023:F0 18        28          BEQ  SECBYT
1025:20 66 FC     29          JSR  LF
1028:7E 38 02     30          ROR  BUFFER,X
102B:B0 F0        31          BCS  ROT1
102D:A9 20        32          LDA  £$20
102F:20 ED FD     33          JSR  COUT
1032:C6 24        34          DEC  CH
1034:E6 07        35          INC  COUNTER2
1036:D0 02        36          BNE  NEXT1
1038:E6 08        37          INC  COUNTER3
103A:4C 1D 10     38 NEXT1    JMP  ROT1
103D:A9 00        39 SECBYT   LDA  £0
103F:85 06        40          STA  COUNTER1
1041:CA           41          DEX
1042:E6 06        42 ROT2     INC  COUNTER1
1044:A5 06        43          LDA  COUNTER1
1046:C9 09        44          CMP  £9
1048:F0 18        45          BEQ  ADJUSTX
104A:20 66 FC     46          JSR  LF
104D:7E 38 02     47          ROR  BUFFER,X
1050:B0 F0        48          BCS  ROT2
1052:A9 20        49          LDA  £$20
1054:20 ED FD     50          JSR  COUT
1057:C6 24        51          DEC  CH
1059:E6 07        52          INC  COUNTER2
105B:D0 02        53          BNE  NEXT2
105D:E6 08        54          INC  COUNTER3
105F:4C 42 10     55 NEXT2    JMP  ROT2
1062:18           56 ADJUSTX  CLC
1063:8A           57          TXA
1064:69 05        58          ADC  £5
1066:AA           59          TAX
1067:4C 0C 10     60          JMP  NEWCOL
106A:60           61          RTS
106B:60           62 RTN      RTS

SYMBOL TABLE    SORTED BY SYMBOL

 1062 ADJUSTX     0238 BUFFER       24 CH          06 COUNTER1
   07 COUNTER2      08 COUNTER3   FDED COUT      FC66 LF
 100C NEWCOL      103A NEXT1      105F NEXT2     101D ROT1
 1042 ROT2        106B RTN        103D SECBYT    FB5B TABV
```

RAM tester

IF YOU NEED a short program which provides a crude test of Apple's RAM chips, Roger Cullis of Cranleigh, Surrey has come up with the answer.

Lines 100 to 140 load a machine-language routine which will shift the contents of four pages of memory to a different location. Line 150 covers the low-resolution graphics page 1 screen with a uniform colour.

Line 180 writes the contents of the Lores screen buffer to a pre-determined block of RAM and then clears the Lores screen buffer. Line 190 then returns the data from the RAM block to the screen buffer.

If the reading and writing operations to the RAM block are functioning correctly, the screen display will remain unchanged and the next RAM block can be tested.

The drawback is that 64 bytes of each of the four pages of the screen buffer are used as temporary storage locations for programs stored in PROM on the peripheral boards and, since these are not used in the display, the corresponding RAM address will not be tested.

In addition, the listed routine does not completely test the memory locations corresponding to the four lines of text.

This could be corrected by a slight modification of the program, using Poke 16304,0: Poke 16302,0 to convert the display to all graphics prior to the memory shift, and Poke 16301,0 afterwards to change back to mixed text and graphics for communication.

```
1  REM  MEMORY TEST
2  REM  PROGRAM COMMENCED 18 MAY 1981
3  REM  LAST AMENDED 19 MAY 1981 (VERSION NO.2)
4  REM  COPYRIGHT 1981 - ROGER CULLIS
5  REM  PROGRAM WRITTEN IN APPLESOFT BASIC ON APPLE II WITH 48K ME
MORY
100  DATA  169,0,133,2,133,4,169,4,133,3
110  DATA  169.8.133.5.162,4,160.0,177.2
120  DATA  145,4.200.208,249,230,3,230,5,202
130  DATA  208,242.96,0.0
140  FOR I = 768 TO 802: READ J: POKE I,J: NEXT
150  GR : COLOR= 13: FOR N = 0 TO 39: VLIN 0,39 AT N: NEXT :N = 3
160 N = N + 1
170  HOME : VTAB 22: PRINT "TESTING MEMORY BLOCK "1024 * N" TO "10
24 * (N + 1)
180  POKE 775.4: POKE 779,(4 * N): CALL 768: CALL  - 1994
190  POKE 775,(4 * N): POKE 779,4: CALL 768
200  PRINT  TAB( 8)"PRESS 'RETURN' TO CONTINUE"
210  GET A$: IF A$ < > CHR$ (13) THEN  GOTO 210
220  GOTO 160
```

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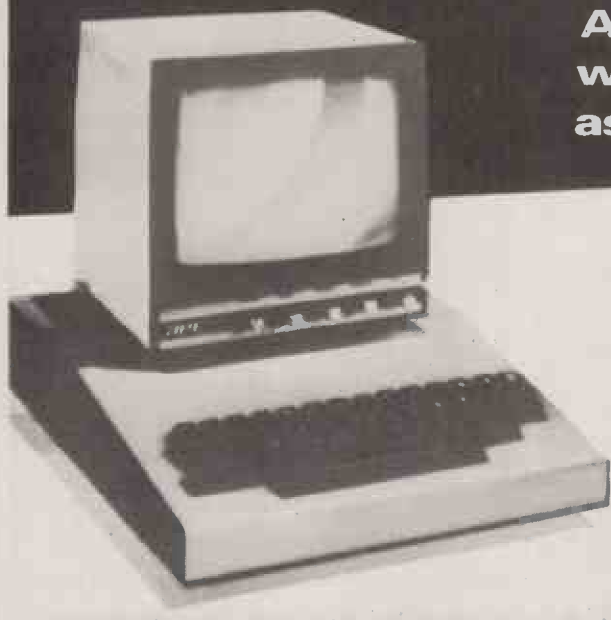

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Wait for input

WHEN RUNNING frequently-used programs, such as those for instrument-control purposes, I find I am often required to enter the same parameters every run, or else rewrite the program using constants, which leads to loss of flexibility, writes Anthony Bater of Cardiff.

This subroutine checks for a carriage-return entry before the Input command, thus overcoming the Pet's annoying habit of answering a null input with "Ready". This feature allows the use of a prompt displaying a default value which is retained if only the Return key is pressed, but which is replaced by a new input string following any other key press.

Lines 210 to 230 are the important part and should be amended to Wait 525,1 and Peek(527) for old ROMs. Those with Basic 4.0 will have to discover the relevant alterations themselves. In line 220, the Get is necessary to clear the input buffer, and the Print resets the screen display to a new line.

The remainder of the listing is merely to demonstrate possible use of the subroutine. In this case it is for resetting the internal clock, and for checking the validity of an identity code. Note that the listing contains CLS for the clear screen character, and CD for cursor down.

This subroutine hinges on the use of the Wait command, which is a very versatile, if little-used command. For example, Wait 152,1 will hold program until the shift key is pressed — very useful as it causes no entry into any input buffers and cannot be overridden by the use of the stop key.

Wait for input

```
10 REM##INPUT ROUTINE, A.J.BATER, AUG.1981
20 ID$="AJB":REM##INPUT DEFAULT VALUE
30 PRINT"(CLS)ENTER NEW IDENTITY CODE IF REQUIRED     (CD)(DEFAULT = ";ID$;")";
40 GOSUB200:IFDF=0THENID$=A$
50 PRINT"(CLS)SET CLOCK.(DEFAULT = ";TI$;") ";
60 GOSUB200:IFDF=1THEN100
70 IFVAL(A$)<0ORVAL(A$)>235959THEN10
80 IFLEN(A$)<>6THEN10
90 TI$=A$
100 PRINT"(CLS)TIME IS ";TI$
110 PRINT"(CD)YOUR IDENTITY CODE IS ";ID$
120 END
200 REM##INPUT SUBROUTINE##
210 WAIT158,1
220 IFPEEK(623)=13THENDF=1:GETA$:PRINT:RETURN
230 INPUTA$:DF=0:RETURN
```

Print facility

```
a9  0a      LDA  #10
85  7c      STA  124
60          RTS
a9  4c      LDA  #$4c
85  01      STA  1
a9  03      LDA  #$03
85  02      STA  2
a9  03      LDA  #131
85  7c      STA  124
60          RTS
c9  40      CMP  #'@
d0  08      BNE  .+8
a9  fc      LDA  #252
24  78      BIT  120
d0  05      BNE  .+5
a9  40      LDA  #'@
c9  3a      CMP  #'
60          RTS
20  75  d6  JSR  $d675
86  46      STX  70
20  76  00  JSR  $0076
20  cc  d6  JSR  $d6cc
e0  28      CPX  #40
b0  1b      BCS  .+27
a4  46      LDY  70
c0  19      CPY  #25
b0  15      BCS  .+21
8a          TXA
b6  e0      LDX  224,y
30  05      BMI  .+5
69  28      ADC  #40
88          DEY
b6  e0      LDX  224,y
86  c5      STX  197
85  c6      STA  198
b9  48  e7  LDA  $E748,y
85  c4      STA  196
84  d8      STY  216
4c  76  00  JMP  $0076
```

Print facility

PET USERS who want a Print @ facility of the kind found in certain other Basics will appreciate this machine-language code sent in by A R Browne of Mobberley, Cheshire. It can be incorporated into programs which would benefit from such a facility.

The facility which is implemented here allows the Basic programmer to specify the Y,X co-ordinates of the screen position at which he wants the next print item to start. The first co-ordinate is the line number, counting from zero, and the second is the column number, also counting from zero.

The line

```
200 PRINT @ 12,16 "COMPUTER";
```

would cause COMPUTER to be printed at the centre of the screen.

The co-ordinates can be any Basic expressions, simple or complex, since ROM-Basic routines on new ROMs are used to fetch both values. A value outside the range 0-255 will result in an illegal-quantity error. A value within this range but defining a point off the screen would result in both co-ordinates being ignored, leaving what was the current print position intact.

Once the 78 bytes of machine code have been loaded starting at 826 — Hex 033A — in the second cassette buffer, the Print @ facility can be enabled at any time by Sys(831) and disabled by Sys(826). Enabling and disabling facilities have been added because the main subroutine, at 844, works by intercepting every @ character in the Basic program. If an @ character is being used for something else, the interception must be disabled. Note that the enabling subroutine places values in the USR address at memory locations 1 and 2.

The machine code may be entered using Data statements and loaded using a Basic subroutine. Alternatively, it may be entered, saved and loaded using the Pet's monitor, Tim.

One convenient feature of the Print @ facility is that the @ Y,X component may be placed anywhere and does not have to be part of the Print statement affected by it. For example, the following is valid

```
200 @20,20 A = B + C
204 PRINT A;
```

although not ideal.

Storing strings

AS A TEACHER of computing, I found the article by Rex Tingey in the July issue on multiple-choice questions very interesting, writes W J McCormack of Brighton, East Sussex. I personally believe that this type of questioning is extremely efficient as an examination method and very useful for revision for all types of examination.

With respect to the "particular and peculiar phenomenon" when writing word data to disc, I am afraid Tingey is his own worst enemy. The Pet presumably uses the same subroutine when any Print or Print# statement is executed and this will result in the addition of line feed LF, ASCII 10, and carriage return CR, ASCII 13, characters at the end of a word. This is:

WORD 1/CR/LF/WORD 2/CR/LF/WORD 3/CR/LF etc.

Notice that the first word has no characters preceding it and is immediately followed by a carriage return. For subsequent words, a line-feed character immediately precedes them.

When reading a file using Input # — it has same subroutine as Input — characters are read and concatenated until a carriage return is encountered. For the file given, this would result in the following being read:

WORD 1 (LF)WORD 2 (LF)WORD 3

If the file contained numeric terms written in string form, then any attempt to convert back to a numeric will result in a value of zero, for example if:

A$ = "(LF)12"

then

VAL(A$) = 0.

Any searches you try will not work either. Some time ago I was writing a very complex statistical/mathematical program to predict the pools. The two teams playing were entered from the keyboard

(continued on next page)

```
100 REM***PROGRAM ONE***
110 REM***W.J.MCCORMACK***
120 PRINT"❐"
130 OPEN 2,8,2,"0:TEST DATA,S,W"
140 PRINT"ENTER TEN NUMBERS"
150 DIM A(10)
160 FOR I=1 TO 10
170 PRINT"NUMBER";I;:INPUT A(I)
180 PRINT#2,STR$(A(I));CHR$(13);
190 NEXT
200 CLOSE 2
210 PRINT"PRESS ANY KEY TO READ FILE"
220 GET A$:IF A$="" THEN 220
230 CLR:REM***TO PROVE THERE IS NO FIDDLE!***
240 DIM A(10)
250 OPEN 2,8,2,"0:TEST DATA,S,R"
260 FOR I=1 TO 10
270 INPUT#2,ZZ$
280 A(I)=VAL(ZZ$)
290 PRINT A(I)
300 NEXT
310 CLOSE 2
320 END
READY.
```

```
100 REM***PROGRAM TWO***
110 REM***W.J.MCCORMACK***
120 PRINT"❐"
130 OPEN 2,8,2,"0:TEST DATA,S,W"
140 PRINT"ENTER TEN NUMBERS"
150 DIM A(10)
160 FOR I=1 TO 10
170 PRINT"NUMBER";I;:INPUT A(I)
180 PRINT#2,STR$(A(I));CHR$(13);
190 NEXT
200 CLOSE 2
210 PRINT"PRESS ANY KEY TO READ FILE"
220 GET A$:IF A$="" THEN 220
230 CLR
240 DIM A(10)
250 OPEN 2,8,2,"0:TEST DATA,S,R"
260 PRINT"NUMBER  LENGTH  ASCII CODES OF CHARS."
270 FOR I=1 TO 10
280 INPUT#2,ZZ$
290 PRINT " ";ZZ$;TAB(9);LEN(ZZ$);TAB(16);
300 FOR J=1 TO LEN(ZZ$)
310 PRINT ASC(MID$(ZZ$,J,1));
320 NEXT J
330 PRINT
340 NEXT I
350 CLOSE 2
360 END
```

(continued from previous page)
and the program searched for the record in a file read from disc. However, apart from the team at the top — Liverpool at the time — all other teams began with the character ASCII10 (LF), and no other team was ever found: (LF) Millwall is different to Millwall.

The whole problem can be circumvented when you write a file to disc and I now always follow a standard routine.

- Convert all numeric variables into strings; it is wise not to mix numerics and strings.
- Delete the CR and LF characters by following the string variable with a semicolon.
- Follow this with a CHR$ (13); — note the semicolon, without which this would be followed by a CR and LF.
  e.g., PRINT#2, A$; CHR$ (13);

Storing numbers as strings is the method that the Pet uses anyway, not as five-byte floating points as you might imagine, so it uses the same space on disc.

The two programs illustrate these points.

Program 1 saves 10 numbers on disc; program 2 enables the user to investigate how the Pet writes variables on disc. Change line 180 to the following:

```
180 PRINT#2,A(I)
180 PRINT#2, STR$(A(I))
180 PRINT#2, STR$(A(I))
180 PRINT#2, STR$(A(I)); CHR$(13)
180 PRINT#2, STR$(A(I)), CHR$(13)
```

or any other combination you choose, to test the writing of data on disc.

Go forth and multiply

THIS MULTIPLICATION program is written in Pet Basic, but by omitting the few graphic symbols, it should run an any Microsoft machine and will evaluate the product of any two numbers of up to 127 digits each, writes Ben Enran of Rathfadden, Waterford, Eire. Accuracy is up to 254 significant digits and is not affected by the use of a decimal point.

Only numerical entries can be made and the following are not accepted:

- Leading zeros.
- More than one decimal point per number.
- More than 128 characters — 127 digits for one decimal.
- Alpha graphical characters.

Should 128 digits be entered, then the last digit entered is scratched and the calculation performed with the 127 remaining. After keying in the appropriate number, the return key should be pressed to register entry.

The program is in four sections: Lines 600 to 695 contain the input and acceptance routine; lines 230 to 370 set up the maximum-results string; lines 800 to 890 are the intermediate result evaluation; and lines 500 to 585 output the result.

Section three is looped a maximum of 126 times for a 254-digit result. Loop numbers are printed on the screen during calculation.

```
190 FORA=1TO100:NEXTA:FORA=1TO10:GETK$:NEXTA
200 REM #MULTIPLICATION - BEN J. ENRAN#
201 REM ##WATERFORD-IRELAND-17/3/1981##
205 D=0:C=0:C$="":B$="":A$="":GOSUB891
210 PRINT"ENTER NUMBER (1)":GOSUB600:A$=C$:PRINT
220 D=0:PRINT"▮ENTER NUMBER (2)":GOSUB600:B$=C$
230 GOSUB891:PRINT"▮▮ CALCULATING ▮"
235 IFLEN(A$)<LEN(B$)THENC$=A$:A$=B$:B$=C$
240 IFLEN(A$)=LEN(B$)THEN260
250 FORA=1TOLEN(A$)-LEN(B$):B$="0"+B$:NEXTA
260 FORA=1TOLEN(A$)
270 Q=VAL(MID$(A$,A,1))*VAL(MID$(B$,A,1))
280 IFQ=0THENS$=S$+"00":GOTO310
290 IFQ<10THENS$=S$+"0"+RIGHT$(STR$(Q),1):GOTO310
300 S$=S$+RIGHT$(STR$(Q),2)
310 NEXTA:IFLEN(S$)=2THEN500
320 S=S+1:IFLEN(A$)=STHEN500
330 FORA=1TOLEN(A$)-S
340 C=VAL(MID$(A$,A,1))*VAL(MID$(B$,A+S,1))
341 C=C+VAL(MID$(A$,A+S,1))*VAL(MID$(B$,A,1))
350 T=0:GOSUB800
360 NEXTA:TC=TC+1:PRINT"▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮▮";TC
370 GOTO320
500 REM #PRINTOUT ROUTINE#
540 IFDP=0THEN555
544 IFDP=LEN(S$)THENS$="."+S$:GOTO560
545 S$=LEFT$(S$,LEN(S$)-DP)+"."+RIGHT$(S$,DP)
550 IFRIGHT$(S$,1)="0"THENS$=LEFT$(S$,LEN(S$)-1):GOTO550
551 IFRIGHT$(S$,1)="."THENS$=LEFT$(S$,LEN(S$)-1)
555 IFLEFT$(S$,1)="0"THENS$=RIGHT$(S$,LEN(S$)-1):GOTO555
560 PRINT"❐";A1$;" ▮TIMES▮ ";B1$;" ▮EQUALS"
565 PRINT"▮▮";S$
570 PRINT"▮▮▮ANOTHER RUN  Y/N?"
575 GETA$:IFA$="N"THENEND
580 IFA$="Y"THENPRINT"❐":CLR:RUN200
585 GOTO575
600 C=C+1:C$="":REM #INPUT & ACCEPTANCE ROUTINE#
605 K$="":GETK$:IFK$=""THEN605
610 IFK$="0"ANDC$=""THEN605
615 IFK$=CHR$(13)ANDC$>""THEN640
620 IFASC(K$)<>46ANDASC(K$)<48ORASC(K$)>57THEN605
625 IFK$="."THEND=D+1:IFD=2THEND=1:GOTO605
630 PRINTK$;:C$=C$+K$:IFLEN(C$)=128THEN640
635 GOTO605
640 IFD=0ANDLEN(C$)=128THENC$=LEFT$(C$,LEN(C$)-1)
645 IFD=0THEN685
650 IFRIGHT$(C$,1)="0"THENC$=LEFT$(C$,LEN(C$)-1):GOTO650
651 IFRIGHT$(C$,1)="."THENC$=LEFT$(C$,LEN(C$)-1)
652 GOSUB685
655 FORA=1TOLEN(C$):IFMID$(C$,A,1)="."THEN665
660 NEXTA:RETURN
665 DP=DP+LEN(C$)-A
670 IFA=1THENC$=RIGHT$(C$,LEN(C$)-1):RETURN
675 C$=LEFT$(C$,A-1)+RIGHT$(C$,LEN(C$)-A)
680 RETURN
685 IFC=1THENA1$=C$
690 IFC=2THENB1$=C$
695 RETURN
800 Y=VAL(MID$(S$,(A+A+S+T),1))+C
810 C=INT(Y/10+.001)
820 R=INT(Y-C*10+.001)
830 R$=RIGHT$(S$,LEN(S$)-(A+A+S+T))
840 R$=CHR$(48+R)+R$
850 IF(A+A+S+T-1)<1THEN870
860 R$=LEFT$(S$,(A+A+S+T-1))+R$
870 S$=R$:R$="":T=T-1
880 IFC>0THEN800
890 RETURN
891 Z$="❐▮▮  MULTIPLICATION  BY  BEN J. ENRAN  * "
892 Z$=Z$+"▮▮▮▮▮   PET BASIC  --  MARCH 17TH 1981   *❐▮*"
893 Z$=Z$+" ▮▮****************************************▮▮▮▮"
   :PRINTZ$:RETURN
```

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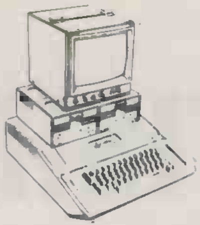

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THEZEUS AND SON

ALAN DIBLEY, creator of Thezeus and Son of Thezeus, is one of the most successful and least-rewarded mouse builders in Europe. Working on his own, he has built two mice that have succeeded in solving a maze. He came third at the English final and, after a disastrous last-minute software blunder, seventh in the European final. When I learnt he would be in London for a week — he lives in Cheddar — I invited him to put his two mice under the microscope.

Both Thezeus and Son of Thezeus use a Sinclair ZX-80 as their brains. Alan believes the ZX-80 is better than the ZX-81 — it has faster integer arithmetic and uses less memory to store variables. To save weight Dibley believes the best mix might be a ZX-81 with a ZX-80 ROM — but would it work?

by Mike Hughes

The major advantages of using a ZX-80 or ZX-81 are:

- A built-in monitor and Basic interpreter to make software writing and debugging easy.
- A reliable cassette interface for saving and loading mouse programs.
- A separate, plug-in power supply, so that there is no need for a mouse to lug a transformer around.
- A built-in TV Interface.
- A built-in sensor interface — normally used for the keyboard.

Dibley carries a battery portable TV-radio-cassette around with his mice so that he always has a complete development system available. His only complaint is that the portable cost him more money than both mice put together. To save weight and reduce size, and for aesthetic reasons, Dibley has made the following modifications:

- The ZX-80 keyboard is sawn off and reconnected with a ribbon cable and plug-and-socket assembly. The carriage return key CR is duplicated on the mouse. After setting up the mouse, you key Run, disconnect the keyboard, place the mouse in the maze and key CR.
- A 4K RAM pack is taped to the top of the ZX-80 and joined up with a ribbon cable and an edge connector.

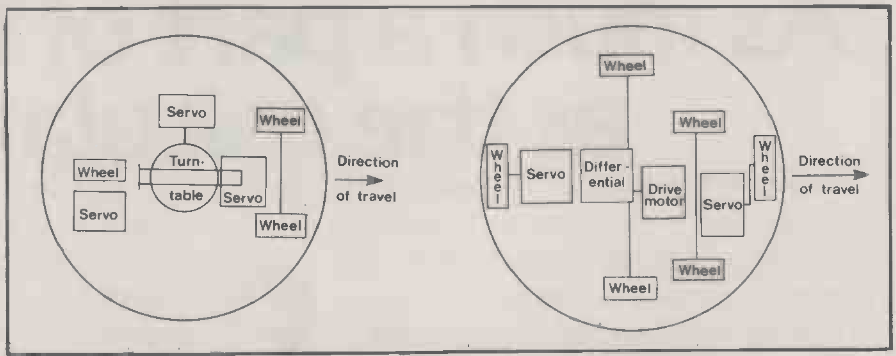


Figure 1. Drive arrangements for Thezeus (left) and Son of Thezeus.

The bases and wheels of Thezeus and Son of Thezeus are built out of plywood held together with glue, nuts and bolts and modellers' pins. Motive power comes from three radio-controlled servos on Thezeus, and two servos and an electric motor on Son of Thezeus — you might have guessed that Alan Dibley's other hobby is building and flying radio-controlled gliders.

The mechanics of the designs are somewhat complex overall, although each component is simple — the general layout of Thezeus is shown in figure 1. Thezeus runs on three wheels: the rear wheel is driven by a servo, and the front ones control straight-line running via mechanical servos and links.

Steering is not controlled by the ZX-80. The 90° turns needed at corners and complete about-turns for dead ends are performed using a rotating turntable. One servo operates a lever arrangement to raise and lower the turntable. The sensors are simultaneously pulled in by nylon thread or levers to eliminate the possibility of jamming.

Lowering the turntable engages a cog on the second servo which turns the mouse. A microswitch operates on a disc with four dents to tell the ZX-80 when a 90° turn has been completed.

One of the real highlights of the English final was watching Thezeus pull in its sensors and, insect-like, lift itself off the ground, spin and settle down again with its sensors out. Its one drawback was that it was very slow.

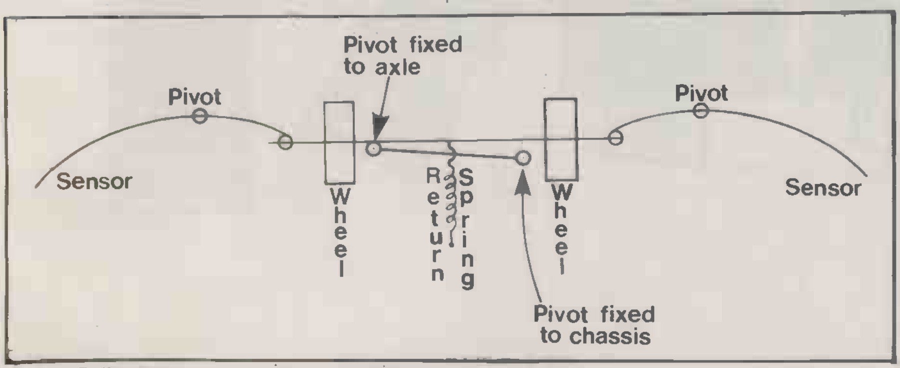


Figure 2. Panhard rod steering used for Son of Thezeus.

Son of Thezeus is outlined in figure 1. It is a high-speed version of Thezeus which runs at about 7in. per second. It has the same steering linkage as Thezeus but power is supplied by an electric motor through a differential to two centrally-mounted wheels. Stopping the motor locks the differential which then forces the mouse to spin about its axis.

Turning is accomplished in two stages. The front wheel, which does not normally touch the ground, is lowered first. It then pulls in the sensors, lifts the steering wheels off the ground and lowers the rear wheel to the ground by racking the mouse backwards on the drive wheels. The rear servo-driven wheel then turns the mouse about its axis.

Although faster than Thezeus, Son of Thezeus is less attractive because of its mechanical instability. In particular, under hard acceleration it tends to do a wheelie, lifting its steering wheels and bouncing its near turning wheel on the ground.

Rubber tyres

Both Alan Dibley's mice use Panhard rod mechanical steering which is his pride and joy, and contributes to the complete reliability he has achieved. The principle is shown in figure 2. When the left sensor hits a wall it is pushed back, pulling the left wheel forward and turning the mouse away from the wall. The axle turns on the pivot fixed to the chassis, with the return action provided by an elastic band. Like many others, Dibley has also discovered that thick, brown elastic bands make very good tyres.

All the power requirements for Alan Dibley's mice are met by four high-discharge 1.2-volt AA Nicad cells. The ZX-80 will run satisfactorily from 4.8 volts connected directly to the 5-volt output on the rear connector. Fully charged Nicads last for about 20 minutes, and when the mouse is stationary the standard Sinclair 9-volt supply can be connected without any ill-effects.

How to program and interface the 6800

By Andrew C Staugaard, Jr. Published by Sams 1980 in the U.S. U.K. price £10.35. Prentice-Hall. Paperback. ISBN 0 672 216841.

STAUGAARD'S fat volume is a comprehensive, self-teaching manual on coding the Motorola 6800 microprocessor. Although the book would be of some use to anyone wishing to learn assembly language for computing and process control, the details and development experiments are based on two 6800 trainers.

These are the Heath ET 3400 and the Motorola MEK 6800D2. Of the two, the Heath is far more versatile; the Motorola development kit drops out of this course early.

The nine chapters, ranging from fetch/execute/reset fundamentals to system interfacing, each consist of detailed, reasonably well-written text and sample codes, several hands-on experiments, and a variety of assessment questions. The workshop material is extremely well presented.

Appendices skate over digital electronics basics and the principles of computer arithmetic for those new to or rusty in those areas. I doubt however if a real novice would find them in any way comprehensible. The 6800 instruction set and specifications of all chips used are also reproduced in full.

Conclusions

- **Likely to be very valuable to those with the necessary knowledge, incentives and equipment.**
- **For others, a fair treatment of assembly coding, but not outstanding enough for purchase for this purpose alone.**

Eric Deeson

TRS-80 interfacing. Book 1

by Jonathan A Titus. Publishers Howard W Sams and Co. ISBN 0 672 21633 7. Price £5.80. Paperback. 190 pages. Aimed at the Model I user with 4K level II Basic or more.

THIS BOOK and its companion book 2 are part of a series produced by the Blacksburg Continuing Group based in the

U.S., which has been involved in the American hobbyist market for several years.

Book 1 consists of three sections; the first contains four chapters. Chapter one deals with the Z-80 processor, memory, I/O devices and software-control instructions. Chapter two explains I/O device address decoding and device addressing. Chapter three covers I/O parts and memory-mapped I/O, and chapter four explains I/O synchronisation, flags and interrupts.

Each topic is clearly explained with a reasonable number of examples. Various integrated circuits which can be used for latches and decoding are discussed and truth tables provided.

This section takes the beginner through to a reasonable understanding of the principles of interfacing the model TRS-80. The second section, chapter five, offers a description of the construction and use of an interfacing board which plugs into the edge connector on the rear of the model 1 keyboard. This provides the basis for examining the functions of various integrated circuits such as analogue-to-digital converters.

The third section contains 18 experiments in interfacing using the interfacing board and provides an extension to the first section which the author suggests could be used as a course in schools. The experiments bring together the hardware construction and software skills needed to control external devices.

The interfacing board is available in this country from E and L Instruments Ltd, Wrexham, as the IF-100 Interface Box, price £150 built or £115 in kit form, or the printed-circuit board can be obtained from Techniques Inc, 235 Jackson Street, Englewood, New Jersey, U.S., price $29.95 plus tax and postage.

Despite having only a brief knowledge of construction, I chose to be ambitious and construct the board from scratch using a 233mm.-by-160mm. Eurocard from R S Components of Birmingham. This involved some conversions of the circuit but did allow the lay-out of the integrated circuits to be kept.

The approximate cost using this method is £90, and I was pleasantly surprised to find that it worked first time. However, I would not advise the novice to do this unless he knows of a more experienced constructor who can help him in the event of problems.

To assist with construction and fault-finding, clear schematics of each section of the board are provided. These are power supply, logic probe, device and memory decoders, bus buffers and control circuitry. The board has its own power supply via a 12.6V AC transformer or similar and provision for other voltages can be made in addition to the +5V available.

I discovered no errors in the experiments I tried, which were carefully explained with questions and answers, and constructing the board taught me a great deal about the principles of interfacing.

Five appendices are provided — two are parts lists for the board and the experiments, the other three give details of logic functions, Z-80 microprocessor technical data, and the printed-circuit board artwork. A useful and comprehensive index is also provided.

Conclusions

- **£5.80 is expensive for a 190-page paperback, but the information provided is excellent and useful even if one does not construct the board.**
- **The interface board and experiments will cost at least £100, but a school or college may have some of the components available and it provides a good starting point for interfacing more advanced projects and for teaching the principles of interfacing.**

Michael Trott

Database analysis and design

By Hugh Robinson. Published by Chartwell-Bratt, Old Orchard, Bickley Road, Bromley, Kent BR1 2NE.

ANY BOOK on computing which has, as the heading to the first chapter, a quotation from a spaghetti Western, deserves to be taken seriously:

> In these parts a man's life may depend on the existence of a mere scrap of information. —
> *Don Miguel, A Fistful of Dollars.*

An author with so catholic a sense of humour is likely to be a good teacher, able to draw on life to illustrate an argument and able to keep complex subjects in a sane perspective. *Database analysis and design* is coherent and thorough.

The author's style is deceptively simple and leads you through the architecture of a database system, relational database systems and other systems such as hierarchical, inverted file and networks as fundamental material.

Two other sections deal with the analysis and design of databases. Once you have started reading the chapter on conceptual models, the book becomes difficult to put down.

The word "professional" is often abused, frequently by those who protest too much about their social status. The technical skills used by a doctor are powerful and potentially dangerous. It is the exercise of those skills within an agreed framework of ethics which prevents misuse and elevates doctors into a professional group.

In the same way, the technical skill which allows a person to create and manipulate a database on a computer is open to abuse, and Chapter 11 of *Database analysis and design* contains an excellent section dealing with data privacy and data security which should be required reading for anyone who works with computers.

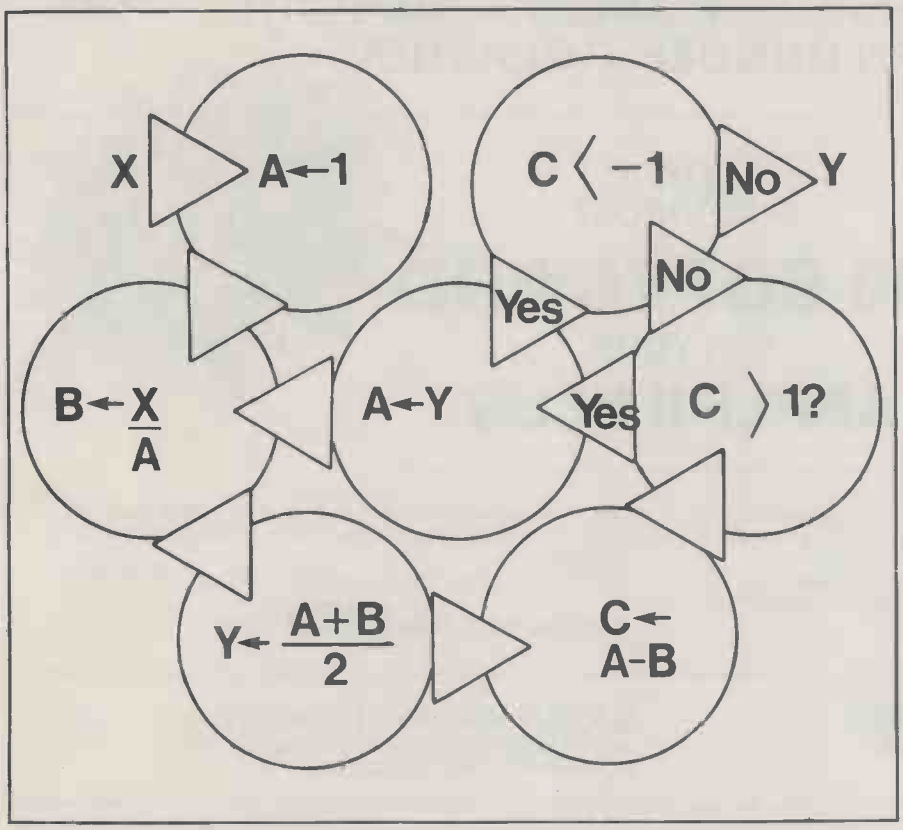
Conclusions

- **The book is attractively laid out and well produced and should provide a point of reference in a fast-moving field.**
- **Worth keeping close at hand.**

John Dawson

Flowchart

by Tony Roberts

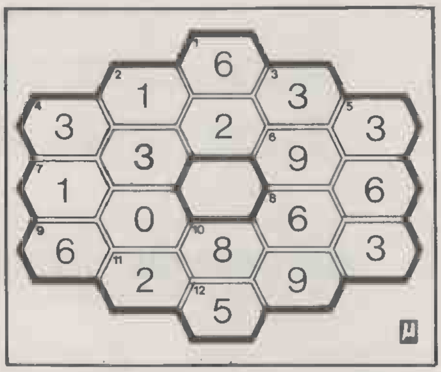


THIS strange diagram in fact defines a relationship between an integer X and a result Y. The X is fed in at the top left-hand corner, and, after a moment or two, Y appears at the top right.

What is the relationship?

November solution

THE SOLUTION to the Figure ring puzzle which appeared in the November issue of *Practical Computing* is as follows:



Index

A cumulative index to Volumes 1 to 4 of *Practical Computing*, 1978 to 1981, compiled by Nigel Martin.

*An asterisk against a page reference indicates that it contains information to debug a program referred to in the preceding page reference.

SHOPWINDOW

BUYERS' GUIDE

The Buyer's Guide to microcomputers is a summary of low-cost computers available in the U.K. It appears every third month; we add new computers and amend existing information, as required, to keep it up-to-date. Systems are listed by manufacturer.

Microcomputers

ACORN COMPUTERS

Systems 1, 2, 3, 4, 5: 6502-based. 1-32K RAM COS or DOS. Hex or full keyboard. Personal, scientific business or educational use. Disc module, CMOS RAM Card, 80-by-25 character VDU interface, 8K static memory, analogue interface, daisywheel printer interface, cassette interface, VDU, laboratory interface, in-circuit emulator, universal interface, PROM program, Econet interface, switched-mode PSU. Software includes, Pascal, Lisp, Forth, floating-point extension, ONLI extension. System 1-3 Reviewed September 1979.	*From £65 for System 1 kit; £285 for System 2 kit; £670 for System 3 kit*
Atom: 6502, 2-12K RAM, up to 40K external memory, full keyboard, Basic in ROM, high-resolution graphics, cassette and TV interface, parallel port, I/O lines. Should eventually be able to link into a ring. Acorn Computers Ltd., 4a Market Hill, Cambridge CB2 3NJ (0223) 312772. Reviewed November 1980.	*From £130*

ALAN PEARMAN LTD

Maple: Z-80A, 16-64K RAM, S-100 bus, CP/M, 8in. discs, RS232 serial and parallel. Sold mainly as Micro-APL system. Alan Pearman Ltd., Maple House, Mortlake Crescent, Chester CH3 5UR. (0244) 46024.	*From £2,450*

ALPHA MICRO

AM-1010, AM-1051: WD-16, 64K-16MB RAM, S-100, four 8in. up to 90MB hard discs, RS232 up to 20 ports. Alpha Micro, 13 Brunswick Place, London N1 6ED. (01) 250 1616.	*From £7,500*

APPLE COMPUTERS

Apple II Plus: 6502, 16-48K RAM, 8K ROM, colour graphics, 5¼in. discs, general use. Own bus. Reviewed October 1979.	*From £695*
Apple III: 6502A with supporting chips, giving it a superset of 6502 instruction set. 96-128K RAM, colour graphics, integral 5¼in., RS232, four 50-pin expansion slots. Microsense, Finway House, Hemel Hempstead, Hertfordshire HP2 7PS. (0442) 48151.	*P.O.A.*

ATTACHE

Attache: 8080, 64K RAM, S-100, parallel port, 8in. discs, business system. Friargrove Systems Ltd., 494 Great West Road, Hounslow, Middlesex. (01) 572 3784. *From £1,737 to £7,000*

BASF

System 7100: Z-80A, 64K RAM, RS232, 5¼in. discs, business systems. MPR, 4 Fitzroy Square, London W1. (01) 388 4200. *From £4,937*

BILLINGS

BMS: Z-80A, 64K RAM, 8in. 200MB hard discs, business system. Mitech Data Systems, 8 Guildford Road, Woking, Surrey. (04862) 23131. *From £4,295*

BL MICROELECTRONICS

Biproc: Z-80 or TMS9980 kit, 1K RAM, 2K monitor, RS232, cassette, TV. BLM, 1 Willow Way, Loudwater, High Wycombe, Buckinghamshire HP11 1JR. (0494) 443073. *From £150*

BLEASDALE COMPUTER SYSTEMS

UDS: 8080, Z-80, 6809, 32K-1MB, Multibus, CP/M, 5¼in., 8in., hard, RS232, four parallel ports, IEEE 488, development system. Bleasdale Computer Systems, Francis House, Francis Street, London SW1. (01) 828 6661. *P.O.A.*

BMG MICROSYSTEMS

BMG MS 5000 RANGE: 8085 or 8086, 64-768K RAM, CP/M, MP/M, BOS 8in. discs or Hard Disc — 40Mbytes, 20Mbytes of which are in an exchangeable cartridge. Up to 8 remote VDU's and printers. BMG Microsystems Ltd., Micro House, Hawksworth, Swindon, Wiltshire SN2 1DZ. (0793) 37813. *From £6,000*

BRUTECH ELECTRONICS

BEM: Single-board processor with 6502 and no RAM. Data Precision Equipment, 81 Goldsworth Road, Woking, Surrey GU21 1LJ. (04862) 67420. *From £133*

BYTRONIX MICROCOMPUTERS

Megamicro: 8080/Z-80, 64K RAM, 8in. discs, CP/M. Business and University use. Bytronix, 83 West Street, Farnham, Surrey GU9 7EN. (0252) 726814. *From £6,080*

CANON BUSINESS MACHINES

Canon BX-1/BX-1d: 6800, 64K RAM, 5¼in. integral, RS232, V24 ports, business use. Canon Business Machines, Wadden House, Stafford Road, Croydon, Surrey. (01) 680 7700. *From £3,250*

COMMODORE BUSINESS MACHINES

Pet: 6502, 8-32K RAM, IEEE ports, integral 9in. screen, personal and general use. Reviewed August 1979. *From £460*

8000 Series — SuperPet: Upgrade of original Pet. 12in. screen, 5¼in. discs, business and general use. Reviewed October 1980. *From £895*

Kim-1: 6502, LED six-digit display, 1K RAM, cassette and Teletype interface, evaluation board for 6502 chip, Commodore Business Machines, 818 Leigh Road, Slough Industrial Estate, Slough, Berkshire. (75) 74111. Reviewed November 1978.	*From £99.95*

COMPSHOP

UK101: 6502, 4-8K RAM, TV interface, RS232, full keyboard, single-board, personal use, similar to Ohio Superboard. Compshop, 14 Station Road, New Barnet, Hertfordshire EN5 1QW. (01) 441 2922. Reviewed May 1980.	*From £199 for kit*

COMPUCOLOR

Compucolor II: Z-80, 8-32K RAM, 5¼in. integral discs, 13in. colour VDU, RS232. General use. Dyad Developments, The Priory, Great Milton, Oxfordshire OX9 7PB. (08446) 729. Reviewed June 1979.	*From £998*
Copernicolor II: 8080A, 8-32K RAM, 5¼in., 8in. and Winchesters available, VDU, RS232 bus, standard ASCII keyboard with optional keyboards available, graphics 128 by 128, Basic, assembler, Fortran. Based on Compucolor II, wide range of software. General use. Copernicus Ltd., 7 Wey Hill, Haselmere, Surrey. (0428) 52888.	*From £1,200*

COMPUCORP

655-675: Z-80, 60K RAM, own OS but will run CP/M with modifications, RS232, IEEE and others optional. 1-4 5¼in. discs, 16 by 80 VDU. Business use. Barnet House, 120 High Street, Edgware, Middlesex. (01) 952 7860.	*From £2,595 to £4,750*

COMPUTER CENTRE

Minikit: Z-80, 16K RAM, serial and parallel, 5¼in., CP/M, S-100.	*From £800*
Maxikit: Z-80, 16K RAM, serial and parallel, 8in., CP/M, S-100. Computer Centre, 9 De la Beche Street, Swansea SA1 3EX.	*From £911*

COMPUTERMART

Computermart 2000 range: Z-80A, single/multiple, 16-256K, CP/M, S-100 bus, graphics, 8in. single-density double-sided 180MB hard disc, general/business use. Computermart, 60 St. Faiths Lane, Norwich, Norfolk. Norwich 615089.	*From £6,000*

COMPUTHINK

Act System 800: 6502, 48K RAM, full keyboard, graphics, 5¼ or 8in. discs, 12in. VDU integral. Business system. Act, 66-68 Hagley Road, Edgbaston, Birmingham B16 8PF. (021) 455 8686. Reviewed February 1980.	*From £4,000*

CROMEMCO

Single Card Computer: Z-80, S-100, 1K RAM, 20mA/RS232. OEM and industrial use.	*From £273*
Z2: Z-80, 31A power supply, motherboard, 21 sockets, serious hobbyist and OEM use. Reviewed February 1979.	*From £573*
Z2-H: Z-80A, 64-512K RAM, S-100 bus, CDOS, 10MB formatted fixed disc, two 5¼in. discs, hard discs up to 70MB.	*From £5,373*
System 2: Z-80A, 64-512K RAM, S-100 21 slots, CP/M, VDU, two 5¼in. discs, hard discs up to 70MB. Multi-channel interface available. General/business use.	*From £2,095 to £6,408 for seven users*

System 3: Z-80A, 64-512K RAM, S-100, CP/M, two or four 8in. discs, hard discs up to 70MB, general/business use. Datron Microcentre, 2 Abbeydale Road, Sheffield S7 1FD. (0742) 585490. Microcentre, 30 Dundas Street, Edinburgh EH3 6IN (031) 556 7354. Comart, P.O. Box 2, St. Neots, Huntingdon, Cambridgeshire PE19 4NY. (0480) 215005. — *From £3,568 to £8,304 for seven users*

DATA APPLICATIONS

DAI Personal Computer: 8080, 48K RAM, colour graphics, 20 Eurocard industrial interface modules, RS232, industrial use. Data Applications, 168 Dyer Street, Cirencester, Gloucestershire GL7 2PF. (0285) 2588. Reviewed February 1981. — *From £595*

DIGITAL DATA ELECTRONICS

SPC/1: 8085, 32-48K RAM, own OS, COMAL, Assembler and Pascal, graphics, up to three 5¼in. drives, up to four 8in. drives, 10MB Winchester, up to four 20MB cartridge, many ports. DDE, Clark House, Pump Lane, Hayes, Middlesex. (01) 573 8891. — *From £1,995*

DIGITAL MICROSYSTEMS

DSC-3: Z-80, 64K RAM, CP/M, 8in. discs, hard discs up to 28MB, RS232/V24, business and general use. — *From £3,445*

DSC-4: Z-80, 128-512K RAM, CP/M, 8in. discs, hard discs up to 28MB, RS232, RS422, business and general use. — *From £3,995*

Hex-29: AMD 2900, 16-bit, 64K-1,024K RAM, Hex bus, 8in. discs, hard discs up to 28MB. Eight to 32 Ports, RS232. Modata, 30 St. Johns Road, Tunbridge Wells, Kent TN4 9NT. (0892) 41555. Extel, 73/5 Scrutton Street, London EC2A 4TA. (01) 739 2041. — *From £6,445*

DURANGO

F85: 8085, 64K RAM, own bus and OS, graphics, four RS232 ports, integral 9in. VDU, 9 x 9 printer, keyboard and two 5¼in. disc drives. General use. Comp Ancilliaries, 64 High Street, Egham, Surrey. (07843) 6455. — *From £7,500*

DYLE HOUSE

System 2000: Z-80, 64K RAM, dual 8in. discs, own OS, business use. Dyle House, 36 Abbot Way, Wellingborough, Northamptonshire. (0933) 79135. — *P.O.A.*

DYNABYTE

Dynabyte 5000: Z-80, 32-64K RAM, S-100, CP/M, MP/M, CP/Net, RS232, 5¼ or 8in. discs, hard discs up to 96MB, expands to multitask/user system. Business use. Microtech Ltd., Waterloo Road, Uxbridge, Middlesex UB8 2YW. (0895) 57780. — *From £1,600 to £12,000*

EACA

Video Genie EG3003: Z-80, 16-48K RAM, S-100, CP/M, 5¼in. discs, RS232, personal and general use. Lowe Electronics, Bentley Bridge, Chesterfield Road, Matlock, Derbyshire DE4 5LE. (0629) 2430. Reviewed February 1980. — *From £369*

ECS MICROSYSTEMS INC

Aristocrat: Z-80A, 32-180K RAM, 12K PROM, dual 5¼in. drives, 964K. Three RS232 and one parallel port, CP/M, wide range of protocols, business and general use. Telecomputing Systems Ltd., Seacourt Tower, Westway, Oxford. (0865) 723621. — *From £3,950*

EQUINOX

200: Z-80, 64-512 RAM, S-100 bus, CP/M, Omnix, MicroCobol, MVT FAMOS, cartridge disc, six serial and one parallel port, business use. *From £7,500*

300: WD-16, 64-256K RAM, S-100 bus, CP/M, Omnix, MicroCobol, MVT FAMOS, cartridge disc drive, six serial ports, business use. Equinox, 16 Anning Street, New Inn Yard, London EC2A 3HB. (01) 729 4460/(01) 739 2387. *From £10,500*

EUROCALC

Euroc: 8080, 64K RAM, 8in. discs, 15in. VDU, CP/M, business use. Eurocalc, 55/56 High Holborn, London WC1. (01) 405 3113. *From £8,000*

EXIDY

Sorcerer: Z-80, 48-55K RAM, S-100, RS232, CP/M, 5¼in. discs, MBasic, CBasic, Pascal, Algol, Fortran, Cobol, plug-in ROM pack programs, Separate VDU. Liveport, The Ivory Works, St. Ives, Cornwall TR26 2HF. (0736) 798157. Reviewed May 1979. *From £749*

GNAT

System 10: Z-80, 65K RAM, own bus, CP/M, graphics, 5¼in. discs, RS232, RS449, 12in. VDU, full keyboard, optical IEEE. Business use. Millbank Computers, 98 Lower Richmond Road, London SW16. (01) 788 1083. Reviewed December 1980. *From £2,995*

HAYWOOD

Systems 1000-8000: Z-80, 32-65K RAM, 6000 is S-100, 3000 single-board, CP/M, graphics, 5¼in. discs, three serial and parallel ports. Business, scientific and general use. Haywood Electronics Assoc., 11 Station Approach, Northwood, Middlesex. (01) 428 9831. *From £2,359*

HEATH/ZENITH

H8: Single-board WH8 assembled, 8080, 16K-65K RAM. Heathbus nine slots, cassette interface, nine-digit LED. *From £321*

Z89: Z-80, 16-48K RAM, CP/M, integral 5¼in. drive, optional dual external, two RS232, full keyboard, 12in. VDU. *From £1,570*

WH-11A: LSI-II, 16-bit 16-32K RAM, own bus and OS, optional dual 8in. drives, serial and parallel ports. Heath Ltd., 11b Bristol Road, Gloucester GL2 6EE. (0452) 29451. (01) 636 7349. *From £1,250*

HEWART

6800Mk II: 6800 single-board, 1K monitor, 1K user RAM, 1K VDU RAM, 128byte scratchpad, education and home user. S-50 bus. *From £155*

6800S: 6800, 16K monitor, 8K Basic in ROM, graphics, 5¼in. drive. Hewart, 95 Blakelow Road, Macclesfield, Cheshire. (0625) 22030. *From £229*

HEWLETT-PACKARD

85A: 16-32K RAM, 32K ROM, IEEE 488, RS232, graphics, 5¼in. drives, integral 32 by 16 VDU, integral thermal printer, QWERTY and numeric keypad. Scientific use. Hewlett-Packard, King Street Lane, Winnersh, Workingham, Berkshire. (0734) 784774. *From £1,830*

SHOPWINDOW

SHOPWINDOW

HYTEC MICROSYSTEMS

H-3000: Z-80A, 4MHz, 32-128K RAM, two minifloppy discs, standard I/O, two parallel, three serial ports, single board. *From £2,381-£2,640*

H-4500: Z-80, 64-208K, two minifloppy discs, standard I/O, two parallel, three serial ports. 4MHz option. *From £3,110*

H-7000: Z-80A, 4MHz, 32-128K, two 8in. floppy discs, standard I/O, two parallel, three serial ports. *£3,350*

IMAGE DATA PRODUCTS LTD

Image Data Eight: 6802, 4-40K RAM, 43-way bus, own OS, Basic assembler and editor, viewdata-style graphics, up to four 5¼in. discs, up to 12 RS232 ports. Image Data Products, 1-4 Portland Square, Bristol BS2 8RR. (0272) 40248. *£500-£4,000*

INDUSTRIAL MICROSYSTEMS

Series 5000: Z-80, 16-56K RAM, CP/M, S-100, two or three 5¼in. discs, two serial and one parallel port, desk unit, business and general use. *From £1,500*

Series 8000: Z-80, 64-256K RAM, S-100, CP/M, MicroCobol, MVT FAMOS, Omnix, two, three or four 8in. disc drives, two serial and one parallel port, desk unit, business and general use. Equinox, 16 Anning Street, New Inn Yard, London EC2A 3HB. (01) 739 2387/(01) 729 4460. *From £2,500*

INSTAR

Omegar: 16-bit, 48-256K RAM, dual floppies, hard discs, up to 12 simultaneous users, business use. *From £7,500*

Asatayd: Z-80, 16-56K RAM, dual floppies, CP/M, S-100 bus, business use. Instar, 61 High Street, Croydon, Surrey CR0 1QD. (01) 680 5330. *From £4,950*

INTERTEC

Superbrain: Z-80, 64K RAM, 256 static RAM, dual Shugart, optional hard disc, CP/M, S-100 bus, business and general use. Encotel, Succombs Hill, Upper Warlingham, Surrey. (820) 5701. Sun, 138 Chalmers Way, North Feltham Trading Estate, North Feltham, Middlesex. (01) 751 6695. KGB, 88 High Street, Slough, Berkshire. (75) 38581. Icarus Computer Systems Ltd., 27 Greenwood Place, London NW5 1NN. (01) 485 5574. Reviewed April 1980. *From £1,495*

ITHACA INTERSYSTEMS

Pascal Micro DPSI: Z-80, 64K-1MB RAM, full IEEE S-100 bus, CP/M version 2.2, graphics, 8in. and hard discs, RS232, four parallel and two serial ports per S-100 board. Ithaca Intersystems, 58 Crouch Hall Road, London N8 8HG. (01) 341 2447. *From £4,258*

ITT

2020: Built under licence from Apple. See entry under Apple II. ITT, Star House, Mutton Lane, Potters Bar. (77) 51177. *From £827*

KEMITRON ELECTRONICS

UDS 3000: Z-80, 1-64K RAM, Kbus, own OS, CP/M, 8in. and hard discs, ports up to 256. Kemitron Electronics. (0244) 21817. *From £640 to £4,000*

LOGABAX

LX-500: Z-80, 32K RAM, S-100, CP/M dual 5¼in. drives, business use. LogAbax Ltd., 1-7 Wesley Avenue, London NW10. (01) 965 0061. *From £3,000*

LSI COMPUTERS

M-One: 8080, 8-16K RAM, own OS, dual Shugart 8in. drives, two serial and one parallel port, 12in. VDU and full keyboard. Business use. *From £5,995 with software package*

M-Two: 8085, 64K RAM and 4K EPROM. Launched in December 1980. LSI Computers, Copse Road, St. Johns, Woking, Surrey GU21 1SX. (04862) 23411. *P.O.A.*

LUXOR

ABC 80: Z-80, 16-40K RAM, 12in. VDU, IEEE 488, RS232, 5¼in. drives, loudspeaker, personal and education use. CCS Microsales, 7 The Arcade, Letchworth, Hertfordshire ST6 3ET. (04626) 73301. *From £795*

MICRO V

Microstar: 8085, 64K RAM, three RS232, serial inputs, StarDOS, twin 8in. drives, general use. Data Efficiency Ltd., Maxted Road, Maylands Avenue, Hemel Hempstead, Hertfordshire. (0442) 63561. *From £4,950*

MICROMATION

Z-Plus: Z-80, 64K RAM, S-100 bus, CP/M, MP/M two serial and six parallel ports, business use. Rostronics, 115-117 Wandsworth High Street, London SW18 4HY. (01) 874 1171. Reviewed May 1980. *From £3,950 to £8,550*

MICRONEX

MX-100: Z-80A, 64K RAM, S-100 bus, RS232, CP/M, Pixel graphics display system, twin 8in. drives. Micronex, Harford Square, Bristol BS18 8RA. (027) 589 3042. *From £3,485*

MIDWEST SCIENTIFIC INSTRUMENTS

MSI 6800: 6800, 16K-56K RAM, 5¼ or 8in. or hard discs up to 10MB. Systems 1,2,7 and 10. System 7 runs Flex, MSI, DOS and SDOS, RS232. System 10 is System 7 with hard disc. Business use. Strumech (SEED), Portland House, Coppice Side, Brownhills, Walsall, West Midlands. (279) 4321. Reviewed March 1980. *From £1,100 to £12,000*

SHOPWINDOW

MODULAR BUSINESS SYSTEMS

Tutor: 8085, 32-64K RAM, Intel Multibus, CP/M, optional graphics, twin 5¼in. drives or four 8in., two RS232 serial ports. — *From £2,500*

Elite: 8085, 32-256K RAM, Intel Multibus, CP/M, 5¼in. to 24MB hard discs, RS232, 24-bit TTL programmable port. Modular Business Systems, 21 Chappel Lane, Yeadon, Leeds LS19 7NX. — *From £5,400 to £25,000*

NASCOM

Nascom 1: Z-80, 2-64K RAM, serial and up to 16 parallel ports, 8K Microsoft Basic, 1K monitor in EPROM. Personal use. Reviewed January 1979. — *From £125*

Nascom 2: Z-80, 1K RAM expandable to 256 with Nascom System 80 case. Nasbus, 8K Basic, 2K monitor and 2K character generator, low/high resolution graphics and colour. 5¼in. single or twin floppy discs, RS232, parallel port, Kansas City cassette port. Nascom Microcomputers, 92 Broad Street, Chesham, Buckinghamshire. (02405) 75151. Reviewed April 1980. — *From £295*

NATIONAL MULTIPLEX

Pegasus: Z-80, 48K RAM, S-100 bus, 5¼in., 8in. drives, CP/M, 12in. VDU, business use. London Computer Store, 43 Grafton Way, London W1. (01) 388 5721. — *From £2,700*

NEWBURY LABORATORIES

7768: CPU board, 4K RAM, cassette and VDU interface, up to 64K RAM, kit only. — *From £45*

NewBrain: Z-80A, 2K static RAM plus 4K static or 16K dynamic, RS232 ports, 16-character, LED display, hand-held. Newbury Laboratories, King Street, Odiham, Hampshire. (025) 671 2910. — *From £155 for model without LED*

NEWTRONICS

Elf II: Single-board on 1802, 256bytes to 64K RAM, Hex keypad, RS232 I/O and VDU interface, optional keyboard, machine code, tiny Basic, full Basic, assembler/disassembler, Text Ed, personal, R & D, and educational. — *From £50 for kit*

Explorer 85: 8085, 4-64K RAM, S-100 bus, RS232, VDU interface, CP/M, TV and cassette interface, personal and full business system. Newtronics, 255 Archway Road, London N6. (01) 348 3325. — *P.O.A.*

NORTH STAR

Horizon: Z-80A, 16-56K RAM, 5¼in. twin drives, S-100 bus, own OS, business, educational or scientific use. Comart, PO Box 2, St Neots, Huntingdon, Cambridgeshire PE19 4NY. (0480) 215005. Equinox, Kleeman House, 16 Anning Street, New Inn Yard, London EC2A 3HB. (01) 729 4460. Reviewed April 1979. — *From £995 to £2,500*

OHIO SCIENTIFIC

Ohio Superboard and Challenger 1: 6502, 8K Basic in ROM, 2K monitor, 4K RAM, full keyboard and VDU interface. Hobbyist use. Reviewed June 1979. *From £160*

Challenger 2: 6502, 48K RAM, dual 8in. drives, serial port, low-cost business use. *From £1,500*

Challenger 3: 6502, Z-80 and 6800, 48-56K RAM, OSI 48-pin bus, serial port for VDU, CP/M, expands to eight users, 10, 20 and 75MB hard disc, business use. *From £2,300*

Challenger 4: Similar to Challenger 1 but 64 by 32 display, colour and sound option. U-Microcomputers, Winstanley Industrial Estate, Long Lane, Warrington, Cheshire WA2 8PR. (0925) 54117/8. CTS (0706) 79332. Millbank, 98 Lower Richmond Road, London SW16. (01) 788 1083. Reviewed September 1979. Mutek, Quarry Hill, Bath, Wiltshire. (0225) 743289. *From £450*

PANASONIC

Panasonic: 8085, 56K RAM, full keyboard, integral 24 by 80 VDU, integral twin 5¼ or 8in. floppy drives. Three RS232, business use. Panasonic Business Systems, 9 Connaught Street, London W2. (01) 261 3121. Reviewed June 1979. *From £4,150*

PROCESSOR TECHNOLOGY

Sol: 8080, 16K RAM, S-100 bus, 5¼in. drives, VDU integral, business system. Comart, PO Box 2, St. Neots, Huntingdon, Cambridgeshire PE19 4NY. (0480) 215005. Reviewed July 1979. *From £1,750*

RAIR

Black Box: 8085A, 64-512K RAM, mini-floppy discs, up to sixteen RS232C serial ports, 5MB and 10MB hard discs, IEEE 488 interface, CP/M and MP/M, general and business use. Rair, Wellington House, 6-9 Upper St. Martins Lane, London WC2H 9EQ. (01) 836 6921. Reviewed November 1979 and August 1980. *From £2,750*

RCA

Cosmac: 1802 micro with Hex pad and TV interface. Machine-code programming with Tiny Basic option. HL Audio, 255 Archway Road, London N6 5BS. (01) 348 3325. *From £79 for kit*

RESEARCH MACHINES

380-Z: Z-80, 4-56K RAM, RS232, CP/M, twin 5¼ or 8in. discs, high-resolution graphics. Sold principally to higher and secondary education. Reviewed December 1978. *From £830 to £3,500*

SHOPWINDOW

280-Z: Board verson of 380-Z. Research Machines, PO Box 75, Mill Street, Oxford. (0865) 49791. — *From £722 for 4K version*

ROCKWELL

Aim-65: 6502, 1-4K RAM, full keyboard, RS232, discs, hobby use. Portable Microsystems, Forby House, 18 Market Place, Brackley, Northamptonshire NN13 5SF. (0280) 702017. Reviewed July 1979. — *From £250*

SALMON ELECTRONICS

Archives: Z-80 at 4MHz, CP/M, S-100, serial and parallel I/O, 12in. display, 5¼in., 8in. or 19MB hard disc or 8in. Winchester, 104 keys including 23 configured for Wordstar. Salmon Electronics, PO Box 26, Croft-on-Tees, Darlington. (0325) 721368. — *£3,400*

SATTCO

Databoard 4680: Z-80, 16-64K RAM, own bus, full-colour graphics, 5¼in., 8in. and hard discs up to 10MB, 64 interface units. General use. Microsystems Technology, PO Box 5, Knutsford, Cheshire WA16 9DU. (0565) 52911. — *P.O.A.*

SD SYSTEMS

SBC-100: Z-80, 1-48K, S-100 bus, Basic in 8K ROM, four ROM sockets, optional 5¼in. drives, RS232 serial and parallel, single-board. Reviewed January 1981. — *From £155*

SD-100/200: Z-80, 64-265K RAM, 8K PROM, S-100 bus, RS232, CP/M, 12in. VDU, twin 8in. drives, business, industrial and general use. Barcellos, Kimberley House, Vaughan Way, Leicester. (0533) 26584. — *From £3,750*

SEN ELECTRONICS

Organiser: Intel 8085, 64K RAM, multi-user Basic, 8in. drives or 20MB hard discs, three RS232, business use. SEN, 5 London Street, Chertsey, Surrey KT16 8AP. (09328) 66744. — *From £7,500*

SGS-ATES

Nanocomputer: Z-80, 6-64K RAM, Gamma bus, 2K NC-2 monitor in ROM, Basic as option, RS232, cassette interface, Hex keypad. Midwich, Hewitt House, Northgate Street, Bury St Edmonds, Suffolk IP33 1HQ. Reviewed October 1979. — *From £350*

SHARP ELECTRONICS

MZ-80K: Z-80, 16-48K RAM, 10in. integral VDU, integral cassette, loudspeaker, 5¼in. disc optional, general use. *From £480*

PC-1211: Pocket computer. Programmable in Basic with cassette interface. Sharp Electronics, Sharp House, Thorp Road, Newton Heath, Manchester M10 9BE. (061) 205 2333. Reviewed July 1980. *From £85*

PC-3200: Z-80, attractive package for business use with separate keyboard and computer unit, printer, display and twin 5¼in. drives. Software now available on-line and conversion for CP/M being developed. *From £3,500*

SINCLAIR RESEARCH

MX-14: 8060, 256bytes user memory to which ¼K RAM can be added, Hex pad, cassette interface, seven-digit LED, single-board. Reviewed May 1979. *From £39*

ZX-80: Z-80A, 1-16K RAM, 4K Basic in ROM, cassette and TV interface, touch-sensitive keyboard, educational use, 22 graphics. Sinclair Research, 6 Kings Parade, Cambridge CB2 1SN. Reviewed July 1980. *From £79 for kit*

ZX-81: Z-80A, 1-16K RAM, 8K Basic in ROM, cassette and TV interface, printer soon available, touch-sensitive keyboard, education and games use. Animated-display facility. Two modes, fast with screen blinking, slow without. Reviewed June 1981. *From £49 for kit*

SINTROM ELECTRONICS

Perlflex 630/48: Z-80A, 32-48K RAM, S-100, CP/M, twin Micropolis 5¼in. discs, two serial and three parallel ports. *From £1,995*

Perlflex 1024/64: Z-80, 64K, S-100, CP/M, dual 8in. discs, two serial and three parallel. Sintrom Electronics, Arkwright Road, Reading, Berkshire RG2 0LS. (0734) 85464. *From £2,750*

SIRTON COMPUTERS

Midas Range: Z-80, from 8K RAM, S-100 or IEEE bus, CP/M, MP/M, graphics, up to four 5¼in. or 8in. drives, hard disc, RS232, 8-bit parallel, IEEE 488. Sirton Computers, Unit 14, 29 Willow Lane, Mitcham, Surrey CR4 4NA. (01) 640 6931. *£785-£2,150*

SMOKE SIGNAL

Chieftain 511-821: 6800/6809, 32-64K RAM, S-50 bus, Flex DOS68/68d/69 dual 5¼in., 8in., dual RS232, video board, wide range of options, general use. Windrush Micro Designs, Gaymers Way, North Walsham, Norfolk. (069) 245189. *From £1,807*

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MICRO WANTED — 48K or 64K, complete with discs etc. Cash waiting. 01-501 1122, 01-888 8216, Mr Bernard.

SUPERBRAIN 64K QUAD. Over £1,000 worth of software. Diablo 1500 with tractor feed and stand (needs attention). Private sale, no VAT, bargain at £1,995. Phone: 01-989 0430.

GIVEAWAY — SORCERER 32K, 630K double disc unit, prof monitor, S100 bus with 5 slots + disc controller fans fitted, extensive software included in price. Details by phone. Worth £3,800 without software, offers, £1,600. Phone: 0222 568286 or 0222 27336.

HIGH QUALITY Computer Grade Tape Cassettes (C60), certified error free, £1.25 inc. p&p each in library box, 4 or more £1 each inc. p&p. S. L. J. Gilinsky, 15 Thornhill Park, Sunderland SR2 7LA.

ACORN ATOM 12K + 12K, full floating point and graphics, originally £300+, only £245 ono. St Ives, Cambridge. (0480) 67884.

ACORN ATOM 24K, power supply, manual, leads, colour board, excellent condition and value, £200 ono. Tel: 01-561 4176 weekends only.

ZX81 ARCADE GAMES 4K in machine code. New Space Invaders, 49 aliens, flying saucer, deflector shield. Galaxy Invaders, independently moving aliens, random directions. Suicide Mission, moving backgrounds, obstacles, missiles, alien installations, bombs and laser. Asteroids. £3.95 each on tape or send SAE for details. J. Steadman, 6 Carron Close, Leighton Buzzard, Beds LU7 7XB.

PRACTICAL COMPUTING No 2 to date for sale. Offers to: S. Reid, 6 Culloden Crescent, Arbroath DD11 1JX.

PET 8K 2001 SERIES, excellent condition, games, green screen, toolkit, dust cover and many manuals, £325 ono, must sell soon!! Ring: 01-790 6437.

TRAILS OF DOOM — An exciting 48K Apple program with full graphics, £5.50. Tel: 0279 52846 after 6pm weekdays.

VIDEO GENIE software. Mathstech 1 — numerical integration, Ellipse co-ordinates, Mensuration, Series (arithmetic & geometrical progression), menu driven, graphics. £8. Beginners series — programs 1 & 2 (Peek & Poke, ASC11, Inkeys, etc). Available now on one cassette. £8. Cheques/POs to T. Smith, 26 Wesley Grove, Portsmouth, Hants PO3 5ER.

YOUR ZX80 can now play an intelligent game of Connect Four (need 3K). Cassette and listing, only £2.50. Send to Francis, 26 Machrie Drive, Helensburgh, Dunbartonshire.

SOLID STATE TECHNOLOGY

Athena: 8085, integral dual mini-floppies and mini-cassette, and matrix printer, can be expanded with 10 micros beyond CPU. Memory to 1.2GB. Claims performance similar to DEC PDP-11/34. Butel-Comco, 50 Oxford Street, Southampton, Hampshire SO1 1DL. (0703) 39890. — *From £3,000*

SORD COMPUTER SYSTEMS

M200 Range: Z-80A, 64K RAM, S-100 bus, Sord OS, graphics, 5¼in., 8in. or hard discs, two RS232, integral 80 x 24 VDU. Business use. Midas Computer Services Ltd, 2 High Street, Steyning, Sussex. (0903) 814523. — *From £1,850 to £6,950*

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S/09: 6800, 128K RAM — 380K RAM, Uniflex, OS, support up to 16 users in foreground and background mode. Southwest Technical Products, 38 Dover Street, London W1X 3RB. (01) 491 7507.

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SJL 8000: Z-80A, 64-208K RAM, integrated database system to user specifications, 8in. discs to 4MB Winchester to 80MB. Sun Computer Services, 60 Broad Lane, Hampton, Middlesex. (01) 979 9824. — *From £8,000*

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Sym-1: 6502, 4K-64K RAM, port-expansion kit, TV interface, Kim software, hobbyist use. Newbear, 40 Bartholomew Street, Newbury, Berkshire. (0635) 30505. — *From £160*

TANDBERG DATA

TDV Series: 8080A, 32-64K RAM, Intel bus, 4K Basic disc system in ROM, one plus three 8in. discs, or 2.5MB disc cartridge, eight ports, semi-graphics, CP/M version available, educational use. Tandberg Data, 81 Kirkstall Road, Leeds, LS3 1HR. (0532) 35111. — *From £4,000*

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Model 1: Z-80, 4-48K RAM, RS232, Level I and Level II Basic in ROM, separate keyboard and 12in. VDU, small business and personal use. Reviewed November 1978. — *from £349*

Model 2: Z-80, 64K RAM, integral 8in. disc, integral 12in. VDU, detachable keyboard, CP/M serial and parallel ports, Level III Basic, business use. Tandy, TRS-80 Division, Bilston Road, Wednesbury, West Midlands WS10 7JN. (021) 556 6101. Reviewed March 1980. — *From £1,995*

Model 3: Z-80, 4-48K RAM, 12in. display, integral unit with slots for two 5¼in. drives, 65-key keyboard, 12-key data pad, printer interface, compatible with Model 1 software. — *From £499*

TANGERINE COMPUTER SYSTEMS

Microtan 65: 6502, 1-48K RAM, Tanbus, IEEE 488, Tanbug in ROM (1K), Pixel graphics, 5¼in. discs, 32 I/O lines and three serial ports, from single-board upwards. Tangerine Computer Systems, Forehill, Ely, Cambridgeshire. (0353) 3633. — *From £69*

TECHNALOGICS

TECS: 6800, 56K RAM, Basic and Prestel terminal software, RS232, two cassette ports, two parallel ports, 5¼in. discs. Technalogics, Windmill Works, Station Road, Swinton, Manchester M27 2BU. (061) 793 6323. Reviewed November 1979. — *From £895 for kit*

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TMZ-80: Z-80, 64K RAM, CP/M, MP/M, CP/Net, twin 8in., up to 32MB hard discs, multi-user business use. Terodec, 17 The Gallop, Yately, Camberley, Surrey. (0252) 874790. — *From £3,000*

TEXAS INSTRUMENTS

TI-99/4: 990 16-bit, 16K RAM, Basic in 26K ROM, high-resolution, colour graphics, up to three 5¼in. discs, joystick, cassette and other ports, RS232, personal use. Texas Instruments Ltd., Manton Lane, Bedford MK41 7PU. (0234) 67466. Reviewed August 1980. — *From £950*

TRANSAM COMPONENTS

Triton: 8080, 32K RAM, CP/M, 1K TBIOS in ROM, up to three 5¼in. discs, or four 8in., serial and parallel ports. Reviewed December 1979. — *From £296*

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STARTREK ZX81. Full 16K, the best and toughest on tape, £3.50 for tape. JWV, 139 Allington Drive, Strood, Kent.

UK101, REPORICLE, a tiny editor, interpreter and compiler for writing video games. Unsuitable for women. Supplied with instructions and two demonstration programs. £13 inclusive. 59 Copeland Avenue, Mirehouse, Whitehaven, Cumbria.

IBM Printer pin feed or platen. Aculab TRS80 interface 6 golfballs perfect. £295. 01-328 1888 day, 01-444 8954 night.

MZ-80K PROGRAMS. 5K Dogfight £3, 10K Lunalander 10K Silverstone £3.50, 26K Adventure £4.50. Any 2=£1 off; 3=£2 off; All 4=£10. Also anti-LIST, 2-key entry £1; Both £1.50. G. Smith, 7 St. Davids Grove, B'ham, B20 1BT.

PET 3022 Tractor Printer, IEEE connector, as new, £295. Tel. Heathfield (04352) 2499 day.

VIDEO GENIE/TRS 80, Superboard/UK101 owners: We have enhancements / expansions for your computer including; input/output boards, programmable sound generator, Eprom programmer & more and various mod's! S.A.E. for info/price list to: Mr. B. Mistry, 75 St. Margaret's Road, Bradford BD7 2BY.

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TRS-80 16K LEVEL II, screen, cassette deck and manuals, hardly used. £400 ono. Tel: Burton-on-Trent 65779.

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ZX-81 16K software, Wordex, Statement, Zonopoly. Send S.A.E. for details to Richard Emery, 14 Verwood Road, Headstone Lane, Harrow, Middx.

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Cx504: Z-80A, 64K-208K RAM, CP/M, MP/M, MicroCobol 20MB Winchester disc, cartridge tape back-up, 8in. floppy disc, four RS232 interfaces. Business and general use. Transdata Limited, Battlebridge House, 87-95 Tooley Street, London SE1. (01) 403 5115. *From £7,990*

ULBRICH AUTOMATION

Powerhouse II: Z-80, 16-32K RAM, RS232, 5in. internal VDU, integral mini-cassette, 2K monitor, IEEE, 14K Basic DOS, OEM users. Powerhouse Microprocessors, 5 Alexander Road, Hemel Hempstead, Hertfordshire HP2 5BS. (0442) 42002. *From £1,200*

VECTOR GRAPHIC

MZ: Z-80, 48K-64K RAM, CP/M, 5¼in. discs, optional graphics, serial and parallel ports. Business and general use. Almarc Data Systems, 906 Woodborough Road, Nottingham (0602) 625035. Reviewed October 1980. *From £2,300*

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Pascal Microengine: MCP1600, executes P-code directly, 64K RAM, own bus, 5¼in., 8in. or hard discs up to 18MB, two RS232, two parallel ports. Pronto Electronics Systems, 466-478 Cranbrook Road, Gants Hill, Ilford, Essex IG2 6LE. (01) 554 6222. *From £2,295*

ZENTEC

ZMS-70: 8080A-1, 32-64K RAM, up to 12K ROM, dual integral 5¼in. discs, 600MB, RS232, integral 15in. VDU, 16 function keys. Zigal Dynamics Ltd., Bank Chambers, 13 High Street, Chesham, Buckinghamshire. (02405) 75681. *From £4,000*

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MCZ Series: Z-80, 64K RAM, RIO OS, Zilog bus, optional graphics, 8in. discs, and hard discs, four RS232, one parallel, stand-alone or networking. Zilog (U.K.) Ltd., Babbage House, King Street, Maidenhead, Berkshire. (0628) 36131. *From £3,000*

Mike Costello presents a selection of war games and simulations from *The War Machine*, starting with a space strategy game reviewed by Ralph Kirby.

Galactic Empire

GALACTIC EMPIRE is a totally strategic game concerned with the simple problem of conquering the known galaxy. It's a real-time game which should strike a chord with you if you prefer not to have all the time in the world to work out the next move.

The time rate is, of course, an accelerated one since interstellar travel takes place at the speed of light. Sitting in front of a TRS-80 screen for 1,000 years may be someone's idea of heaven but it probably is not yours.

The aim of the game is to start from a single planet called Galactica, and use your fleet of space fighters and military transports to expand the empire through the galactic cluster of various distinct worlds.

The game is marketed by Adventure International, and is available for the Apple and the 16K TRS-80. My version was quite difficult to load, which I blame on Adventure International — in my experience, American software is always very difficult to load. Once the program was successfully loaded I saved the game for future use.

The display shows your position in the galaxy, your available resources and what control mode you are in. You have four control modes:

Attack
Embark
Computer
Orders

The first two are obvious in function, just do not attack an Empire planet.

Three aspects

Calling the computer gives you access to three types of information. Using Star Maps you can study a whole galaxy map of 20 stars or a local map of the closest stars. You can use a range-finder to discover the distance between stars. These maps are excellent, and one of the best parts of the game presentation.

A Planetary Directory gives you data on the planets you have scouted but not landed on before. Status Reports tell you what scout ships are out and what ships are being built.

The Orders subroutine allows access to the four officers of the Command ship. Lieutenant Starbuck is in charge of scouting missions and will send out exploratory missions to any planet. Navigator Kirman will set up a course to these planets for the fleet, activated by the Embark control.

Lieutenant Bayliss is in charge of three aspects of the game:

Taxation, where credits can be levied from a subject population according to their population level.
Ship building, where you can satisfy your megalomania by spending the credits to good effect.
Recruitment, where you can find your cannon fodder.

Finally Dr Henderson of Cryogenics allows you to speed away the years. Remember that travel is at the speed of light and the game lasts 1,000 years, so this facility can be quite useful: 1,000 years should be enough time to emulate the Asimov's "Mule".

Three types of space ship form part of the fleet under the command of your computer from the deck of the Command ship:

Fighters — expensive air-superiority units for use against advanced planets.
Transports — cheaper ground-attack units which you must remember to fill with cannon fodder. They are needed to take all planets.
Scouts — the cheapest vehicles which are used to find out the population and technological level of a planet.

A new galactic map is generated for each game, making the game much more enduring in its attraction. The display and presentation is excellent, so it provides a good source from which to steal subroutines. The planets themselves are randomised with respect to their population and technology although the names are fixed. As the distances vary too, this plays an essential part in the game strategy.

You are provided with 1000 credits, 100 fighters, 100 transports and five scouts at Galactica to begin with. The first thing to do is to fill the transports. Empty transports are unable to attack planets.

The primary element of game strategy is to try to do things in the correct order. Mistakes can add years to the game. Next, you must tax Galactica, build ships and send out scouts.

The best strategy I have found is to find two planets which are closer then three light years, of which one is advanced enough to allow you to build ships. It is helpful if you have a high population too, to provide tax to build the ships. Then your fleet can shuttle between the two planets, building and taxing to your heart's content.

Technology v. population

The distance between the planets is critical: after five years without contact, returned scouts and newly-built ships go native and disappear. If you use Dr Henderson you must wake up every five years too. It is possible to cheat by stacking ship-building programs on top of each other, but this trick is self-limiting due to restricted storage space for data.

Air-superiority combat depends on the technological level and population versus ship numbers. Ground attack take the form of population versus ship numbers, so planets with large populations and low technology can thrash you.

There are no important bugs. The number limit of the computer itself can crash the programs if you amass too many credits. I did find the ship-ordering system tedious, but it could easily be improved to allow groups of up to five years to be ordered at once.

The time spent travelling between planets can also become boring as it takes 15 seconds per light year or six minutes for 30 light years — 30 light years is the size of the cluster. Cryogenics could have been built into the system to short circuit this delay.

Conclusions

Galactic Empire is a fun game. I have had it for a year or so and still play it once in a while.

- There is a lot of pleasure to be gained from working out the optimum game strategy, though there is no feeling of playing against an intelligent opponent. It should appeal to SF fans even if they are not — yet — computer enthusiasts.
- **Ratings:**

Physical quality	**Fair**
Perceived complexity	**Good**
Subject complexity	**Fair**
Realism	**Good**
Play balance	**Excellent**
Overall	**Good**

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The ADCOM 8/8 is a completely self contained, general purpose data acquisition and control system that plugs directly into your ZX81 computer.

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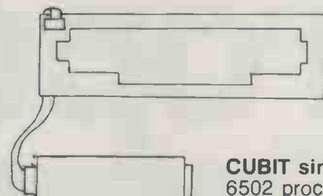
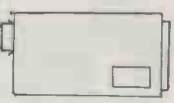
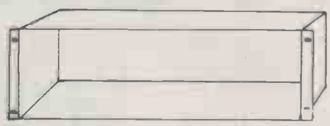


CU-KEY £40
53 key high quality keyboard (non-encoded).

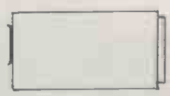


CUBIT single board computer £83
6502 processor, 6522 i/o chip (VIA) 4K bytes 2114L RAM, 4K byte ROM.
CUBOS cubit operating system £20



EURORACK with buffered backplane. For 14 cards £98
For 7 cards plus disk £69
For 4 cards £55

ACORN VDU card, 25 line display, colour, teletext type, 40 col. £100
Monochrome, 80 column £150



CUMEM holds eight memory devices in two independent banks, can include up to 16K battery — backed CMOS RAM or 64K ROM £60

CUBIO 64 channel i/o card
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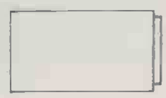
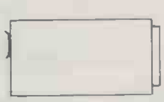
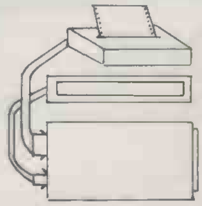


CUBAN (the "Wireless World" interface) 16 eight bit analog inputs, one eight bit analog output and 16 digital i/o channels £120

FUTURE PLANS



CU-GRAPH. Graphics processor and printer interface. Very high resolution colour graphics, up to 48K bytes display approx **£180**



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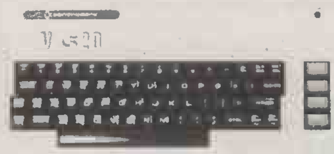
the vic centre

Adda Computers Ltd., a major supplier of computer systems to industry and business, have opened the Vic Centre in West London. Here you can see, discuss and buy everything to do with the new VIC 20 personal computer—in person or by mail. Hardware, software, technical advice and information is available from an experienced staff. Even if you already own a VIC 20, get on our mailing list to know about new developments. Remember—everything has the backing of Adda's reputation, and there's a full 12-month warranty on all hardware. The Vic Centre is easy to reach—Just off the A40, close to North Acton tube station.

Not just a computer but a whole expandable system



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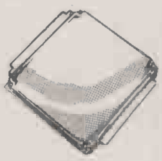
- ★ PRINTER—80 COLUMN, 30 CHARACTERS-PER-SECOND

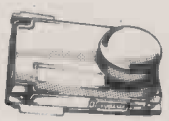
First time users can operate it immediately with plug-in program cartridges, and using your own colour T.V. to get up to 24 colours on screen, four different sound tones and even write your own programs in BASIC. The VIC-20 lets you build a system as needs and budget dictate, so that your VIC-20 can be more than just a personal computer.

VIC-MEMORY 3K £44.85
Small size—low cost memory expansion. Plugs into Vic and reproduces memory-port. Can be used with other expansions gives a total of 6k user static ramon Vic.
FEATURE This board allows Vic to move Basic to begin at 1024 ($0400) as in Pet, and enables the use of HIGH RESOLUTION COLOUR GRAPHICS



VIC-LIGHT PEN £28.75
This high quality light pen works in both normal and Hi-Res modes on the Vic allowing simple interaction with the Vic without keyboard entry.
Easy to program and easy to use.
e.g. Menu selection. Non-keyboard entry. Teaching Games.
FEATURE touch sensitive "Enter" contacts to eliminate accidental entry.

VIC-RS232 INTERFACE £56.35
Fully implemented (true levels) RS232C-V24
BI-DIRECTIONAL INTERFACE
Allows Vic to work as Mainframe Terminal Drive a Qume Daisywheel or a Paper Tape Punch etc. etc.
FEATURE This unit contains master power supply which supports Vic's own supply when carrying Memory Expansions. Cassette Drives. Light Pens. Printers etc.



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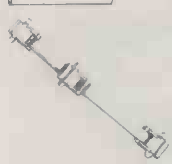

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VIC software Each of these tapes £14.95
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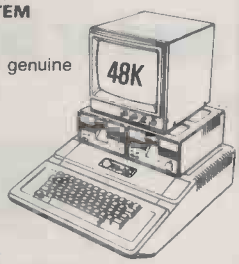

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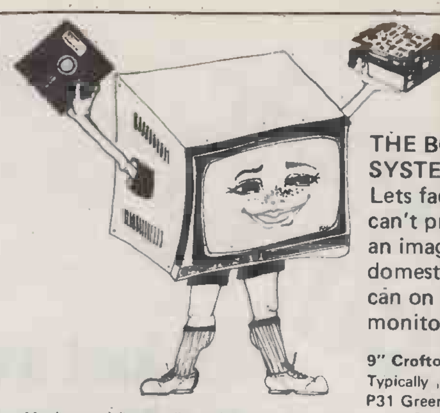

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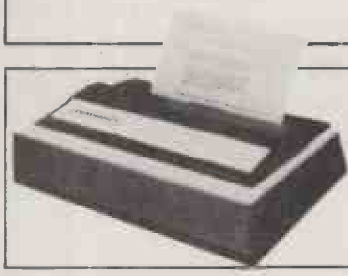

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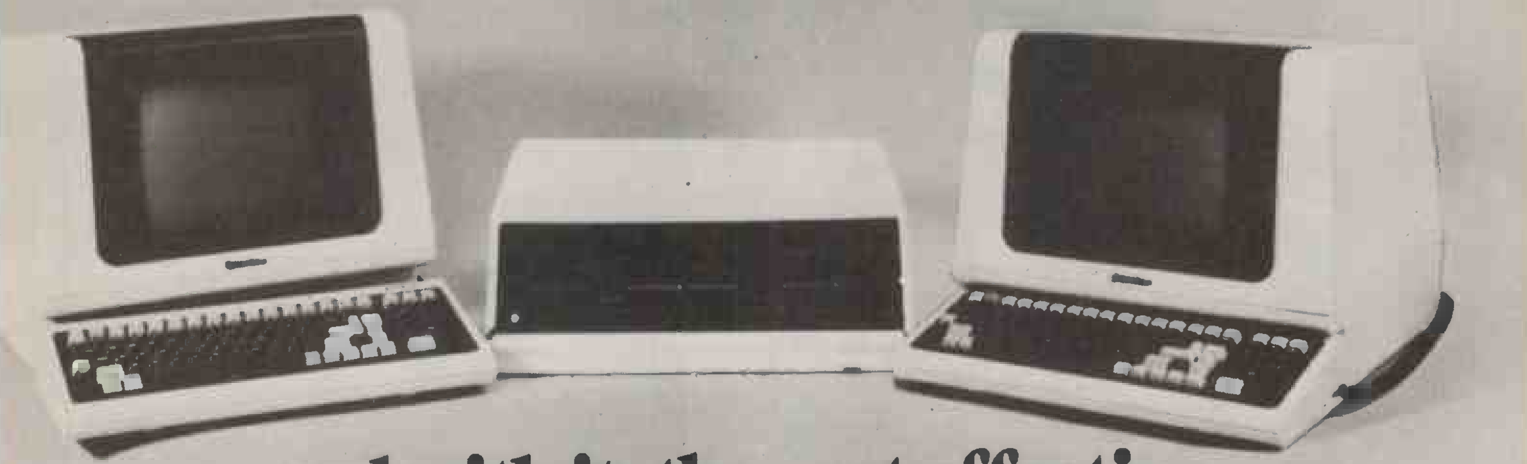

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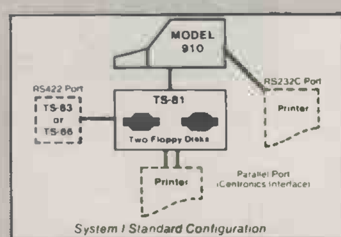

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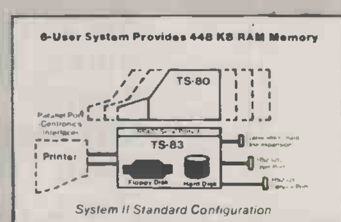

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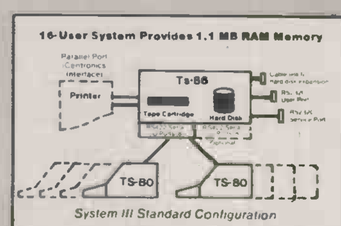

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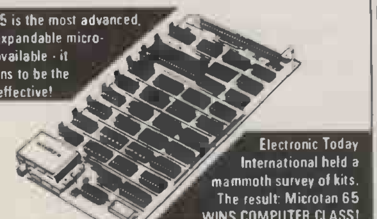

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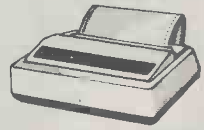

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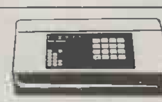

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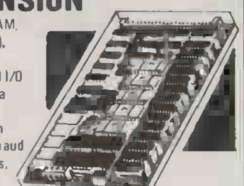

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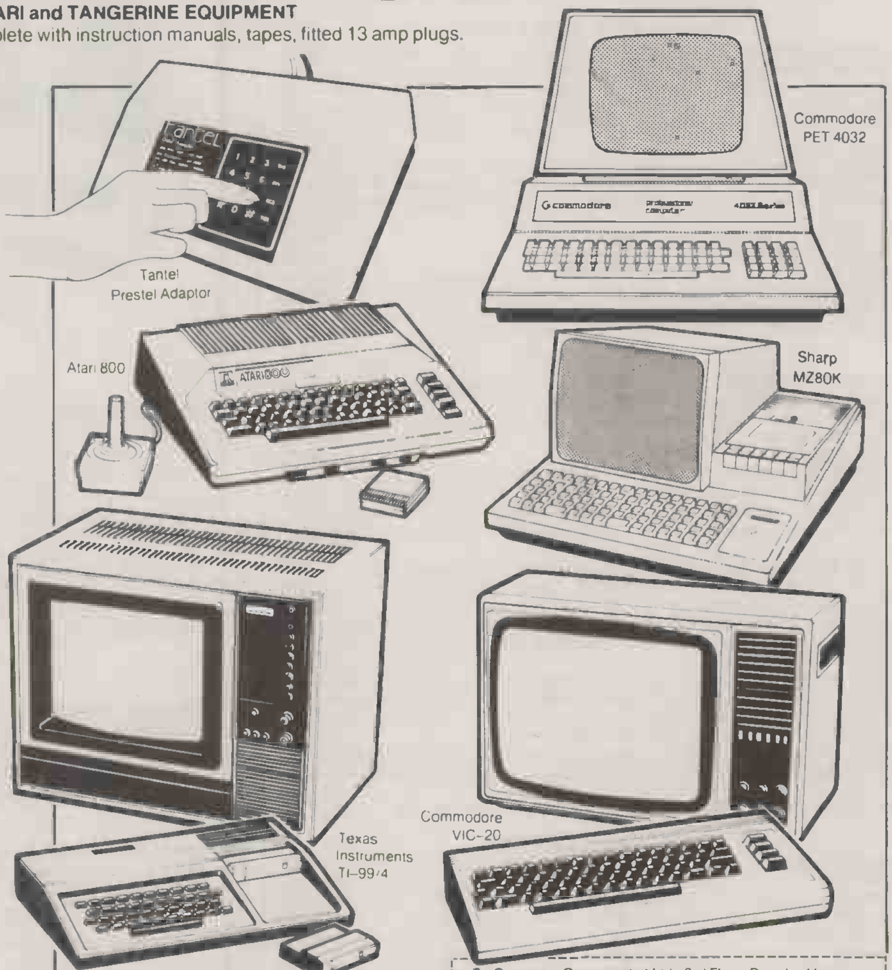

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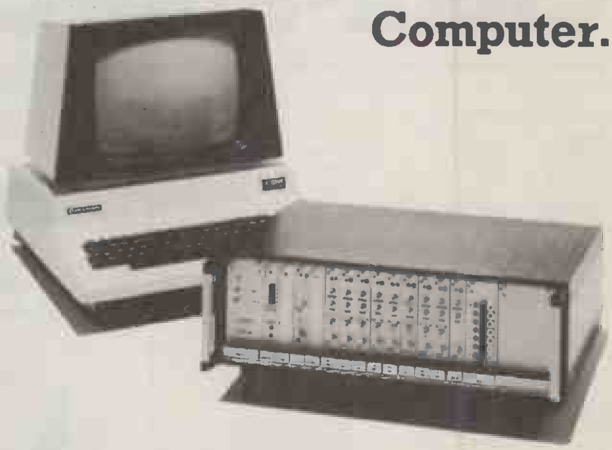

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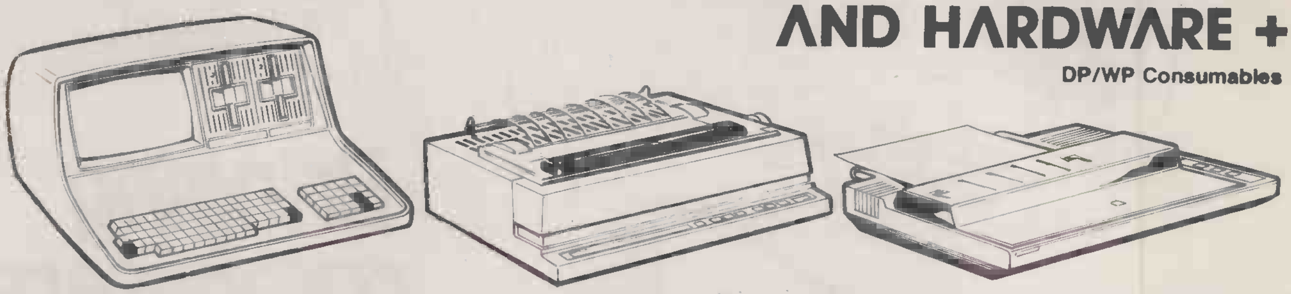

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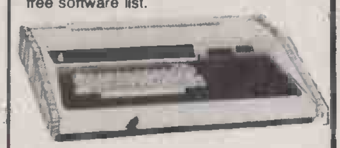

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Getting microelectronics into products

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Ken Edwards, Chief Executive, BEAMA.

Are designers responding?
Trevor Gilpin, Electronics Applications Division, Department of Industry. Overview and comments on UK industry's response to microelectronics technology.

Identifying an application
Ron Wainwright, Patscentre International. Observations from an organisation with experience of identifying, advising on and developing applications of microelectronics.

Case Study 1
M. A. Morling, Technical Director, Harmer & Simmons Ltd. Microprocessor boosts battery charger technology.

Case Study 2
Dr E. W. Firth, Product Engineer (Industrial Electronics), Normalair-Garrett Ltd. Digital micro-ohm meter improves field measurements.

Case Study 3
Derek Pay, Sales Director, Tempatron Ltd. Programmable controller ensures a market share.

Panel Session The day's speakers will answer and discuss delegates' questions.

There will be ample opportunity for delegates to inspect recently developed equipment which will be displayed.

Wednesday, March 3
Microelectronics for manufacturing industry

A large range of off-the-shelf equipment employing microelectronics is now available to industry. More can be made to meet individual requirements, and new developments are constantly widening the scope for increased automation and improved control. No company can afford to ignore the worldwide trend towards programmable devices in the factory.

Chairman's introduction
Ken Edwards, Chief Executive, BEAMA.

Is industry grasping the opportunities?
Trevor Gilpin, Electronics Applications Division, Department of Industry. Review of industrial response to microelectronic technology and available Government support.

Applications in the factory
David Foster, Project Officer, Microelectronics Applications Unit, UMIST. Where micros are finding use, plus a look at points new users should consider and possible problems.

The role of the process controller
Chris Griffiths, MTE Limited. What P.C's can now do – and where they are finding applications both sophisticated and simple.

Towards programmable automated manufacturing
Professor Keith Rathmill, Robotics and Automation Group, Cranefield Institute of Technology. Technology now exists – and more is on the way – to help industry boost productivity.

Microcomputer-aided design
Dr Peter Wilson, Principal Research Officer, Lucas Research Centre. Low cost entry has widened the appeal of CAD.

Panel Session
The day's speakers will answer and discuss delegates' questions.

There will be ample opportunity for delegates to inspect recently developed equipment which will be displayed.

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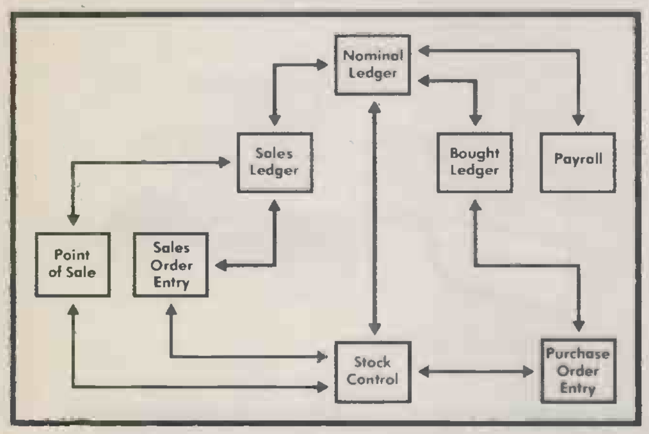

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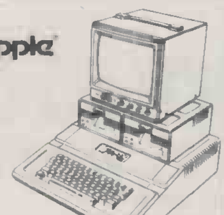

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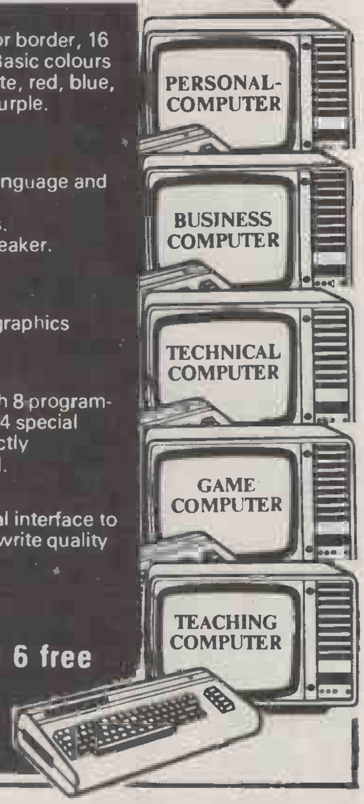

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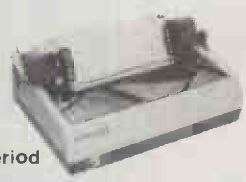

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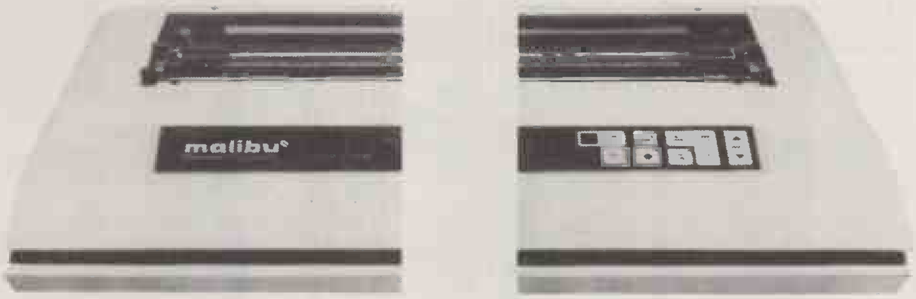

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