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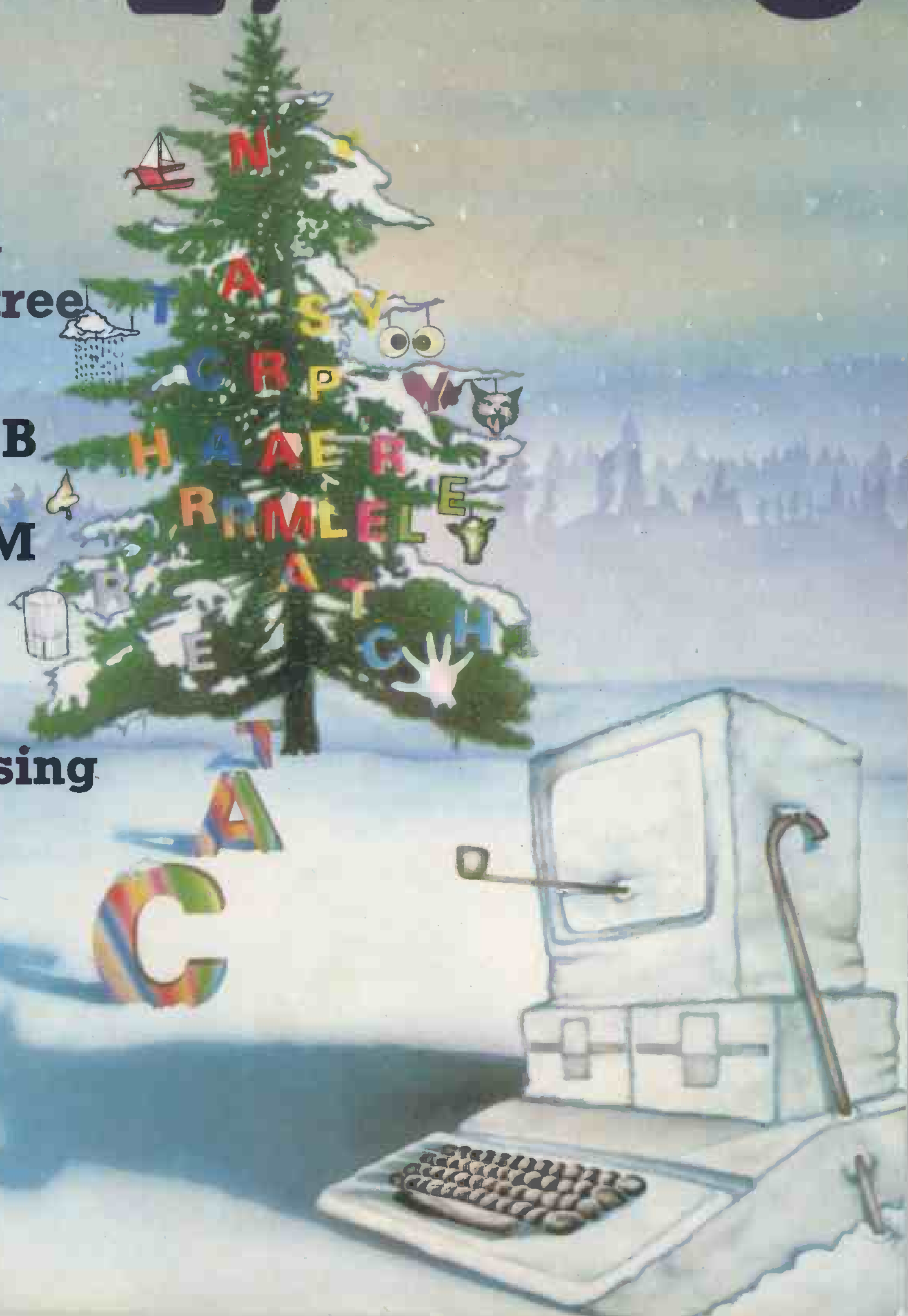
Practical Computing

December 1981 Volume 4 Issue 12



Adaptive processing — the decision tree

Reviews: NEC PC-8001B Piccolo DMS for CP/M

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Word-processing programs

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Graphics software

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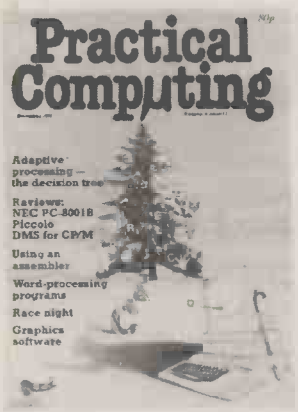

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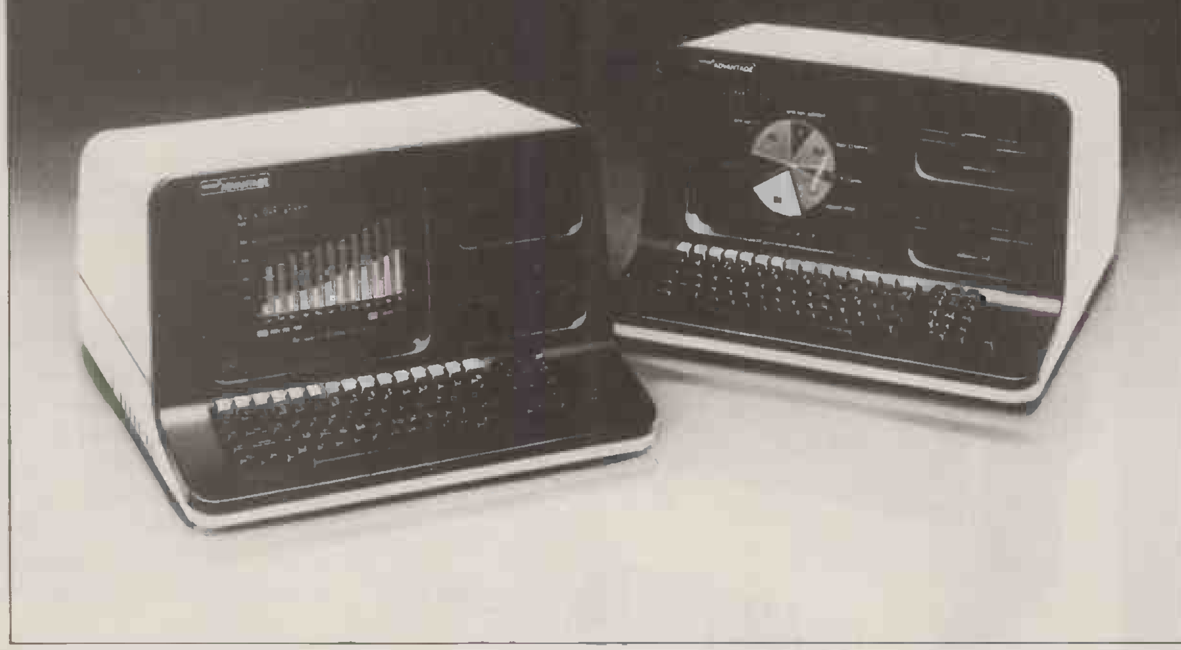
Trust Comart to turn a new ADVANTAGE



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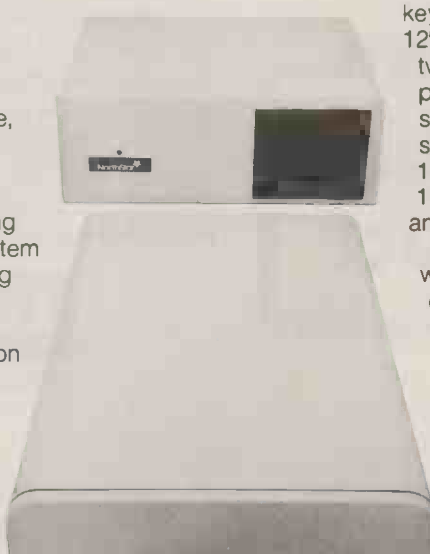

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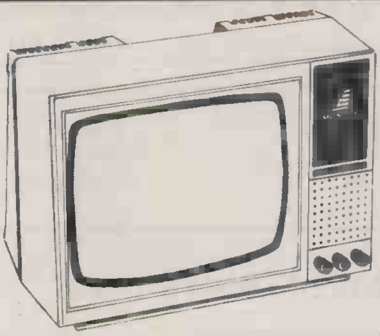

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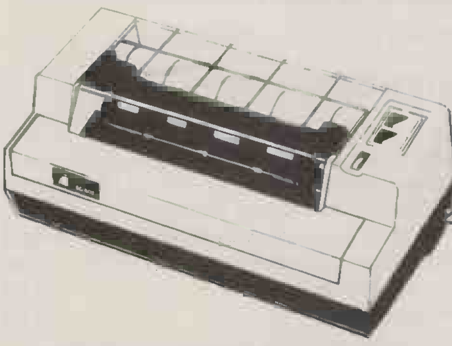

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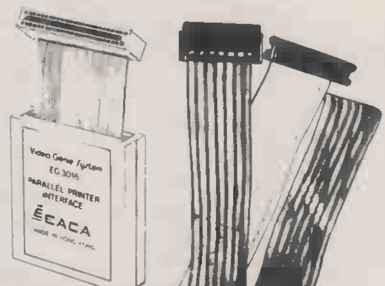

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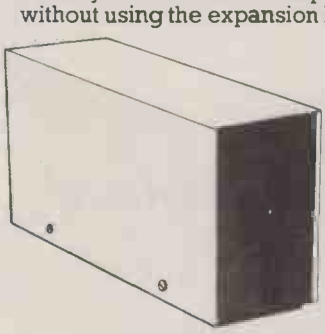

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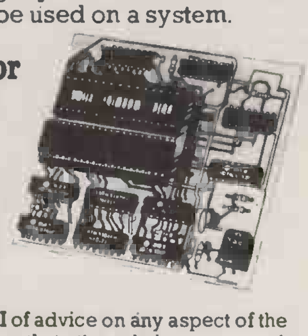

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FEATURES

Input: TDL, PSA or MicroSoft relocatable file. The MicroSoft format file is becoming the defacto industry standard, although some other manufacturers create non-standard versions. Check with your dealer to see if the compiler you wish to use is supported.
Output: COM file, Intel .HEX file, PSA PRG file with overlays, or PSA .REL file (not allowed if MicroSoft input). The .HEX and .REL files may be created in ASCII or binary form, and the .REL files may be used in a subsequent linkage edit if desired.
Memory map: PLINK-II can create four different reports: symbols sorted alphabetically, program segments sorted alphabetically, the entire program printed in address order, and program modules printed with date and time of creation and version number (PSA .REL files only).
Common blocks: PLINK-II supports Fortran-type common blocks, with no requirement that the largest instance of the common be input first.
Memory allocation: Program modules are broken down into code, data, and common segments, regrouped into 'sections', and allocated at any memory address desired by the user. A symbol .END, is created to signify the free memory available to the program and its location may be defined at any point.
Library search: Libraries of relocatable files may be loaded in their entirety, or with specific modules included or excluded. They may be searched, so that a module is included only if required by portions of the program already loaded.
Overlays: Any number of 'tree-structured' overlay areas may be created, to a depth of 32 levels, and these may be overlapped in an arbitrary fashion to create non-tree-structured organizations.
Control statements: Fifty temporary 16 bit variables are supplied. These may be assigned values, simple arithmetic and logical expressions, or console input, and may be tested via relational operators and branch instructions. Temporary variables, character strings, and simple expressions may be displayed on the console.

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*** MULTIPLE FIELD ATTRIBUTES ***
dbms2 and bus10.00

The following is a list of the **field attribute arithmetic functions** that may be set up against up to 16 fields per record and found to be both complex and of considerable power.

fn1 = **Multiply** one field against another and total per record/file.

fn2 = **Add** one field against another and total per record/file.

fn3 = **Divide** one field from another and total per record/file.

fn4 = **Subtract** one field by another and total per record/file.

fn5 = **Total** vertical columns within a file of records.
The result per record and per file.

fn6 = **Calculate** a percentage of the value of one field and if the **toggle** is set to *1* then **add** that result to the field; whereas if the **toggle** is set to *-1* then simply store the result.

Example:

			record.5 ....computed values .... record ......file ....
Field 01 = number	(5)		
Field 02 = code	(MICRO)		
Field 03 = quantity	(50)	[50,000.00]	[70,000.00]
Field 04 = s. price	(1000.00)	[150.00]	[170.00]
Field 05 = profit	(250.00)	[.25]	[.27]
Field 06 = cost	(800.00)	[1,000.00]	[1,145.00]
Field 07 = allocated	(20)	[30.00]	[450.00]

The two results to the right of the record show the use of several of the functions listed above.
Field 03 **function 1** (03 * 04) has a value of 50,000.00 pounds worth of 'MICROS' for the number '5' and 70,000.00 pounds worth of for all such records so far scanned.
Field 04 **function 6 'toggle -1'** (04 * .15) has the increase that is required to raise the price of record '5' by 15%, and so on averaging for all such records.
Field 05 **function 3 (05 / 04)** has the value of itself divided by the value found in field 04, for the record and all such records scanned. (profit margin ?).
Field 06 **function 6 'toggle 1'** (06 * 1.25) has the value of record '5' as if it were subject to an increase of 25%, and all such records scanned.
Field 07 **function** 4 (03 — 07) **has** the quantity remaining in stock after allocations are subtracted.

You have a combination of *multiple field searches* of **5 TYPES** and *multiple compute functions* of **10 TYPES** against up to *16 fields*, using words **you** choose and printing only those columns in the order **you desire** in one SINGLE CORE PROGRAM.

*** MULTIPLE FIELD SEARCHES ***
dbms2 and bus10.00

The following trajectory of a file interrogation may be set up and found to be both complex and of considerable power.

Try a **Sequential search** that is **Slow** and on **Multiple fields** within a range say of record '1 to 30'.

Notice that the cursor prompter will move to the first field in the record form. You will be able to ask any of the following types of questions on each field. When you set the question against that field; if the carriage return is not enabled by the fact that you hit the right-hand-field-bracket, then hit (cr).

There are **five** types of questions you may ask against a permutation of up to sixteen fields. (Think about them).

1 = straight text identity **(p = p)** which is to say that you can enter TONY in a **name** search where the record may look like TONY WINTER or WINTER TONY. the 'TONY' text is sought for **in any part of the field.**

= Greater than identity **(P› Q)** which is to say that you may first enter the symbol › followed by a numeric value (say 100) where the records may possess **different ranges of numbers in that field,** and you only want 100 upwards.

3 = Smaller than identity **(P ‹Q)** as '2=' above in reverse using X

4 = Not identical **(P ‹ › Q)** which is to say that all records found on other criteria **must not** possess the stated attribute. (ie: all records with TONY but **not** in W.C.1.). You must first enter the symbol ~ followed by the criteria that is to be excluded from the comparison.

5 = Either or identity **(P∧Q)** which is to say that you may search for either TONY or someone in W.C.1. or telephones with a *01* in their number. **Note:** that only *one* match of those **disjunctive** premises is sufficient to provide the **truth** condition establishing a match. That is to say you may find records of TONY in Birmingham and FRED in W.C.1. You must first enter the symbol ∧ followed by the text. A multiple example is shown below.

Field 01 = number	( )	) The question is:?
Field 02 = name	(TONY	) straight text (cr)
Field 03 = postcode	(^ W.C.1.	) one or
Field 04 = town	(^ London	) other
Field 05 = income	(› 5000)	greater 5000
Field 06 = age	(‹ 40)	younger than 40
Field 07 = sex	(– female)	not female

If you are interested enough to study this section of our new manual, **then** you are probably in need of a program embodying such features. **If** you understand the text, that is, if at least its meaning is a *touchstone* that fires your imagination towards *grasping* it with the mind **then** *you* and *it* are converging.

contact:

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Tandon's revolutionary new 8 inch floppy disc drive is only half the thickness of earlier drives so that you can pack twice the storage into the same space. In addition a new method of construction allows the drive to constantly compensate for changes in temperature and humidity so that real capacities of up to 4.M.bytes are now achievable in the usual 8 inch floppy disc drive envelope size. The TM800 series drives require only D.C. power (5v and 24v) so that they run cool and no changing of pulleys and belts is needed for manufacturers who want to ship products abroad.

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TRS-80 compatible (in cabinet with power supply)	DUAL UNITS	40 track	£399.00
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APPLE II Compatible	Single disc	£249.00	
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We carry a complete stock of emergency spare parts for Tandon disc drives and we can fix any drive on a short turn-round. All final testing is carried out on an in-house ATE drive testing system which can run 73 separate diagnostic programs to ensure that your drive leaves us in absolutely first class condition. A less complex calibration service is also available. Full product support exists for genuine OEM customers and we run single day training courses at regular intervals. Call our service engineering department for further information.

We carry the full range of Dysan alignment diskettes and a staff of Sales Engineers will be pleased to help you with any queries.

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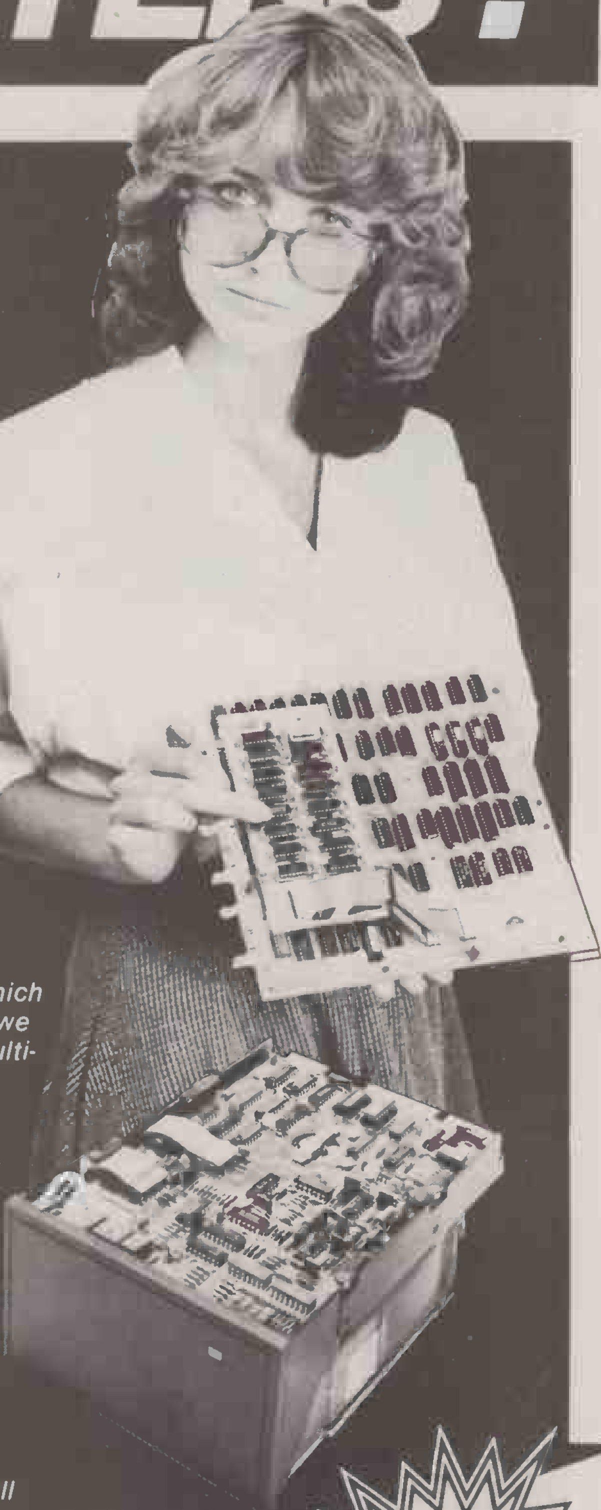
" WINCHESTERS?



I've got just what you're looking for....

Our new Micro Winchester gives you from 5 to 20 M.bytes of hard disc storage from as little as £1425.00 for a complete ready-to-go, plug-in system with software.

Floppies and larger more expensive hard discs are no match for our new drives which pack enough data to run serious business or technical applications software into a mini-floppy size 5¼" unit. Your data is protected in the sealed enclosure making diskette handling problems a thing of the past. The disc is fast — 40 times faster transfer rate than a mini-floppy — yet fits into the same space and so can be used as a replacement or an enhancement.

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Our controller comes with a range of adaptors to plug on to most popular micros and there are more adaptors on the way. It supports two discs with ease and while others are struggling with less stable analog data separators and speed-eating error correction circuits, we use a high performance digital design which literally locks into the data stream and stays there. Incidentally we also sell digital data separator cards to OEMs. Real time and multi-tasking applications benefit from the controller's interrupt capability and macro level command structure and the OEM version features a simple software interface and CP/M 2.2 BIOS with extensive development aids. The software comes on either 5¼" or 8" diskettes together with Boot PROMs.

Service and Support

If you are impressed with the specifications so far, there is more to come. Our packaged sub-systems are assembled in-house and they carry a full one year parts and labour warranty. Our controllers are built completely from TTL logic — there are no fancy chips — so we can fix them if they ever break down. Dozens of floppy disc drives go through our workshops every month and we are well known within the industry both for our training courses and our heavy investment in computer based disc test equipment. If your Winchester ever stops working you can depend on us to fix it.

For: SUPERBRAIN, S-100, APPLE II, HEATH H89, TRS-80.

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150 CPS, 15" carriage, dot matrix printer, 9x9 dot matrix, 10 characters per inch horizontal, 6 or 8 characters vertical, 136 cols.

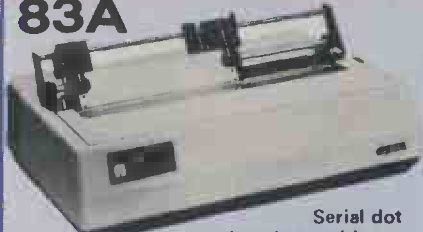
TVI

912/910/950

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

OKI

83A



Serial dot matrix printer with an impressive list of features including: 136 cols, 120 cps bidirectional, short line seeking,graphics,dual interfaces,96ASCII

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5510/5530

5510-RS232
5530-Centronics 8 bit parallel printers with the unique print thimble, produces up to 5 copies, with friction or tractor feed at 55 chrs.per sec.

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The Hazeltine Esprit is a buffered terminal capable of displaying the complete 128 ASCII character set. Based on a 12" diagonal non-glare CRT, the video is crisp and clear with each character presented on a large matrix to reduce eye fatigue.

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Daisy wheel printer for word processing, professional results, Diablo compatible, suitable for most micro & mini computers,

RICOH

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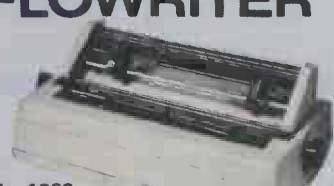

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Would you buy a car on performance figures alone?

Not likely.

You'll consider a host of other factors like quality, reliability, and warranty before choosing.

It's the same with micro-computers.

In the panel below we've listed the main performance features of the Millbank System 10:

The Millbank System 10

- Z80A CPU 4 MHZ
- 65K RAM Standard
- 700K Mass Storage on Dual Minifloppys
- Optional 1.6 Megabytes
- DMA Data Transfer
- Hard Disk Interface for additional mass storage
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- Attractive Desktop Cabinet
- Portable
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- Accounting- Style Numeric Pad
- Low Glare Screen
- Full Screen Editing

*Optional

While it clearly establishes System 10 as a high-performance micro-computer it doesn't tell the whole story.

Because it doesn't cover the vitally important factors that make the Millbank System 10 what we call the 'heavy-duty' computer.

Like exceptionally high design quality and unique internal architecture that gives incredibly fast memory access.

Like manufacture from the highest quality components and materials available.

Like a special switching device which reduces wear and tear on major working parts.

Like a device which protects your programs and files from power failure.

And there's more. Like a non-glare screen for user comfort to take just one example.

It all adds up to a solid, reliable micro-computer with a full twelve month warranty (an important point to check).

It includes the 'industry standard' CP/M disk operating system that gives you access to a vast and ever-increasing software library.

The Millbank System 10 also gives you freedom and flexibility.

Freedom to expand to five or ten Megabyte hard disk storage.

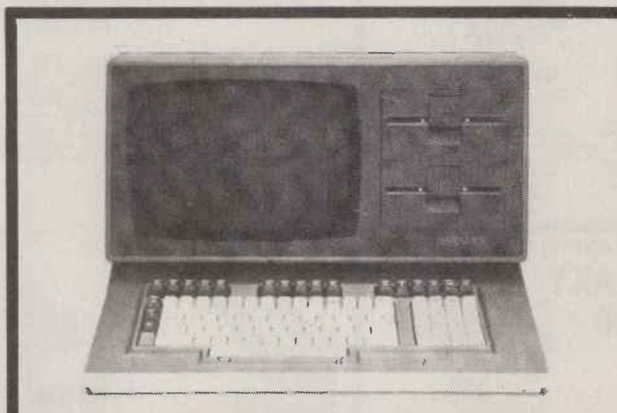
Flexibility, through the input-output panel, to build up a micro network, add all sorts of peripherals or scientific instruments and to link up to mini and mainframe computers.

INPUT OUTPUT PANEL

The Millbank System 10 handles all forms of business accounting and management, word processing, networking, communications - it's ideal for mainframe preprocessing and data entry.

In fact, it'll do virtually everything you want from a micro-computer - consistently and reliably. See it before you make an irreversible decision.

There's almost certainly a Millbank dealer near you.



The Millbank System 10

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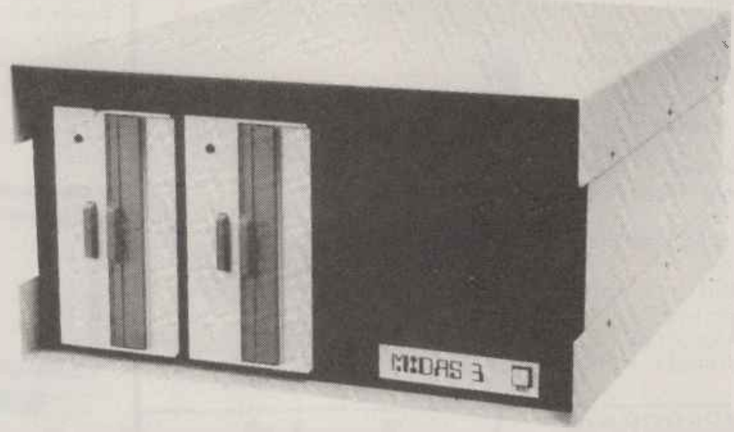

MIDAS 1: From £835
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MIDAS 3: From £2,450
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- MIDAS runs CP/M and MP/M. Other Software includes M-BASIC, C-BASIC, FORTRAN, COBOL, CIS-COBOL, PASCAL and Word Processing.
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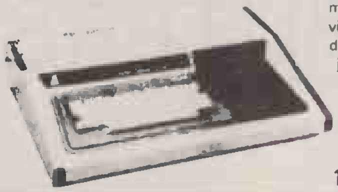

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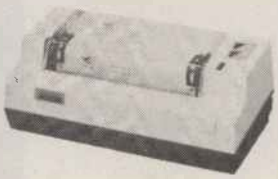

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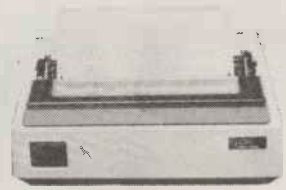

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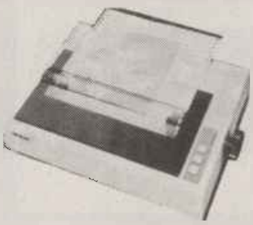

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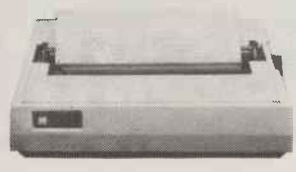

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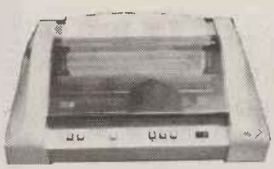

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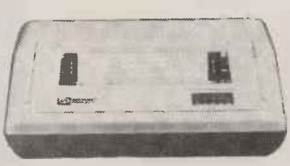

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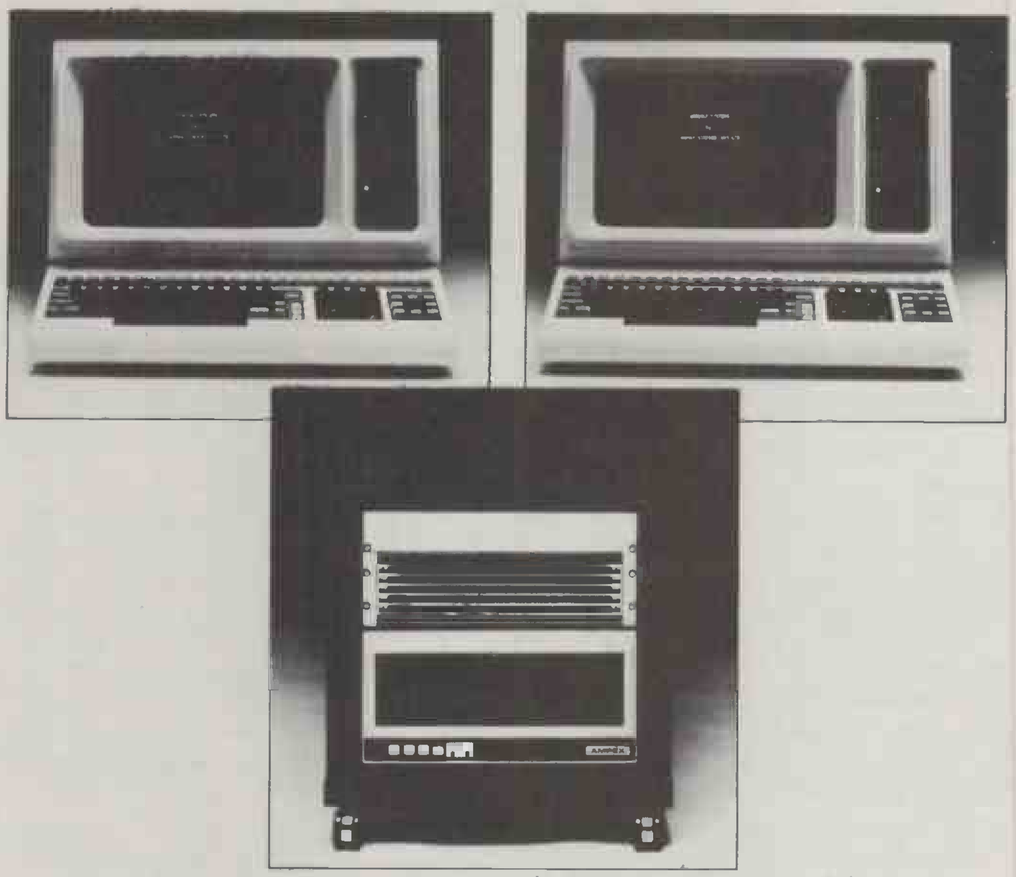

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Welcome the big boys

GOD, BEING A conservative sort of chap — not a surprising trait in one as old as He — is traditionally said to be on the side of the big battalions. At least, this was Voltaire's view, and events since his time have scarcely, if ever, proved him wrong.

We are now about to witness a new and interesting test of the old saw. The big, old computer companies have now shed their towels above high-water mark and are ankle-deep in the briny. They are audibly slapping their arms against their sides and crying out "How can it be so cold"!

In other words, IBM, Xerox and our own sickly ICL — among others — are committed to assaults on the micro market, and it will be very interesting to see what happens. On the one hand there are some friends of mine in Oxford who have been busily burrowing backwards into the sand for two years now, saying "Ooh — just *wait* till IBM arrives — we don't want to be caught in the open when that happens"; on the other, persons of more sanguine temperament are wondering whether the giants do not bring some pretty discouraging handicaps with them to this difficult market.

How might one delineate the issues? The straightforward argument is that the big guns will out-shoot the little guns. The whole world's micro business this year amounted to only five percent of IBM's turnover. If IBM had to *give* a machine to everyone who already has something from their rivals, it could. The giants have the capital manufacturing capability, the designers, the programmers, the outlets, the maintenance people — everything, in short, which the micro business has so far lacked.

There is little doubt that a lot of people who distrust micros will feel much better about the little beasts when they have one of these well-known names on the front. There is little doubt too that micros need to be made in quantity to high standards and sold through efficient dealer networks. Whether the big firms get into the business or not, this will happen spontaneously through the demands of the market.

In one of the first editorials I wrote on this page, I compared the micro business to the early days of the motor industry when

> Cars then were very like microcomputers now. There were dozens of different kinds, allied only by their unreliability, incompatibilty and the fanatical enthusiasm of their owners. Those owners would speak disparagingly of "horse and buggy" ideas and would happily spend six hours travelling six miles because they had had the fun of fitting new big ends after the second mile, re-wiring the ignition after the fourth and then retrieving — as Kipling so movingly describes in one of his stories — the contents of a ball-race dropped along six furlongs of un-metalled road.
>
> Well, so it is now. The difference is that the fans of microcomputing have a more gullible public. Many people are being persuaded to ride in our new bangers. They are holding their hats and waiting for the big thrill. It may come, or, what is more likely, the whole mess of machinery may blow up, cover all concerned with hot oil and sit lifeless by the roadside.

In two years we have got to the point where the big firms are emerging — the Austins, Peugeots, Oldsmobiles. The question is, are these big companies the right big companies? The reason they might not be is twofold. Firstly, the traditional computing business is dedicated to selling answers to expensive administrative problems to people who know nothing about computing but are happy to pay several times what the hardware is worth because they are promised "total solutions".

The structure of the big-computing business means that these firms can — they have to — work with very large margins indeed. A large part of their overhead is spent on publicity and marketing. It is common for salesmen to earn 30 percent of invoices with many, many 0s.

That kind of money is paid to salesmen rather than programmers or engineers because the hard bit is in getting the customer to bite on the bullet. If customers were queueing up to buy, as they are in our business, then the salesman's 30 percent will just disappear as manufacturers compete by cutting costs. One wonders whether a company organised round selling to a small number of rich, reluctant customers can convert itself into a mass-market operation.

The second problem follows from the first. In the big-computing business, the man who signs the cheque will never sully his hands with the keyboard. He expects to get value out of his purchase through the efforts of his data-processing department. It suits everyone in this set-up to make the machine pretty complicated to use, because that increases the mumbo-jumbo that can be used to baffle the businessman and increases the DP people's hold on their jobs:

In consequence, the big computing companies are full of people who have devoted their lives to making computing difficult. If you walk into the technical department of Intergalactic WonderComps and tell them that what they are doing can be, and often is, done by ten-year-olds, they get understandably miffed. If you invite them to reverse the whole trend of their professional careers and try to make the machine easier to use rather than harder they are apt to go very limp on you.

This is unfortunate for IWC because the way things look in the micro business, hardware on its own is going to be a fairly lean market. There will be a lot of it, but the margins will inevitably be thin and a lot of the 200-300 micro manufacturers in the world must go to the wall over the next few years. The problem for the giants is that buyers of micros want the hardware only to get the software to run. But, of course, the giants are full of people who are convinced that software ought to be complicated.

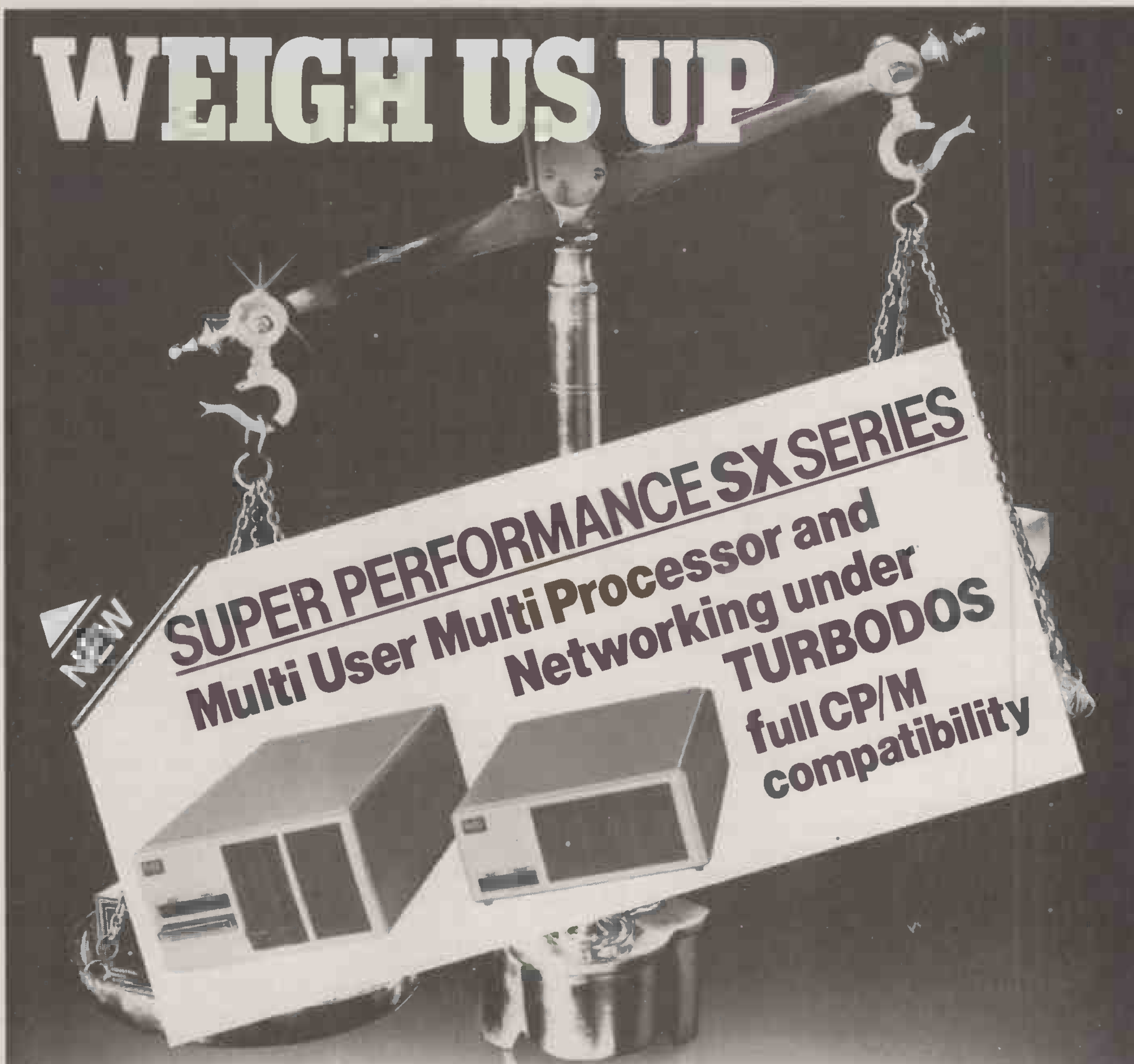
Micro-software needs a completely new cast of mind. It needs people who are violently anti-elitist, who view with deep suspicion everything more complicated than counting on the fingers of one hand. They have to believe that computing is not difficult, merely tricky, and that with luck, time will make it a lot less so.

It may not be easy to get the technical people in the big companies to change their habit of thought. Ever since micros first appeared, they have regarded them as toys. Their companies are now getting into the market only because the money men can see that if they do not do something now there will not be much big-computing business left in a few years' time.

If the technicians cannot be won round, then the big companies are going to be stuck with big overheads and a very standard mass-market product which relies on other people's software to make the sales and take the profits.

There is another reason why the big companies are unlikely to do well in the key area of software. New software comes from someone with a good idea sitting down in front of a keyboard. It makes no difference whether the keyboard is in IWC's technical centre or in a front room in Walsall. Even IWC is limited to the good ideas in the heads of its employees. Even supposing they are not contaminated by obsolete doctrines, there are nowhere near as many of them in there as there are of us out here.

And that argument brings us full circle. If it turns out to be true, the future of big computing companies in the micro market looks hard. However, in the process of getting in, they will do us all a fair amount of good. They will greatly increase the stock of hardware in use in the world, and will improve the reputation of the microcomputer but, one hopes, without putting too many of us out of business.



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● Circle No. 137

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.

Conclusive evidence

BORIS ALLAN'S article on "The limits of my world" in the September 1981 issue does not show that "the world of non-recursive algorithms has increased its limits to include Ackermann's function" but that the Ackerman (A) function is a general recursive function if and only if the Griffin (G) function also is.

The A function, you will recall, is defined on the non-negative integers by:

A1 A (0,N) = N+I
A2 A (M+I,0) = A (M,I)
A3 A (M+I, N+I) = A (M,A(M+I,N))

Allan's "definition" of the G function contains three strings of dots and the phrase: "The sequence of G operators is easily extended". This looks recursive, as does a mathematical definition of my own:

For M> I and N> 0
G1 T Gm1 = T
G2 T G2N = T x N
G3 T G M + 1 (N + 1) = TGm (TGm+1N)

The "ordinary algebraic expression"

A (M,N) = 2 Gm (N+3) − 3

is a relationship between two generally-recursive functions; there is no non-recursive algorithm for computing either the G function or the A function for general M and N.

George Miles,
Wyken,
Coventry.

Stretching language

IN HIS article "The limits of my world" in the September 1981 issue, Boris Allan makes two claims: that he has given an ordinary algebraic expression for Ackermann's function, and that this allows us to perform the computation of the function in a non-recursive manner. Neither is justified.

In the first place, "an ordinary algebraic expression using G-operators" is a contradiction in terms. It is as if I set out to demonstrate that a human being can run a mile in less than a minute, by running using a motorbike.

This is not extending the limits of language; it is just using words differently from everybody else — fine for Humpty Dumpty but not very helpful for the rest of us.

As for the second point, Allan offers no evidence. The non-recursive algorithm clue to Guttman he gives makes no use of his equation. That is not surprising since the G-operators themselves are recursively defined — Gm is defined in terms of Gm-1.

It should be made clear, though, that recursion is never necessary in programming. This is pointed out in, for instance, chapter 3 of Wirth's book *Algorithms + data structures = programs*, where there is even an exercise which asks the reader to formulate a general method for translating recursive programs into non-recursive programs.

Incidentally, the distinction between primitive recursive functions and general, but non-primitive, recursive ones is irrelevant here, as Allan would realise if he consulted a textbook on mathematical logic to find out what these terms mean.

Just because recursive programming can, in principle, be dispensed with does not mean that it always leads to inefficient programs; Allan has clearly failed to show that it does so in the case of Ackermann's function. This is, in any case, a poor choice of function for discussion because the limiting factor is not the depth of stacking. It is easy to write a program for which the maximum stack depth in computing A (m,n) is m+1. The real problem is the rapid growth of the function since A (4,2) is:

(2 raised to the power of 2^{16}) — 3

which has more than 19,000 digits.

R A Litherland,
Cambridge.

Portmanteau word

ROBERT Bittlestone, "The Chile Experiment", September 1981, is plainly a greater exponent of the portmanteau word than even H Dumpty. Can he give a proof, in mathematical notation — rather than in recursive, self-referential, sociologist jargon — that my Gemini 64K RAM board, which has no "parity bits and error corrections", is not working? It does, always. Of course he cannot; no, Stafford Beer is bluffing.

Chris Blackmore,
Ilminster,
Somerset.

Erroneous factorials

I WOULD like to point out an error in the program to calculate factorials written by Simon Harris and published in your March 1981 issue. The author makes the mistake, whenever a carry occurs, of adding it to the next element of the array to be processed. On the next iteration of the inner loop the carry would be multiplied by N, causing an erroneous result. The carries should be performed after all of the elements of the array have been multiplied by N.

Those who write machine code may like to note that the ZX-80 stores the value correctly if a negative Poke is performed. This is useful when calculating relative jump displacements or storing indices for the index registers.

Colin Mongardi,
Eastbourne,
East Sussex.

Contentious bones

DICK WARN'S article, August 1981 issue, succeeded in combining two bones of contention in one package; Basic versus Pascal, and educational computing. There is little in it to be criticised — if it had been written 10 years ago. It seems to ignore the actual microcomputer situation — Basic is.

The only way Pascal, or any other structured alternative, might become generally acceptable is if the manufacturers of microsystems were to sell their machines with it on board. As long as I, as a school and personal computer user, am buying a machine which comes with Basic as part of the package, it is what I am going to use. Even if Pascal is available as an alternative, it costs more money.

The arguments one reads are interesting and instructive, but they are not really concerned with practical computing. There seems to be a group of people, possibly those with professional computer training, who have not yet realised that computing is passing out of the hands of the professional into the arms of the amateur in terms of quantity of programming.

With regard to educational computing, three main objectives can be set. To introduce pupils to computer programming; to acquaint pupils with the use of microcomputer systems; and computer-aided learning, CAL. Warn's article did not differentiate between these but they do have different major criteria both for hardware and software.

Considering the first, he admits that Pascal is more difficult to learn but suggests, by implication, that pupils may be slightly bewildered, frustrated and baffled by the limitations of Basic. I have not found this to be the case. I teach simple Basic to pupils of ages from 13 to 18 years and my major problem is fighting them off the micro.

Most never reach a stage where they run into the situations described in the article. Few school pupils are bothered by a lack of portability and few of us in schools are going to do more than read

(continued on page 45)

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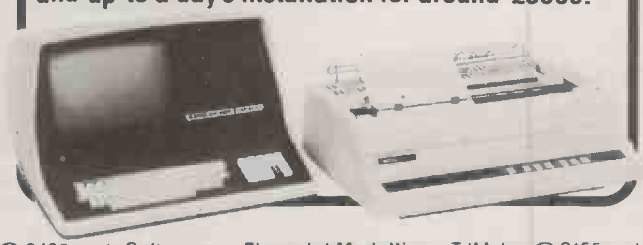

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(continued from page 43)

about the introduction of new and better hardware. Those pupils whose experience and expertise reach a level where these problems become apparent have also reached a level where they can appreciate the reasons and understand the solutions.

The second objective — to acquaint pupils with micros — has accessibility as its major criterion. I should like all pupils in the school to have had experience of operating a microcomputer before they leave, preferably on a reasonably sophisticated data-retrieval system, but I can see no way in which this can be achieved given present resources.

Most of Warn's article seemed to be concerned with CAL which demands portability and sophistication of software. It also needs the involvement of teachers working in that subject discipline to make sure that the content of the software is as valid as the program structure. However, to return to my initial point, the time for decisions on this was some years ago and those decisions were not taken.

The decision which could be made now is to arrive at some standard of operational software for the 16-bit systems before they are in common use. Until then, CAL will languish partly because of the reasons mentioned in Warn's article and partly because of the lack of resources. time and training, for the in-school production of suitable software.

Philip Bolt,
Kirriemuir,
Angus.

Tandy's flashing cursor

IN ANSWER to Graham Nichol's letter in the September 1981 issue of *Practical Computing* asking why the flashing cursor program for the TRS-80 in the June 1981 issue would not work, I think the fault lies in line 150 of the listing. I altered the line from:

```
00150 RETI
```

to:

```
00150 JP 114D
```

However it is necessary to answer the "Mem size?" query with 32671. After loading the programme, respond to the prompt * ? with /32672. If either of these responses are omitted, the computer will jump back to the "Mem size?" query.

The alteration to the program works with level II although I am not sure why, but it may not work with disc Basic.

J E Barker,
Nottingham.

Pet development project

I AM A computer consultant with substantial mainframe experience and an interest in microcomputer implementations of database management systems. Over the past year or so, I have carried out a great deal of work on a true relational database-management system for the Commodore Pet, with a number of innovations including a form of virtual memory and other performance aids, and both menu-driven and query language processing.

Unfortunately, my mainframe commitments are now such that I am unable to complete the development of this system and I would be grateful if any interested individuals or companies would contact me with a view to taking over and completing development of the package. Write to me as Cardendale Ltd, 16 Malvern Road, Gillingham, Kent ME7 4BA.

Graham Seel,
Gillingham,
Kent.

Changing Atom group

FROM THE end of September I shall cease to be responsible for the running of the Atom User Group. The group will be taken over by Peter Frost at 18 Frankwell Drive, Potters Green, Coventry CV2 2F8.

Richard Meredith,
Coventry.

ZX-80 Inkey routine

IN REPLYING to the letter from Charles Drayson published in the August 1981 issue, here is a Get or Inkey routine for the Sinclair ZX-80:

```
IN A, 0 : Get port 0 into Ac
LD L, A : Into L
LD H, 0 : Clear H
RET : Back to Basic
```

The following program will load this and lines 20-26 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
```

This allows a larger time slot to detect a pressed key.

M A Myatt,
Bedford.

Economics of design

IT WOULD seem that D L Fisher — Feedback June 1981 — suffers from a stiff neck, lack of perception and ignorance of the engineering economics of designing, producing and selling low-cost micros. Chip count and memory size related to customer cost resistance is where the business starts and stops.

Memory size and speed is the base line which dictates systems implementation and programming. A "professional" programming job which occupies 32K is useless on a 16K machine. The use of multiple statements and the removal of Rems and blanks is often the only way a non-trivial program can be made to fit into, and run, on a micro. Programs are only useful if they run.

Colin Webb,
Dhahran Airport,
Saudi Arabia.

Compucolor inspiration

AS THERE appears to be very little written on the Compucolor II, I would be interested in contacting anyone who owns a Compucolor II to exchange ideas. My address is Grey Court, 3 Stoke Hill, Bristol. I have a Compucolor II Model 3, 8K RAM.

David Johnson,
Bristol.

Teach Yourself review

WE WERE interested to see the review of our book, *Teach yourself computer programming in Basic,* published by Hodder and Stoughton, in the September 1981 issue of *Practical Computing*.

Despite your reviewer's feelings that our book is unlikely "to rocket to the top", it is now in its second printing — more than 10,000 copies have been sold. In the review, it says that the Teach Yourself book owes "nothing to 1980s' micros"; the programs were developed initially on the Commodore Pet and then also run on a mainframe. The intention was to provide programs that would run on most systems supporting Basic, as there are still large numbers of students at Universities and Polytechnics whose first experience of computing is with on-line systems.

Eric Deeson, the reviewer, is right in concluding that our book is not aimed at experienced programmers. The arts of programming and programming techniques warrant books to themselves. Our book is aimed at beginners including non-computer specialists who wish to gain a knowledge of the Basic language to enable them to use a computer in their field.

As a point of interest, having assessed the many Basic books on the market, Commodore approached us to write a similar book for the Commodore Vic containing additional sections on Peek, Poke, colour, sound and high-resolution graphics. This book will shortly be published by Hodder and Stoughton under the title *Learn Computer Programming with the Commodore Vic*.

L R Carter and E Huzan,
Slough,
Berkshire.

Facit trio designed to keep options open

THE NEW DTC computer system from Facit is available in three versions. Two versions are for business management and one is for colour graphics — all three are based on the Z-80 processor. The graphics version, the Facit 6511, starts at £2,000 excluding printer, but includes a 14in. screen conforming to teletext standards, with 24 lines of 40 characters, and seven colours.

There is a dual mini-floppy unit, providing up to 143Kbyte capacity on each. The 24K ROM-based interpreter has selectable mathematical precision and a time function. Communications interfaces are provided with a programmable transmission rate of between 50 and 19,200baud. One interface is asynchronous, the other offers reverse link-up facilities between synchronous and asynchronous communication systems.

The computer also has an integral sound generator with volume control. An optional high-resolution graphics facility provides 240-by-240 points, each of which can be in colour or white.

The business management computers are the Facit 6510 and 6520. The 6510 has a 10in. screen and a 48K memory, the 6520 a 15in. screen and 64K of memory. There is also a range of software packages available to complement the machines.

Facit has called the packages "positive software" and they include: sales, invoicing, purchase, stock control, nominal general ledger, word processing, Facicalc and DTC register. The Facit computers feature yellow-on-brown screens — apparently they are easier on the eyes.

For details contact Facit Business Systems Division, Wellington House, Wellington Street, Leicester. Telephone: 0533-547149.

Simple payroll for ZX-81

A SIMPLE payroll program designed for use by a small company has been developed by Hilderbay Ltd for use with the Sinclair ZX-81 microcomputer, together with the 16K RAM pack and printer.

The program will be of use to any company with 30 or fewer employees, who will find the package able to cope with payments, deductions, bonus payments, records and printouts. Hilderbay Ltd is a company which seems to be carving a niche as a provider of software for the smallest of machines.

The complete system will cost the user less than £200, and that includes the computer. The software costs £25 and is complete with step-by-step instructions, a training system if necessary, and a replacement service in case there is new tax legislation.

Contact Hilderbay Ltd, 8-10 Parkway, London NW1 7AA. Telephone: 01-485 1059.

This is the Husky 144 portable computer for outdoor environments and robust applications. The machine weighs less than 2kgm. and is a little larger than a book. This British innovation is reasonably powerful despite its size — it has a memory of up to 144K. The screen can display up to 128 characters in four lines. Information can be transferred to a main computer from the field via a telephone. For further information, contact David Viewing, managing director, DVW Microelectronics. 0203 56580/27535.

France looks to the future

FRANÇOIS MITTERRAND, the socialist President of France, is certainly taking an interest in the world of computers and information technology — the "in" phrase for 1981. He has announced his intention to open a world centre for informatics development in Paris at the earliest possible opportunity. This is part of a drive by the French to put their informatics industry at the forefront of as many communication-related activities as possible by 1988.

Mitterrand stated that: "The tools of informatics could be mastered only by thinking on a world scale. France will reinforce its position in all industries related to electronics. The government will do all it can to help small, medium-sized and new companies".

At the other end of the scale, the French Home Secretary has halted computer-produced identity cards on the grounds that they endanger democracy. This is an opinion held by many due to the apparent ease with which a government could form a central file of all citizens.

Birmingham's launch-pad

BIRMINGHAM City Council is creating a multi-million pound partnership as a launch-pad for high-technology industries in the city. The program will start with the establishment of a science-and-technology development centre, with management, consultancy and scientific services being provided by Aston University.

Under such a program, small companies will have the benefit of a powerful research organisation which they would otherwise not be able to afford. Such an enterprise should create thousands of new jobs as similar programs have done in the U.S.

The science-and-technology development centre is similar to a science park — that is, an area where many high-technology industries are concentrated, together with the resources they require.

Wider scope with Pascal

TAKING ADVANTAGE of the power of Portable Pascal. IBC's network and resource-analysis program can cope with projects of up to 30,000 activities — but this is limited by the microcomputer used, and the time.

The package will run on Apple II, North Star Horizon. LSI-11, Microengine. Z-80. Future plans include the Onyx. Superbrain, Dynabyte and Cromemco machines. IBC can supply either a complete system or just the software, together with after-sales support. IBC Computer Systems Ltd, Sunderland House, Sunderland Street, Macclesfield. Cheshire. Telephone: 0625-616399.

Scientist can digitise

A NEW precision analogue-to-digital converter is capable of taking the typical signals a scientist would display on a strip-chart recorder. digitise them and send them to a microcomputer.

Dyson Instruments, Sunderland House, Station Road, Hetton, Houghton-le-Spring, Tyne and Wear. Telephone: 0783-260452.

Olympia fields its strong desk-top team

OLYMPIA IS the latest of the big office-equipment suppliers to weigh in as a manufacturer of desk-top microcomputers. The reputation of Olympia as a major office-equipment supplier will certainly boost its sales — especially to first-time users.

The range of desk-top machines, with both software and hardware, provides for most business uses. The machines are of a standard design with the usual 64K of user RAM, and disc capabilities. One attractive touch is that the computers all have the ability to communicate to larger, mainframe machines.

The new microcomputers are called Boss, and the fully-integrated software packages supplied can be used by anybody. Designed for the smaller business, Olympia expects to be able to sell to departments within much larger organisations.

The range starts at less than £3,000 and there are four machines, all supplied complete with printers. Software packages cover sales ledger, purchase ledger, stock control, payroll and invoicing.

Putting non-expert in the driving-seat

THE PMJH controller is a device which provides extensive control facilities for combinational and sequential timing as well as arithmetic operation using Tiny Basic. The device enables a control system to be developed without any specialised programming skill. The controller is ready for action with only a 5V supply and a VDU for operator interaction, and the device can act as its own development system.

Systems can be developed and modified while actually controlling — a sure and fast way to debug programs. Work can be effected on site or in the field. Once a program has been developed in RAM, it can be programmed into EPROM by any one of a number of techniques.

The PMJH controller was developed by Manitron at Salford University and was first displayed at a press conference held to protest against the cut in the university's budget of 40 percent. A controller was despatched to Prime Minister Margaret Thatcher, together with a note expressing the hope that this would not be the last such innovation the university successfully transferred to industry.

A fully-populated board with 4K-by-eight RAM and 4K-by-eight EPROM costs £239 for one, with reductions for quantity. Manitron Division, Ficention Ltd, Bold Street, Sandbach, Cheshire. Telephone: 09367-4171.

Uncommitted logic at an engaging price

MARCONI Electronic Devices Ltd (MEDL) has recently opened a very smart new factory near Lincoln for the manufacture of microchips. As well as making its own custom-designed devices, it has a product which might well be of great interest to the small manufacturer of micros or add-on products. This is a particularly easy and low-cost version of the uncommitted-logic array idea.

MEDL's System 85 is based on standard chips containing up to 1,440 standard logic cells — 2,014 cells will be available soon. Each cell consists of four transistors. This array can be turned into almost any circuit you like by interconnecting the cells. To make the job easy. MEDL gives the designer a big picture of the array plus decals representing the usual logic gates.

He just has to stick these on to the photograph of the array to specify his circuit. MEDL will then test it using simulator software.

Unlike earlier uncommitted-logic arrays. System 85's Cellmos is realised in CMOS technology. This means that the finished chip draws very little power and could be used. for example, in battery-powered products.

In effect. the designer is packing the logic which might occupy a whole printed-circuit board into one chip. Since a printed-circuit board costs at least £2 a package to make and test. MEDL's prices can be attractive: design kit and handbook — up to £355; production of 10 samples £7,000; 1,000 off in ceramic, packaged £17 each.

A satisfactory design which is wanted in quantity can be made as a dedicated chip in the same CMOS technology. The cost would be a transfer charge of £10,000 but a saving per piece in quantities greater than 10,000 units of 25 to 30 percent. Martin Wolfenden, Marketing Manager Cellmos Marconi Electronic Devices, Carholme Road, Lincoln LN1 1SG. Telephone: 0522-29992.

INNOVATIVE
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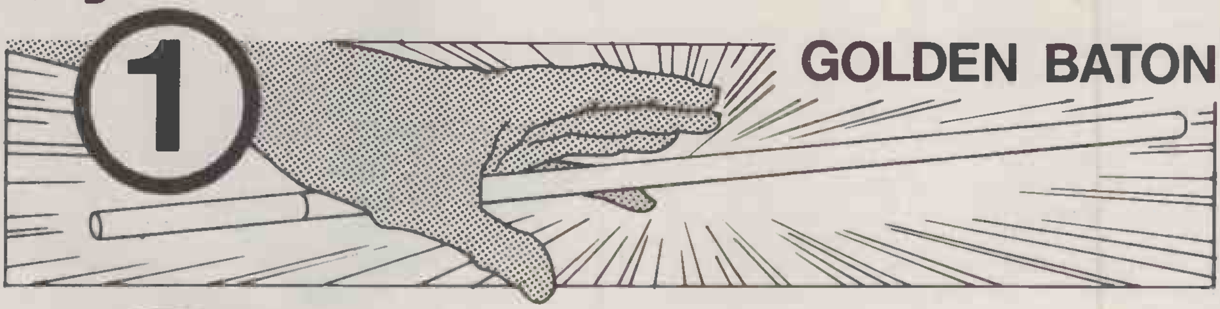
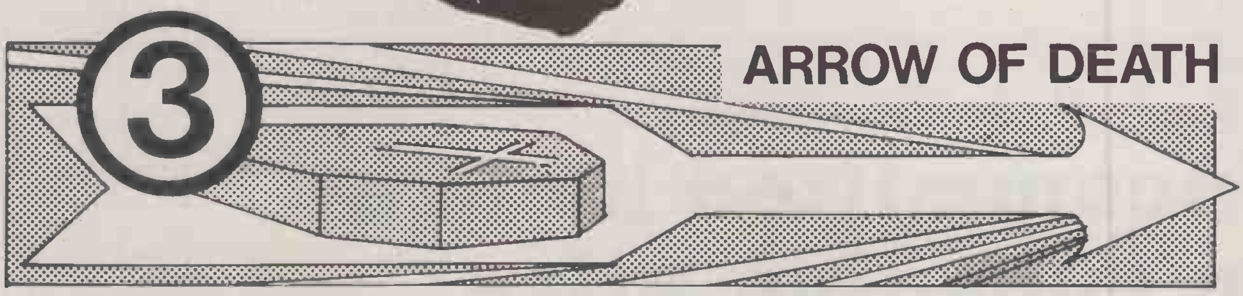
Mysterious Adventure





Three months ago we introduced the Mysterious Adventure series, a brand new series of machine language Adventures written by Brian Howarth. The first one, The Golden Baton, was greeted with enthusiasm by experienced and beginner Adventurers alike. Now the second and third in the series, The Time Machine and Arrow of Death, are available. The Arrow of Death, although entirely self-contained, is the first of a two part Adventure. The second part will be available early in the new year.

Mysterious Adventures are available for Models I and III TRS-80 and Models I and II Video Genie, both on tape (16K minimum) or disk (32K 1 disk minimum). A TRS-80 Model II version will be available shortly.

Any 1 Adventure:	On tape	£10.06	Any 2 Adventures:	On tape	£18.40
	On disk	£12.65		On disk	£23.00

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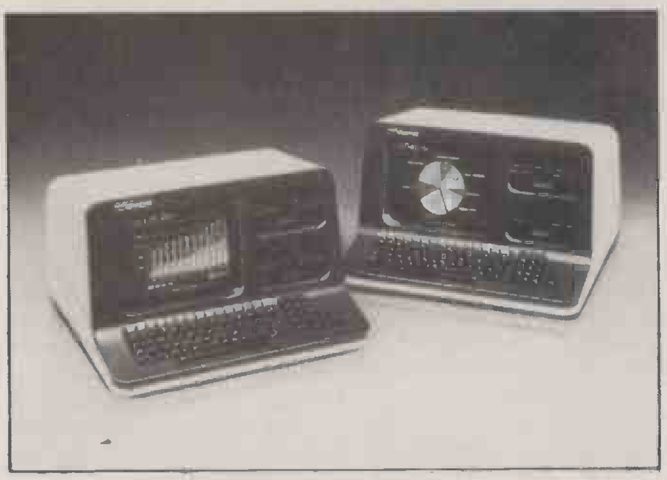


The North Star Advantage, stand-alone desk-top microcomputer, retails at slightly less than £2,500. The machine is supplied complete with a business graphics package, and includes a Z-80A processor, 64K of user memory, a 12in. monochrome screen, twin mini-floppies and a keyboard with 15 programmable function keys. For full details contact Comart Ltd, PO Box 2, St Neots, Cambridgeshire. Telephone: 0480-215005.

Word-processing link for CP/M systems

WORD PROCESSOR users can merge records created with the Compsoft DMS system with standard letters created by the Spellbinder or WordStar word-processing packages. These packages will work on any CP/M system and provide a sorting, searching, and mailing system.

Under DMS, records can be created to the user's own specifications; they can then be sorted into order and preselected according to several criteria before being merged with standard letters. There are many applications, but the system will be of most use to companies which need to send different types of letter to different clientele.

Compsoft's DMS system is available for any CP/M machine and costs £400. For any Commodore system, the same package costs £250 and contains links to VisiCalc, Wordcraft and WordPro. Compsoft Ltd, Great Tangley Manor Farm, Wonersh, near Guildford, Surrey. Telephone: Guildford 39665/505918.

Alpha Plus reveals Pet's true characters

ALPHA PLUS is a character generator for the Commodore Pet range of microcomputers. It is in the form of a ROM which is connected to the second cassette port inside the case of the Pet. There is also some software and a manual, which rests on the top of the keys.

Alpha Plus is, in effect, four different character sets for the computer. Set one gives U.K. users the long-awaited £ sign, which replaces the back slash, while at the same time retaining all the upper-case letters, numerals and graphic symbols of the original CBM set.

Set two also has the £ symbol and supports all the upper- and lower-case letters, numerals and graphic symbols of the original Commodore second set. Set three is a totally new set of mathematic symbols including symbols for set notation, the Greek upper- and lower-case alphabet, the Roman alphabet, the numerals 0 to 9 including an infinity symbol, as well as graphics characters.

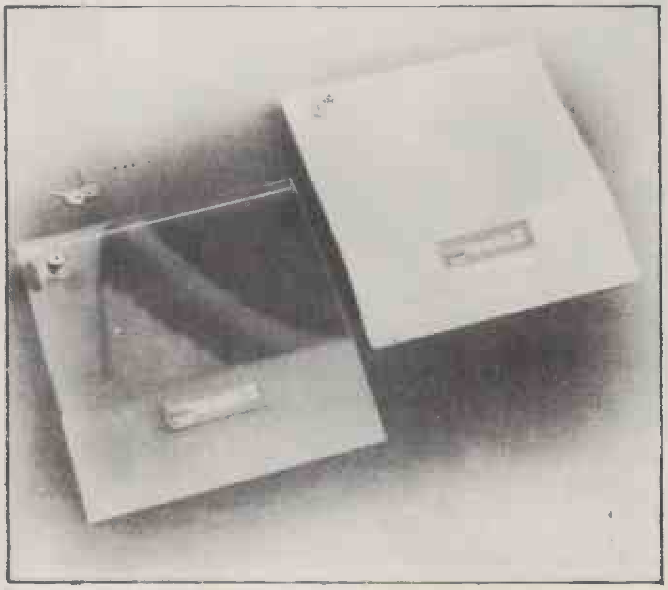
The fourth set comprises various graphics symbols only. They include electronic symbols such as resistors, capacitances, diodes, transistors, as well as games-playing graphics, planes, tanks, helicopters, bombs, cars and space ships. There is also a series of new horizontal, vertical and diagonal lines.

Alpha Plus costs £69 plus VAT for a 2000 series Pet, and £50 plus VAT for a 3/4/8000 Pets. The manual is available separately for £9. The supplier of Alpha Plus is able to provide custom character sets to order. Contact Computer Rentals, 8 Eastbury Close, Thornbury, Bristol. Telephone: 0454-41560.

Lid's role in great Apple cover-up

A LOCKING lid for the Apple computer eliminates the danger of prying hands removing or fiddling with the machine's cards. Applelock can be fitted to the Apple lid by any Apple dealer for just £12 plus VAT, or alternatively send the lid to Datron Micro Centre of Sheffield for fitting. A second new offering from Datron is Appleview, a transparent lid which lays bare your Apple's innards. Appleview costs £17.50 plus VAT.

The two products are combined in Appleview plus, which costs £27.50 plus VAT. Datron Micro Centre, 2 Abbydale Road, Sheffield, Yorkshire. Telephone: 0742-585490.



Any software to declare?

SOFTWARE packages that are approved by HM Customs and Excise for VAT purposes are now available on any CP/M or MP/M computers and most VDUs and printers. The programs, written in CBasic, comprise a fully-integrated set of ledger systems designed by accountants for CP/M.

Business Solutions Ltd, 1 Park Avenue, Ilford, Essex. 01-554 5985/0582.

Zilog adds on-chip Basic to its processor family

THE LATEST addition to the world-famous Zilog Z-8 range of microprocessors is the Z-8671. This is the standard Z-8601 microcomputer chip but with an on-chip Basic and a debug/monitor. The chip contains an internal 128bytes of RAM which can be expanded up to 62K by using additional chips. A single Z-6132 RAM will provide an extra 4K of RAM. The only other component required is a power-supply decoupling resistor.

The chip has four eight-bit output ports, an asynchronous port which can be set for baud rates between 110 and 19,200, and various timers. The chip will enable a small system to be built with the bare minimum of components.

The on-chip Basic supplied is a subset of standard Basic, which supports the USR command, allowing assembly-code subroutines to be run direct from Basic. The most likely application of the chip will be in the construction of microprocessor controllers.

Zilog Ltd, Babbage House, King Street, Maidenhead, Berkshire. Telephone: 0628-36131.

Time for bus systems

THE NATIONAL Semiconductor MM-58174 is a CMOS circuit which functions as a real-time clock and calendar in bus-orientated microprocessor systems.

The versatile device includes an interrupt timer which may be programmed to one of three settings. Other functions include seconds, tenths of seconds, tens of seconds and the same divisions of minutes, days and months. Telephone: Hi-Tek on 0954-81931.

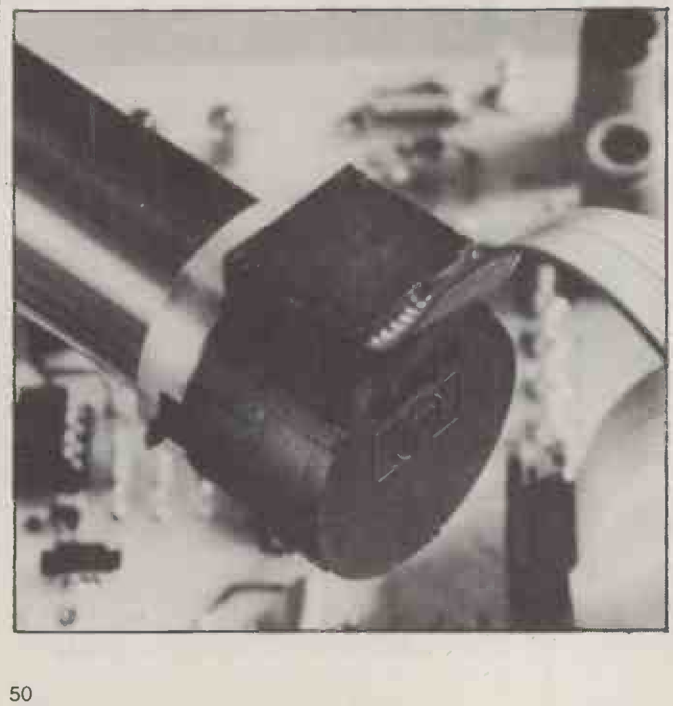
Modem price talks sense

A LOW-COST, direct-connect Modem for microcomputers has been announced by Spreebond Ltd and is compatible with any micro using the RS-232 interface; adaptor kits are available for the Pet and all the Tandy models.

The £200 Modem plugs directly into the telephone line, eliminating distortions and lost-data problems often associated with acoustic couplers.

Spreebond Ltd, Unit 7, Haslemere, Parkwood Estate, Sutton Road, Maidstone, Kent. Telephone: 0622-683866.

The Hewlett-Packard HEDS-5000 optical sensing device can measure a motor's velocity, the direction of its rotation and its position. There are 500 measurements per revolution giving the device a resolution of 0.72°. The main use of this device will be in the field of robotics; Micromouse fans will no doubt be interested. Celdis, 37 Loverock Road, Reading, Berkshire. 0734-586191.



Government says no to data-protection scheme

THE Government has rejected the idea of an independent data-protection authority, but is to publish a White Paper setting out its proposals on the subject. This was made clear by Home Office Minister of State Timothy Raison at a recent conference held at the British Medical Association, London.

"As the basis of our domestic arrangements, we proposed the establishment of a public register of data applications storing and handling personal information by electronic means", Raison told the conference.

The conference included among its speakers Sir Norman Lindop, who reported on data protection in December 1978 and has argued consistently that any data-protection authority must be independent if it is to have any teeth.

Sir Norman had argued earlier for an independent authority which would enforce a set of "modular" codes which would have the force of law, and would also comply with the principles of the European Convention on Data Protection, to which Britain is a signatory.

A modular approach, where each organisation registering with an independent authority would be assigned particular blocks of rules depending on the kind of data processing and storage activity it was involved with, would be consistent, flexible and compatible for different applications, Sir Norman said.

However Raison, giving the Government's proposals, rejected the independent approach and suggested that "the form of independent authority proposed by Sir Norman's committee is fundamentally objectionable".

In particular, the Home Office resisted the idea that data-protection rules would have the force of law and hence be a major extension of criminal law.

The task was, he said, essentially one for the Government and Parliament — though it was still too early to say when detailed preparatory work on legislative proposals would be completed and a Bill introduced to Parliament.

Raison gave no specific ideas on how the register of applications could work in practice, though Sir Norman's interpretation of the Home Office proposals was that each organisation concerned would "volunteer" itself to register under a set of rules to be derived by itself.

"This is surely a recipe for chaos and disaster", he said. "The Home Office can hardly be said to be impartial and disinterested in the area of personal information". The Home Office is the biggest user of data files on private individuals and is directly responsible for the Metropolitan Police.

Doctors are especially concerned lest confidential medical information fall into the hands of people who have no right to see it. GPs say that computerised medical records may threaten the confidentiality which is the basis of the doctor-patient relationship.

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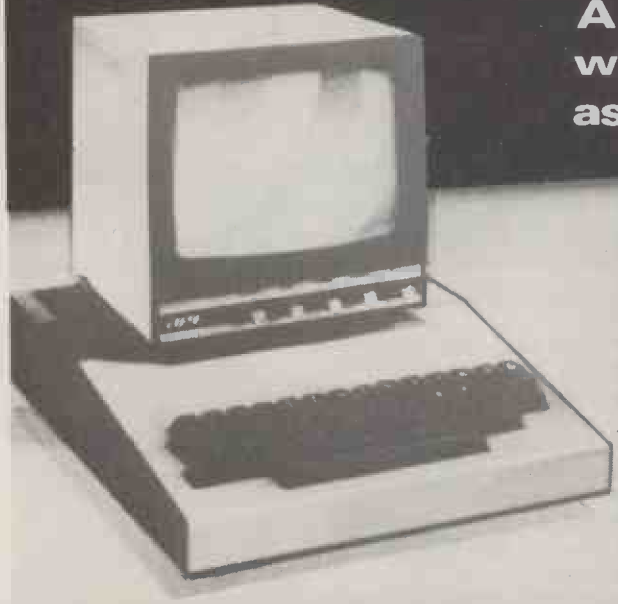

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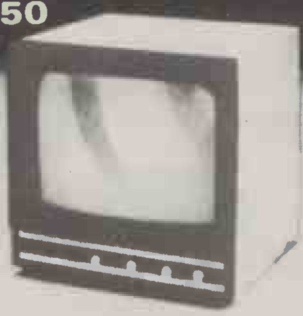

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MZ-80 I/O	Interface unit.	£82.00
MZ-80FD	Dual disk drive.	£693.00
MZ-80FDK	Additional dual disk drive.	£616.00
MZ-80	RS232 interface.	£110.00
MZ-80P3	Matrix printer.	£395.00
CP/M	Operating system.	£196.00
MZ-80 I/O-1	Universal interface card.	£50.00
MZ-80BM	BASIC manual.	£7.00
MZ-80T10B	BASIC tape.	£9.00
MZ-80T20C	Machine language tape and manual.	£19.00
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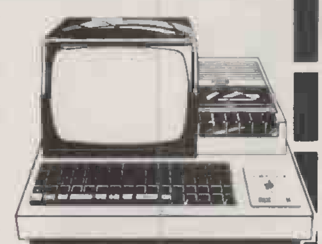
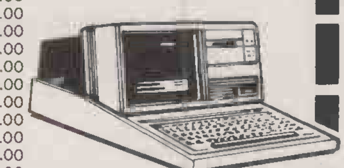
MZ-80T40E	PASCAL interpreter manual and application tape.	£50.00



Sharp MZ-80B Personal Computer

MZ-80B	Computer 64K. 23cm CRT. Tape cassette. ASCII keyboard.	£1095.00
MZ-80FD	Twin floppy disk unit.	£590.00
MZ-80FDK	Additional twin floppy disk unit.	£590.00
MZ-80P5	Matrix printer, 80cps. 80col.	£415.00
MZ-80FI	Floppy disk interface card.	£100.00
MZ-80MDB	Master diskette and manual.	£31.00
MZ-80F15	Cable for MZ-80FD.	£9.00
MZ-FO5	Cable for MZ-80FDK.	£7.00
MZ-BCJ	Floppy disk cable jointer.	£15.00
MZ-80EU	Expansion unit.	£50.00
MZ-80GMK	Graphic RAM-II option.	£120.00
MZ-80 I/O-2	Universal interface card.	£45.00
MZ-80T10C	MZ-80K to MZ-80B converter tape.	£7.00
CP/M.	Operating system.	£65.00



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PC-3201	Computer 64K. ASCII keyboard.	£1500.00
CE-320C	80x25-character display terminal.	£250.00
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● **Circle No. 141**

Revolution of the Rodime disc

Malcolm Dudson of Rodime tells the story behind the development of the innovatory RO-100 series — the 5.25in. disc which offers storage at up to 40 percent less cost than 8in. Winchesters.

THE RO-100 series offers up to eight disc surfaces and up to 16Mbytes of storage in a unit no larger than a mini-floppy drive and is interfaced in the same way.

The head/disc assembly of each drive consists of two chambers, one housing the discs and arms, the other housing the actuator mechanisms. The control circuits and the motors which position the heads and rotate the discs are located around these chambers.

Apart from the heads, discs and motors, virtually every component contained in these drives has been designed by Rodime, and designed to overcome difficulties which may be encountered in 5.25in. Winchesters.

In December 1980, when the Rodime drives were still on the drawing board, we decided we could offer the highest storage capacity and the fastest access time which could be reliably designed and produced using the latest components. Therefore, in the RO-100 Series, we have deliberately not used thin-film heads or thin-film discs. When these enhancements have become reliable and are readily available, they will be included.

We took the view that the drive which contains the largest surface area of recording medium will always be able to offer the greatest capacity. From the beginning, therefore, we planned to produce a series of 5.25in. Winchesters which would contain up to four discs while maintaining size compatibility with

the *de facto* industry standard set by drives with fewer discs.

The actuator mechanism has to be of exceedingly rigid design to position the arm furthest away from the bearings accurately. We have chosen a rotary actuator which is more rigid in this aspect than a linear one. Rotary actuators also consume less power, and because there are fewer moving parts, they produce fewer wear particles.

We also designed special shaft bearings and a hub which improves the air flow between the discs. This allows them to be positioned closer together, and improves the air flow within the disc compartment. New head and media technology can be incorporated at a later date without totally re-designing the product.

The RO-100 series offers one of the fastest access times of any 5.25in. drive. The average access time is 85ms. and the track-to-track access time is 18ms. That is more than twice as fast as the original 5.25in. Winchesters. This access time includes the time taken to find the correct track — the seek time — and the time for the head to settle — the settling time.

The head movements are controlled by a microprocessor. The heads are positioned by a stepper motor, which is controlled by the microprocessor. Among other functions, this calculates the damping required, buffers the incoming step pulses and removes mechanical position hysteresis.

One of the most common causes of errors in disc drives with an open loop positioner, is the lack of adequate compensation for thermal expansion in the arms, discs and other components. We have devoted considerable effort to the choice of metals in the actuator and to the construction of air-flow paths to aid temperature equalisation. Air is pumped from the upper chamber which contains the head/disc assembly, down into the lower chamber where it passes over the actuator linkage, and then back to the upper chamber via an absolute filter.

That ensures that both chambers are always at the same temperature, a feature which dramatically improves thermal compensation for the head actuator. Having ensured this, it is now possible to introduce thermal expansion compensation on a similar principle to a bi-metallic pendulum.

Our design of the Winchester chamber incorporates features which are vital to the efficiency of the drives. Winchester technology relies on a sealed chamber within which the heads fly over the disc surfaces at a very low flying height. In the RO-100's case, this is 17μin.

Here is an example of one of the many important design features of the Rodime drives which contribute to maintaining a completely contamination-free head/disc assembly:

Like all the best design features, it is simplicity itself. Although the Winchester's head/arm chamber is known as a sealed chamber, it clearly has to have a breather filter to allow it to withstand changes in atmospheric pressure. The position of this filter is of crucial importance.

The rotation of the discs causes an increased air pressure towards the periphery of the discs, and an area of low pressure around the central hub. Now, if the breather filter is placed at the periphery of the disc chamber, this high pressure area is strapped to atmospheric pressure and hence the air pressure at the centre is lower than atmospheric.

The drive bearings are at the centre of the chamber, and the drive motor is always at atmospheric pressure, so that particularly on start-up, a pressure gradient is created along the shaft of the drive motor which sucks dirt and, more dangerously, grease from the motor bearings into the disc chamber itself.

One answer could be to tighten the bearings. In this case, either the start-up time could be longer, or else more power has to be put into the motor, which would in turn create heating problems, particularly on drives which do not have thermal compensation.

Our solution is both simple and effective. We have located a breather filter at the centre of the compartment, immediately above the shaft. This point is then strapped to atmospheric pressure, and there is no damaging pressure drop.

Many estimates concerning the market for Winchesters have been published in recent months. One of these estimated the 1981 requirement at 500,000, of which approximately 20 percent would be 5.25in. drives. By 1985, the market is expected to have grown to 2.5 million drives, of which 60 percent, or 1.5 million, will be 5.25in. drives. Other less optimistic reports indicate a requirement in 1985 approaching one million drives.

One of the major uses of the 5.25in. Winchester will be in applications where a floppy disc is being used as a systems disc. The fast access times, low cost and small size and high capacity are all added attractions of the Winchester in these areas. Secondly, consider the 8in. Winchester in capacities less than 20Mbytes.

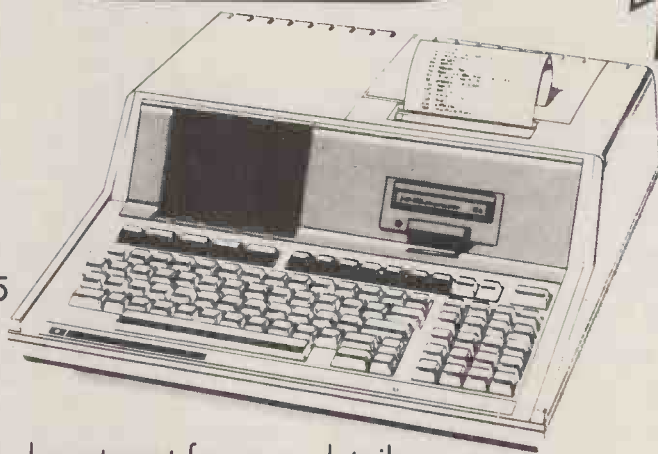
In general terms, in this capacity range, the 8in. Winchester offers the user a cost per megabyte of between \$100 and \$150. In the same range, Rodime's cost per megabyte is less than \$90.

With improved media, both particulate and metallic, thin-film heads, vertical recording, or some of the other exciting recording methods now being developed, giving more than 50,000 bits per inch, it becomes clear that forecasts claiming that the next generation of 5.25in. Winchesters will reach 50Mbytes may even be on the conservative side.

Rodime Ltd are at 12-14 Edison House, Fullerton Road, Glenrothes, Fife KY7 5QR.

HEWLETT PACKARD

HP 85



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The search for a generally-acceptable standard continues, and the answer still seems as far away as ever. Is the time yet ripe for telesoftware?

The Great Standards Hunt

CONNOISSEURS of the "standards loop" will note with a wry satisfaction that the show is getting a grand re-opening this autumn. It is a performance which is expected to run and run.

At the Skyways meeting an *ad hoc* ginger group, mainly of the smaller manufacturers and software houses, got together to urge a new initiative in telesoftware. Now a formal Government committee, ponderously titled the British Videotex Teletext Technical Committee, is to re-convene after an absence of several years to thrash out a representative position on standards for the transmission of

by Martin Hayman

software via Prestel and broadcast receivers. It is to be chaired by Bernard Rogers on behalf of the Industry Department and the British Radio Equipment Manufacturers' Association.

One of the committee's objectives is to optimise the British position with respect to transmission protocols. Since it is expected to be representative, we may be sure that the bigger manufacturers will get plenty of say. Since the world is its oyster, we may reasonably speculate that there will be a long search for the pearls of true wisdom.

There is an argument which says that the smaller outfits are in too much of a hurry to implement telesoftware. They should be looking to the future, and the possible introduction of eight-bit technology and all the other enhancements of which Prestel is capable, and should also take greater account of broadcast telesoftware. As it happens, the public is responding with far greater interest to teletext — broadcast information — than to Prestel, which can still only claim 10,000 or so subscribers.

Prestel users are deserting the ponderous and expensive dedicated sets in favour of small-scale adaptors and portable televisions — the kind which you can pick up and take home in the Granada for the weekend. One major manufacturer reports that dedicated Prestel sets are a dead duck in television retailers' shops. Even at the subsidised Prestel price of over £700, you could well get a decent colour portable plus video recorder. Who is to say that the people who are still watching re-runs of the Test Match highlights and *Emmanuelle Meets the Wife Swappers* are any the worse off than if they had Prestel, except when it comes to finding out the Inter-City train times?

However, I would not sneer at those who are still slogging away at telesoftware. Drafting standards is head-banging work, entirely devoid of the glamour associated with front-line activity, but without which none of it would work. Or at least none of it would work together.

Telesoftware is no new idea. It has been around for almost as long as Prestel itself. Philips, for example, has had a working telesoftware system for a couple of years now. It was demonstrated to me recently by Dr Graham Sharpless, who specified it, and Ludvig Zuidek, who represented Philips at the Skyways meeting. I was most surprised to see a viewdata/microtype keyboard that looked as though it had been taken off the dealer's shelf. They explained to me that it was the prototype of a Philips personal computer, which had yet to be cased up properly in order to present it to sales staff, who find it difficult to relate to operating systems.

The Philips telesoftware system is fairly similar to GEC's; like theirs, it operates quite successfully with Prestel's own retrieval and update centres, like a normal Prestel editing terminal. It can also call a program from a remote computer, located at the Philips Redhill laboratory, which it will then load into memory. So, as between GEC and Martlesham Heath, there is immediate communication between two parties whose aims are the same and who each know exactly what the other is doing.

"So what"? you may ask. Well, it proves that communications are not an intractable problem when you know what you have at either end. It is when you introduce some new variables that the nightmare starts.

The Philips system uses line and block check-sums and a line terminator in program frame. Each frame has a reserved line at the bottom which leads you on to the next frame. This is a useful way of transmitting quite a lot of information. The first field, of two characters, describes the language — unhappily, Philips telesoftware uses DIAB Basic. The second field, also two characters, specifies the version of the language, and the third field, six characters, the memory size required in bytes. The fourth field, eight characters, gives the file name; the fifth gives the number of pages, while the sixth provides extra space to link the program to any data files. These instructions, again, are followed by a check-sum and an end-of-line marker.

Dr Sharpless told me, with the sorrow of an engineer who sees his own creation refused by the powers that be, that he had rather mis-calculated in specifying DIAB Basic. It was his belief that it was a far more powerful and flexible language than the familiar Microsoft version, which he thought was clumsy and, above all, slow. But he had not taken sufficient notice of the fact that the public wants what it can already get, and hundreds of thousands of applications programs have been written in Microsoft for the Apple, Pet, Tandy and so on. So the Philips personal computer never got off the ground, and nor will its telesoftware, likely enough.

Ludvig Zuidek was, incidentally, one of the hawks at the Skyways meeting who argued most strongly that the user of telesoftware would definitely not want to look at the source code of a program, but would merely want to load it as swiftly and seamlessly as possible. He would not be the kind of buff who would welcome playing around and editing code before he cold load it into his machine and use it.

I think many people share this opinion, and they may well be right with respect to any other than the hobbyist/amateur markets. In any case, it does rather go towards explaining the excellent facility on the Philips system: a button marked Telsoft which implements the whole loading-up procedure. It is a shame that such an obviously market-orientated machine is unlikely ever to do battle in the market place.

NEC PC-8001B

Howard Pilgrim and Peter Wood assess the first business micro from the Japanese manufacturer of high-performance hardware, NEC.

WHEN A MAJOR company such as NEC, renowned for quality products like the Spinwriter, launches its own micro, then we all tend to sit up and take notice. The new NEC PC-8001B is certainly an interesting machine with many useful features.

The system consists of a keyboard unit, which houses the micro itself, an I/O box, a double-drive disc unit, a colour video monitor and a small dot-matrix printer. The units come separately boxed, complete with interconnection cables, two reference manuals, and two diskettes.

Actually connecting the components together is one of the most fiddly operations, as there are no less than four data cables, with various types of connectors. A fairly short ribbon cable goes from the keyboard to the I/O unit, which limits the position of the keyboard. We felt this was rather a shame, as a separate keyboard has many advantages in a working environment. Most of the cables bore nasty warnings about disconnection while power was applied, but they seemed to fit very securely to their sockets and we thought accidental removal would be unlikely.

The I/O box allows interfacing with the disc unit and, presumably, various other devices yet to be disclosed. The printer is cabled directly to the keyboard, as is the colour monitor — black and white may be used instead if required. The I/O unit we were supplied for review is apparently designed for the U.S. market, and we understand that the equivalent to be offered in U.K. will be considerably lower in profile. No problems were experienced in powering-up the system, and with the system disc in drive 1, disc Basic is automatically booted.

The Basic is Microsoft's, as usual, and is called N-Basic. There are a number of commands that appear to be unique to the PC-8001B, and some that other machines have only as optional extras, e.g., a re-number facility. The full list of N-Basic commands is shown in table 1.

We particularly liked the built-in Auto, Merge, Renum and Tron functions, which are similar to the Pet's Toolkit commands. The swap feature is fairly unusual and possibly useful, and Print Using is a very welcome inclusion. The facility to alter the screen width, character sizes and design of patterns via dot graphics proved both powerful and exciting to use, especially when combined with the Color command.

A spectacular Star Trek game is included on one of the discs which fully utilises these features. While it took some time to load, it was worth the wait. The PC-8001B's random-access file handling is powerful.

Sensitive keyboard

NEC is obviously well aware of the enormous market for micros as intelligent terminals, as demonstrated by the inclusion of the Term command, allowing real RS-232C communications without apparent hassle. We were not so keen on the necessity for Mount and Remove, when loading and unloading diskettes — although it is impossible to forget to say Mount, as disc I/O is not allowed until the disc has been Mounted. It is possible to forget to say Remove before turning off, which could have serious repercussions if data has been written to the disc and the file-allocation table has not been updated via this command.

The error handling provided is very good, having the ability to specify a subroutine for controlled operator intervention with the On-Error-Goto statement. There are, surprisingly, five types of numeric constants possible — integers, fixed point, floating point, hex and octal — and floating-point variables may be single or double precision, which should please all mathematicians.

Overall, we found the system physically pleasant to use; the keyboard is sensitive

and particularly worthy of mention. The cursor-control keys are "upside down" compared with other systems we have been used to — Cursor Up is non-shifted, and Cursor Down is shifted. However, once we were used to this arrangement, it made screen editing far easier as you do tend to be moving up rather than down most of the time when programming and making errors.

The System Re-set button is sensibly hidden on the rear of the keyboard unit, well out of the way of all but the most masochistic of programmers. The general layout of the keys is good — they are standard typewriter QWERTY, together with an additional numeric keypad. Unfortunately the Stop key is immediately above the Return — as it often is — but we assume that Stop could be disabled for any business application. There is an alternative Return button on the numeric pad, which must be useful for those used to calculators, or where pure numeric data is being entered.

The rather large I/O box, mentioned earlier, will be replaced with a somewhat smaller unit for the U.K. market, which will certainly make the system more attractive overall. It does seem a shame that there are so many interconnections, but perhaps mounted in a desk unit the cables could be discreetly concealed.

The disc unit is a little noisy, especially when the fan is running, but no problems were encountered in using it, and we have heard much noisier models. Only 15 files are allowed per drive, which appears to be a severe limitation when comparing the system to its likely competitors such as Pet, but it may be that prolonged exposure to the operating system would show this to be less important than it first seems.

The disc unit contains two 5.25in. drives, each of 163K capacity. The system disc contains the disc Basic and two utilities — a Copy Disc program for back-ups and a Create program for formatting new diskettes. It would have been good to see more utilities, but no doubt these will appear in due course.

The demonstration disc contains various games, including the previously mentioned Star Trek, most of which show the very versatile graphics and colours well. Since the machine is so new, it is hardly surprising that games are the only programs supplied, though it made it impossible to gauge the performance of the system in a business environment. Certainly, applications software will arrive and it will be very interesting to see how the PC-8001B compares with Apple, Pet and so on in this area.

Clear definition

The Hitachi colour monitor performed well, with clear definition and superb colours. The dot graphics are particularly impressive, and it seems likely that it will be possible to create graphs, pie-charts and other models with good accuracy, using the eight available colours and 690- by 280-dot resolution.

The dot-matrix printer is a NEC product which, while fairly "plastic" in appearance, gives very high-quality output for a matrix unit. The specification claims a print speed of 100 characters per second, which seemed about right. Its bi-directional printing makes quite a difference to overall speed, for instance when making a program listing.

Proportional spacing is also provided, which caused some raised eyebrows until we remembered that NEC makes one of the best-selling letter-quality printers, so the company probably knows what it is doing. A proportional-spacing printer for around £400 is extremely good value.

Finally, on the hardware side, the keyboard includes five programmable function keys, each of which may be used shifted and un-shifted. At switch-on they are set to various commonly-used statements, such as List, Print, and so on; they may be re-defined by the operator to give a very useful and flexible programming aid. The function-key settings are shown on the bottom line of the screen for quick reference, and change as soon as the Shift key is pressed or released. This display may be turned off if preferred.

The manuals which are provided are well written and, as far as we could tell, accurate. A very handy reference card is also included, containing all the N-Basic statements and a brief explanation of each.

The major work is the N-Basic reference manual, which gives a clear understanding of the Basic, disc files, disc formatting and some operating instructions. The second book is the Expansion Unit Reference Manual, which gives very detailed technical information for the use of Prom chips, Interrupts, using the bus, I/O addresses, Priority Interrupts, Interfacing, etc. Obviously of great use to anyone wishing to delve deeper than simple use of the machine as a Basic system, it was too complex a task to give a fair review of these features in the time available.

One complaint is the lack of an "idiot's guide" to connecting up the system, checking it out and using the Mount, Remove and other essential features. It may be that NEC assumes the system will only be sold with installation and training by the dealer — certainly preferable for all computers — but experience teaches us that this may often not happen.

(continued on next page)

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Conclusions

- **A neat, professional system in appearance, although cabling seems a little messy.**
- **Very good-quality graphics and colour, with excellent definition.**
- **Good, versatile Basic, with some interesting extras.**
- **Good-quality matrix print from a fairly low-cost printer. The printer may not be sturdy enough for heavy commercial use.**
- **Apparently restrictive disc-file structure — they have only 15 files per drive.**
- **Good-quality keyboard, sensibly laid out, with Reset button well out of the way.**
- **Readable and informative manuals, although an "idiot's guide" would be a welcome addition.**
- **At present we do not know of any applications programs for the machine, which must severely limit its sales into the business world, though software will obviously appear in due course.**
- **At around £2,700 for the system hardware as tested, the NEC PC-8001B is competitive, but not cheap.**

Table 1.

Statement	Description
AUTO	Generates line numbers after each carriage return.
BEEP	Causes the internal buzzer to beep.
CLEAR	Clears all variables.
CLOAD	Loads programs from cassette.
CLOSE	Closes previously opened files.
COLOR	Assigns a colour, or screen attribute.
CONSOLE	Formats the screen and determines the colour mode.
CONT	Continue after a STOP or END.
CSAVE	Saves programs on to cassette.
DATA	Supplies data to a READ statement.
DEF	Declares a variable, or range of variables, as integer, single precision, double precision or string.
DEFFN	Defines functions, such as DEFFNB (X, Y) = X/Y*100.
DEFUSR	Specifies the start address of a machine-code subroutine.
DIM	Dimensions arrays.
END	Terminates program execution.
ERASE	Eliminates previously Dimensioned arrays.
ERROR	Defines error codes not intrinsic to the PC-8001B.
FIELD	Divides a 256-byte record into fields for a random-disc file.
FILES	Displays the disc directory.
FOR . . . NEXT	Performs series of instruction a given number of times.
FORMAT	Performs level-1 formatting of a diskette for data I/O only.
GET	Reads a record from a random-disc file.
GETC	Saves characters or dot graphics from screen to an array.
GETGC	Saves colour, dot graphics and screen attributes from screen to an array.
GOSUB/RETURN	Causes unconditional jump to subroutine at specified line number, and returns.
GOTO	Unconditional jump to specified line number.
IF . . . THEN	Conditional jump to specified line number.
INPUT	Accepts data from the keyboard.
INPUT#	Reads a record from a random disc file.
KEY	Initialises the programmable function keys.
KEY LIST	Displays a list of strings assigned to the function keys.
KILL	Deletes a specified disc file.
LET	Assigns a value to a variable.
LFILES	Lists disc directory to printer.
LINE	Specifies screen attributes to a line on the screen.
LINE INPUT	Initialises a string to an entire line.
LINE INPUT#	Reads a line from disc as it was saved by LINE INPUT.
LIST	Lists program to screen.
LLIST	Lists program to printer.
LOAD	Loads a program from disc.
LOCATE	Positions the cursor at a specified position on the screen.
LSET, RSET	Moves data into defined fields of a random disc-file buffer.
MERGE	Merges a program on disc with program in memory.
MOTOR	Controls the cassette motor.
MOUNT	Reads the disc file-allocation table — FAT — into memory and checks for errors.
NAME	Re-names a file on disc.
NEW	Deletes program in memory.
ON ERROR GOTO	Sets error trap.
ON GOSUB/GOTO	Program branch dependent on value of specified variable.
OPEN	Opens a random or sequential data file.
OUT	Sends a byte of data to a machine port.
PEEK, POKE	Read/write a byte in memory.
POINT	Checks whether a dot is set at a specified location.
PRINT	Displays values of variables and strings, etc.
PRINT#	Writes image of displayed data to disc.
PRINT USING	Prints data to a formatted field.
PSET, PRESET	Sets or clears a dot at specified location on screen.
PUT	Writes content of a random buffer to a random disc file.
PUTC	Displays characters and dot graphics previously saved by GETC.
PUTCA	Displays characters and dot graphics previously saved by GETCA.
READ	Initialises variables to the data items of a DATA statement.
REM	Remarks.
REMOVE	Updates the file-allocation table before a disc is physically removed.
RENUM	Re-numbers program lines.
RESTORE	Re-sets data items for re-reading by READ.
RESUME	Continues program execution after performing an error-recovery procedure.
RUN	Runs a program in memory, or loads and runs a program from disc.
SAVE	Stores a program on disc.
SET	Sets read-after-write and write-protect attributes on a disc.
STOP	Halts program execution.
SWAP	Exchanges the values of two variables.
TERM	Puts the PC-8001B in terminal mode for communications.
TRON, TROFF	Trace on and off.
WAIT	Suspends program execution until specified machine port sees specific data.
WIDTH	Determines number of characters per screen line.

Comal-based Piccolo blows wind of change

The Piccolo is a Danish-built microcomputer aimed at the educational market where it will compete with the Research Machines 380-Z. The main feature of the Piccolo, also known as the RC-700, is the fact that it uses the Comal-80 programming language. Bill Bennett is the reviewer.

MUCH HAS been written in the pages of *Practical Computing* about the desirability or otherwise of structured programming. Comal is really a structured form of Basic. It contains the structures associated with Pascal while retaining the simplicity of Basic. Comal was developed in Denmark by Borge Christensen, so it is not surprising that a Danish computer should have the language as standard.

The computer itself is neat and compact. The system as supplied includes a display unit, a keyboard, the main CPU and a floppy-disc unit. A transformer is also included to provide the correct voltages for operation — the mains supply in Denmark is different to that in the U.K. The system supplied for review only had a single, mini-floppy unit, but other configurations are possible.

After connecting the units together, the next thing to do is to switch on. Experience in these matters makes this the nail-biting moment, but fortunately the Piccolo came on first time. The first surprise was the display, which is yellow on brown. This is the recommended format in Denmark, where all word processors have similar displays.

The Comal systems disc is loaded into the drive and the re-set button is pushed to boot the system. The display then comes up with the message

RC700 COMAL REV.x.xx

and you can begin.

Some rather uninspiring applications software was provided. A little more imagination over demonstration programs would, no doubt, sell many more computers. The more interesting software was annotated in Danish, which is not particularly useful unless you understand the language. The Danish version of Mastermind was the most exciting program supplied, though anybody with a small amount of programming experience can write a Mastermind program, even in Basic.

The operating system used by the machine is not standard, but provides the necessary functions. The re-set switch initialises and starts Comal. Any indentation required by Comal is performed automatically by the software. The system forces all variable names into upper case, with other words appearing in lower case unless they are enclosed in quotation marks.

Comal statements are checked for syntatical correctness as they are keyed in. Incorrect lines are not accepted and an error message informs the user of the nature of the error. This would be a very welcome feature of the language except that, again, the error message appears in Danish. After a while, you get used to the Danish terms, but they are still a considerable handicap in a system which is intended primarily as a teaching machine. The review machine was one of the first to enter the U.K., and the manufacturers say they will amend the sofware to display

the messages in English, not Danish.

The Piccolo's system commands may be used for program development, program execution, dynamic debugging, calculator functions and file handling. System commands run immediately. Usual commands like Auto, List, Load, New, Save, Run and Print are available, and are almost identical to similar commands on other machines.

The RC-700 system uses the command Bye. Con is the equivalent of Cont on other machines; it is the instruction to resume execution of a program after it has been stopped. The command to scratch a file from the disc is Delete "file name", though you cannot scratch the system files. The Help command writes out the names of the commands which are available to the user. The assignation statement Let is included. It has the same function as the Let statement, but is used to assign values before running or continuing a program.

The Look-up command is one that does not appear in most Basics. It replaces some functions of the Catalogue command by returning a list of all the files on a disc. The Output command directs output to either the printer or the video monitor. The command Re-number is particularly useful, and re-numbers all control statements as well as the program lines.

There is an Edit command and special editing keys, as well as control-key functions. The editing functions include cursor movements, character insertion, character deletion, rest-of-line deletion and the deletion of the last input line.

Like other structured languages, Comal is based on the philosophy that the Goto statement is unnecessary. Nevertheless, Goto does remain in Comal, as do most of the commands of standard Basic. Identifiers are used to define certain entities in a program, and may consist of up to 16 characters. An unknown number can be referred to as Unknownnumber in the program. Many Basics allow one or two characters for identifier names.

The possibility of using recognisable words as identifiers makes programs easier to understand. If you read a Comal program written by someone else, it is immediately obvious what is happening. Debugging is relatively easy in a procedure called Taxcalculation, for example, with variables called Income and Deductions. On the other hand, most Basic programs deal with variables such as A, X1, and subroutines are referred to merely by the line number at which they start. This is really the essence of structured programming — knowing what is going on in the program.

Identifiers are given to simple numeric variables, indexed numeric variables, simple string variables, indexed string variables, user-defined functions, procedures, formal parameters, and file variables. Although an identifier can be input in upper and lower case, it will be forced into upper case once entered.

Most of the commands available in Comal-80 will be familiar to anyone who has programmed in Basic. The RAM statement is retained unchanged, as are many others, such as Print, Read, Input, Data, Restore — which is used to set the data pointer back to the first item in the data list. Goto is retained despite the claims of Comal to be a structured language, as is Gosub.

As in most versions of Basic, the Let statement may be omitted. The Dim statement is slightly different as all strings must be Dimensioned before they can be used in a program. The maximum size of a dimensioned variable is limited only by the available memory.

Def is more or less the same as in most Basics, allowing the user to define functions. The major departure here is that the functions thus defined can have an identifier that actually tells the user what the function does. In most Basic implementations the function would have to be called something pretty meaningless, like FNA for example. User-defined functions in Comal may only have one parameter, and recursive calls are not possible.

Comal allows control of the program to be kept within the limits of certain sub-programs or structures, so it is unfortunate that Comal-80 supports the Goto statement. Proponents of Comal maintain that any program can be written without using Goto, but it is unrealistic to suppose that the statement will not be used if it is there.

Comal has structures to control the flow of the program through gateways such as the conditional statement. This is a more sophisticated version of the If-Then-Else conditional statement — the big bad wolf of Microsoft Basic. For example:

```
1000      if ANSWER$ = "YES" then
2000          exec POSITIVEREPLY
3000          else if ANSWER$ = "NO" then
4000              exec NEGATIVEREPLY
5000              else exec UNWANTEDREPLY
6000          endif
7000      endif
```

The Else part of the structure may be omitted if it is not required, and the statement list between If and Endif can be as long as is necessary.

The For-Next statement is fairly standard, though it must be properly closed at the end. The While-Endwhile statement, which will be familiar to Pascal users, allows a series of statements to be executed as long as a condition is satisfied.

```
1000      while CONDITION$ = "DANGER" do
2000          exec MONITORPATIENT
3000          exec ALERTDOCTOR
4000          input CONDITION$
5000      endwhile
```

The While statement, like all Comal structures, is easy to use. The Repeat-Until structure is very similar: the difference is best illustrated by Borge Christensen's statement that the While structure is a front-door entrance and Repeat-Until is a back-door exit. In other words, a series of instructions is obeyed until a condition becomes satisfied.

The Loop-Endloop can only be left when the Exit statement is reached. The Endloop instruction simply transfers control to the next statement after the Loop command. When Exit is encountered, control is transferred to the next statement after the Endloop instruction.

A procedure is best thought of as a sub-program that may or may not have formal parameters sent to and from it. To call a procedure, the Exec statement is used. Return returns control to the next statement after the procedure call.

In and Out statements are used to communicate with peripherals. One very useful statement is the On Esc command, which transfers control when the escape key is depressed. Randomise seeds the random-number generator, and Output is used to direct the output text to either the screen or another device.

The function set supported by Comal-80 on the Piccolo is reasonably standard, though the file handling is not. Chain is a helpful command which allows another program to be read from disc and executed when the current program has finished running.

The Piccolo Print command is slightly more sophisticated than most thanks to the Tab function and the Print Using instruction. Tab positions the cursor to begin printing at a position on the current line defined by the argument in Tab. The Piccolo has 80 columns on the screen, providing scope for good, clear screen displays.

The machine is weak on graphics. Particular characters provide some screen-control facilities. The codes are more or less the same as in other machines, giving transferred programs a degree of portability. Some codes cause screen flashing — which is very tiring on the eyes — while initiating the semi-graphic character set, inverting the script, underlining and returning to normal script. The printer can be controlled in a similar way.

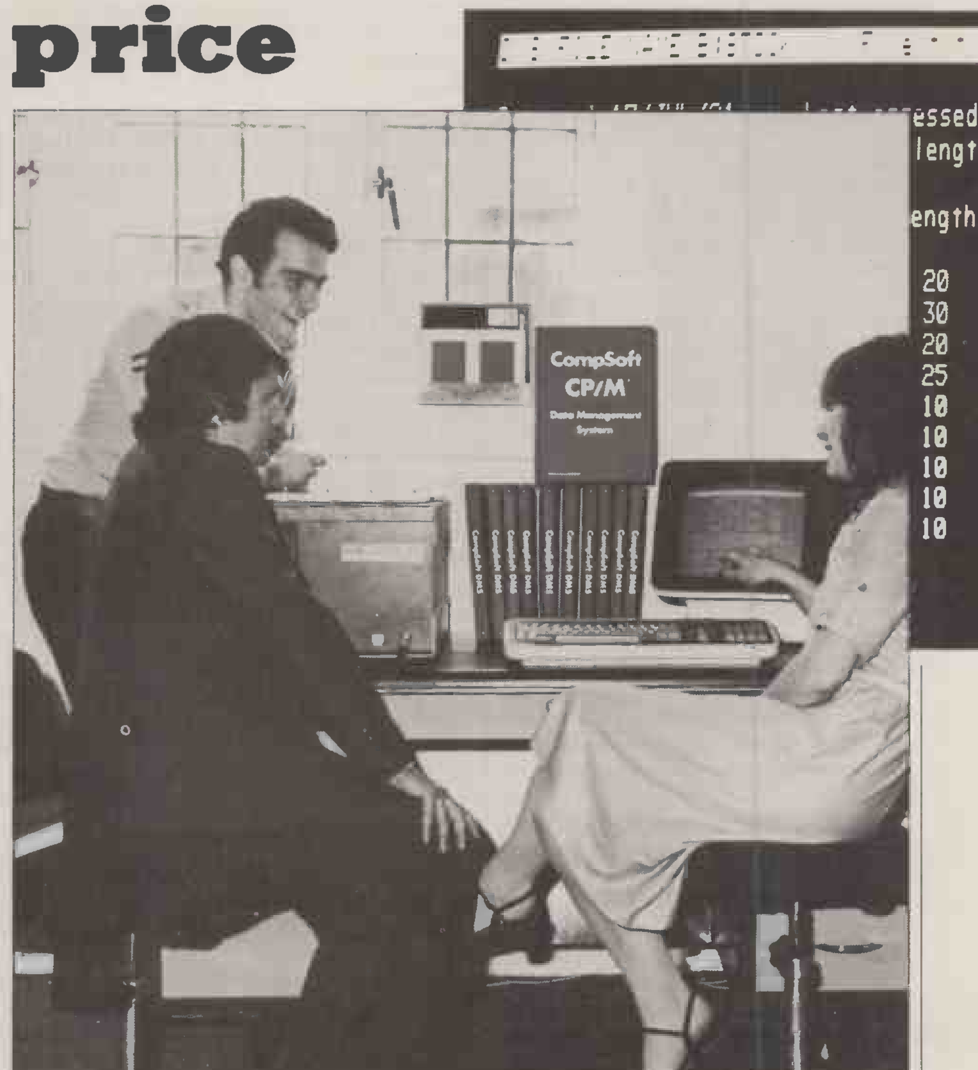
The Piccolo has been designed with communications and networking in mind therefore it is likely to be this fact as well as the Comal programming language that will make this computer popular with educationalists.

Conclusions

- **The Piccolo is a fine piece of hardware, compact and well designed, though it has many cables.**
- **It will however have to be vigorously promoted to break Research Machines' grip on the education market.**
- **The Comal language is a useful educational tool, being easy to use and structured.**
- **Danish error messages are confusing; the software will be greatly improved by removing this problem.**

Tailoring the package — and the price

Information storage and retrieval to suit your requirements without the need to program are the big attractions of Compsoft's DMS. Peter Wood evaluates the system designed to run on CP/M 2.2 systems.



CP/M IS the most popular operating system for micros, and the wide range of software available for CP/M systems offers the user obvious and attractive advantages. So, it would seem likely that an increasing number of the commonly-used micros will eventually support such an operating system — perhaps in addition to their own more esoteric ones. A recent move in that direction has been the launch of the Small Systems Softbox, a device which allows the Pet to run several of the CP/M packages with no modification whatsoever.

Compsoft's DMS has been available for some time on the Pet, and has now been released for use on CP/M version 2.2 machines. DMS, which stands for Data-Management System, is an information storage and retrieval system that the user can configure to his own requirements without recourse to programming. It means the cost of personalised software can be reduced very significantly, providing that the job is a card-index type of application.

The manual provided with the package is well written and informative. While any software product's documentation must assume that the user understands his hardware and operating system — or else be too heavy to lift — this manual goes into sufficient detail to make the task of getting to grips with the program reasonably easy. The style is easy going without becoming trivial and at no time appeared condescending.

We tested the program on an SD Systems MS-20 with 64K of RAM and two 1Mbyte 8in. floppies, running under MS-DOS which is the SD version of CP/M. The program is written in compiled Microsoft Basic and requires 46K of user RAM.

The program is loaded by typing DMS and pressing Return. A menu is then displayed which gives 15 options, each selectable by a single letter, A to N, or X. The user's company name is displayed at the top of the screen together with a licence number and date.

There is also a very user-friendly paragraph describing how to load the various programs, and offering further detailed explanations of them for the inexperienced operator. The 15 options are:
A: CONFIGURE B: CREATE C: KEY D: SHORT E: SELECT F: RE-DEFINE G: TRANSACT H: REPORT I: LABEL J: SCREEN K: PROCESS L: COPY M: LINK N: RESET X: EXIT

As each selection is made, the screen displays the selected program name in large type together with an explanation of its function, and asks you to confirm by pressing the space bar. Pressing E at this stage returns you to the menu screen.

The Configure option allows you to set the program for use with your particular system. The kind of information required at this stage is the type of printer being used — 80 or 132 columns — and the control codes for performing the various screen functions such as clear screen, reverse video and so on. These tend to differ from machine to machine. Configure is used only when you first receive the package and should be run before you do anything else.

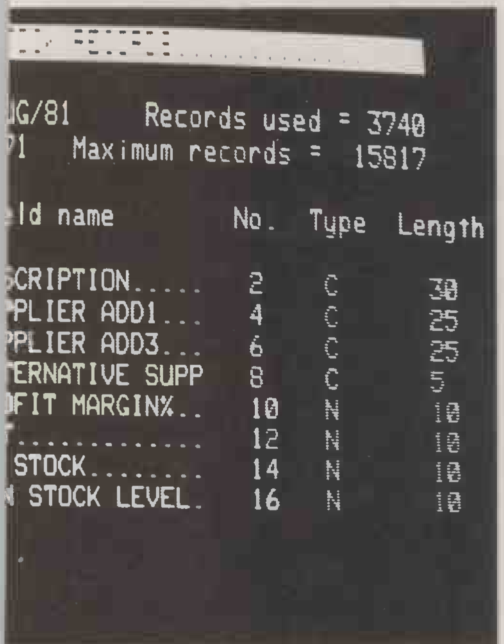
Before you can begin entering information, you must, of course, define what you want to store and how it is to be displayed — this is the role of the Create function. Its job is analogous to setting up a blank record card which is best done first on paper to plan the content and style of the card. The decisions you would need to make are:

- How many fields of information on the card. A maximum of 60 fields are allowed.
- What to call each field, e.g., name, telephone number, etc. Up to 15 characters may be used in the field name.
- Whether the field is character, which means text, numeric — numbers only — or date.
- Decide which is the key field. The information in the key field must be particular to each record, and must be the first field on the card.
- Check that the total length of all the fields does not exceed 1,000 characters, which is the maximum record length.

A worked example of this is supplied in the manual, and provides useful practice for the new user.

In DMS each record has its own key. This key is used for rapid access to the record, as against searching through all the records in the file for a particular piece of information. If, for instance, you had set up a personnel file, the employee's name may well be the key.

Whenever you needed to change the



information relating to a specific employee, you could do so by simply typing his name, using the Key option. The computer could then go directly to his record card and retrieve it.

Having selected Key, the first question you are asked is:

Do you want transaction logging Y/N?

If you respond Y, every change you make to the information is copied on to the printer. This is very useful for checking the data you have entered — especially if there is plenty of it. The next question is:

Do you want the contents of new records displayed after keying in data for each field Y/N?

This option allows you to see, on the screen, the entire record card as it is after each field entry. I imagine most users would not use this facility once they have become familiar with the package, since it slows down data entry considerably. Five options are now displayed:

C: to continue without displaying the record after each entry.
D: to display the file description, i.e., the field headings.
R: to re-start the program.
E: to return to menu.
SPACE: to continue.

Having pressed the space bar, you are requested to enter the first field which is the key field. If a record already exists with this key, it will be displayed for alteration. If no record exists, you are asked whether you wish to create a record with that key. You may then proceed to enter information for all the fields on the record.

Two useful features exist at this point. First, if you wish the same information to appear in the same field in the current record as it did in the last, then pressing Control P will duplicate from the last record being used into the current one.

Secondly, pressing Escape will return you to the first field of the current record, allowing re-entry of data if mistakes had been made. Date fields may be filled automatically with the current date, by pressing C when date is requested.

When records already exist on file, five options are available:

P: Print the current record.
D: Delete the current record.
A: Amend a field in the current record.
S: Store the amended record on file.
C: Get the next record or end.

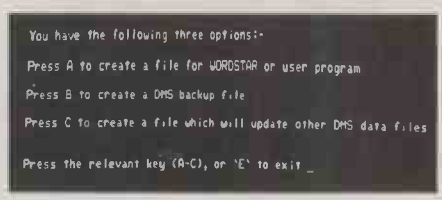
After amending a record, you return to these five options, and the S is highlighted to remind you to store the altered record. If the change is to be aborted, C may be selected instead.

The obvious and straightforward way of retrieving a DMS record is by Key. The other method is more complex, and ultimately, more powerful — Select. The Select option allows you to search the entire file for information contained in one or more of the non-key fields.

An example may be a personnel file, where you wish to extract all employees who are: paid weekly and; over 40 years of age and; live in Sussex or; live in Sutton. Up to eight criteria may be set on one pass of the file, and each may be joined by using And and/or Or. Confused? — well, it works like this.

First, each selection criterion is allocated a number, 1 to 8. Then each pair of selections — 1 and 2, 3 and 4, etc. — is joined with an And or an Or. Next, each pair is evaluated as true or not-true, giving a maximum of four answers, one per pair. These pairs are then joined with And or Or and evaluated in their turn.

Finally, the results of that evaluation are in turn evaluated giving a final true or not-true result. If this answer is true, then



the record is selected and may be printed, displayed or even transferred to another file. A simple truth table can be shown as follows:

TRUE	AND	TRUE	=	TRUE
NOT TRUE	AND	TRUE	=	NOT TRUE
TRUE	AND	NOT TRUE	=	NOT TRUE
NOT TRUE	AND	NOT TRUE	=	NOT TRUE
TRUE	OR	TRUE	=	TRUE
NOT TRUE	OR	TRUE	=	TRUE
TRUE	OR	NOT TRUE	=	TRUE
NOT TRUE	OR	NOT TRUE	=	NOT TRUE

It is certainly a very good idea, as the manual suggests, to calculate all this on paper beforehand so that you are sure that you really obtain the results you expect. The results can be, say, extremely useful reports, once you realise the full potential of this system of selection.

When searching on a Character-type field, each selection can be for the whole field, or only a position in the field. If you select position, DMS requests you to give the start position and length of the character string by which you wish to search.

If you select the whole field either an exact match for the string or an embedded search is performed on the field. The type of comparison is then requested: EQ, equal to; NE, not equal to; or RN, in the range of. If you select EQ or NE, the next option allows you to compare against a constant, which you supply, or against information contained in another field.

The RN option is more complicated and requires you to type in the two constants between which you want to search. For instance, all records between A and E, or between 678 and 1,999. The last question you are asked is whether you want to see if the constant appears anywhere in the line, so that if you were searching for Sussex, you may wish all records having the word Sussex in the field called county, whether or not they contained East Sussex or West Sussex.

When searching on numeric fields more options are available:

EQ equal to
NE not equal to
GT greater than
LT less then
GE greater than or equal to
LE less than or equal to
RN in the range of

You may compare constants or other fields as in the character searches.

In date fields you have the ability to look for whole or part dates. For instance, you could find information for 1981 or September and range searching is particularly useful for finding dates between two dates. All the selection criteria you enter may be stored on disc for use again and again. The And/Or facility used in combination with the selection criteria described makes the package very versatile and is, in our view, the most significant single feature.

All the DMS reports allow you to use the selection feature and sorted files, and also allow you to choose which fields from the records are printed. There are four types of report.

In the standard report type A, fields from each record are printed across the page with headings at the top enclosed within dotted lines. You may supply a date and title for the report; page numbering and pagination are automatic. Standard report type B is like type A, except that the fields are printed down the page with the headings on the left.

User-defined reports are created using a report generator which allows you to format your printing so that invoices, statements, stock cards, etc., can appear exactly as required. Again, the manual suggests you use pen and paper to set it out before wasting too much time on the machine — and too much listing paper. User-defined address labels may be

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printed — you can specify up to five across. Each label can be individual or the same label may be printed up to 50 times.

On each report it is possible to total numeric fields and print them at "control breaks" which are set so that each time the contents of a field changes, say, department number, the totals are printed automatically. Totals for the entire print are also produced.

Three options are used for reporting: A to print standard DMS reports, B to set up tailored reports and C to print tailored reports. Again, you may store the formatted report layouts on disc for future use.

Sorting may be carried out on only part of a file, and generates a sorted index which is then stored. You may create as many sorted indices as you wish, up to the capacity of the disc. When an index is selected, DMS tells you if any updates have been carried out since that index was created. That protects you from missing new information.

One of your previously-defined selection criteria may be used, and the sort will apply only to records chosen on that basis, so that sorting all employees in Sussex into ascending salary order is very easy indeed.

If you are sorting on a character field, you need not sort on the entire field, but specify the start position and length within the field of the sort criterion. The full contents of date and numeric fields are always used, however.

Having created a sorted index, selecting Screen allows you to make an entry that DMS uses to position itself in the index. The record nearest to the data you entered will then be displayed. It is then possible to nudge up or down the file using the less-than and greater-than keys, print the displayed record using P, or change the search parameter with R.

Obviously, using Screen and Sort is useful only if the index is up to date, and users who change the contents of their files frequently would need to regenerate sorted indices reasonably frequently.

The process function is a batch-processing facility which allows a series of calculations to be performed on all or part of the file. An example may be a stock file, where you needed to increase the price of all items in a particular product group by 10 percent. Again you have the ability to store the process instructions on disc for repetitive use. The following operations are possible:

- \+ addition
- − subtraction
- / division
- * multiplication
- = make equal to

These operations are performed on fields from the records, accumulators or constants. Up to eight instructions may be entered, each of up to 100 characters in length. In our example relating to stock records, you may set up the following:

1. SELLING PRICE = SELLING PRICE* #1.1
2. COMMENT = PRICE INCREASE DUE TO DOLLAR FLUCTUATION

There are 30 accumulators which may be used to produce totals. They are divided into three groups: 1-10 which are cleared to zero as each record is entered before processing begins on that record; 11-20 which are also cleared to zero, but only after processing the record and non-zero accumulators are printed out; 21-30 which are cleared to zero only at the beginning of a processing run, and are printed at the end of a run for end totals, etc.

All the instructions are evaluated from left to right, so you need not remember the precedence of division, multiplication, addition, subtraction. Records may also be deleted by including an up-arrow sign, followed by Delete in a processing line. Processing instructions appearing after that line will, however, by ignored.

You may opt to print the complete record contents both before and after processing, or only after, or only those fields affected by the processing. Errors can also by printed — for example, trying to inserted too large a number in a particular field.

A lovely feature of the program is the file-to-file copy. It allows you to define a new, and possibly different, record format, with perhaps more or longer fields and copy all or part of the old file across. The saving on re-typing because you changed your requirements is tremendous.

You may also want to combine the contents of two files, or to extract records for one file into another because you are forming a new company or division. The options available must be obvious by now, as DMS is consistent throughout. Printing options are available, as are selection criteria.

The Link option is used to create files for use with word-processing software, such as Wordstar, and many be used in a mail-merge run, for automatic insertion of names and addresses and so on. It is also used for creating back-up or update files for re-input to DMS itself.

The option exists to use a sorted file which you have previously created, and a pre-defined record selection as with many of the other sections. You may then specify which fields you wish to transfer to the output file.

Up to 60 fields may be output, in any order, and the same field may be output more than once if required — very useful for those involved in direct mailing and personalised letters.

The ability to define a screen mask is important if you wish the information to be presented in a special format, of if you wish to allow updating of certain fields only. It will also allow you to hide certain pieces of data. The Transact feature permits you to create screen masks, each with its own password, so that an operator with the key word can perform his specific task and no other.

If you had a stock-control system where you wished to protect the prices, minimum stock levels, etc., but wanted to allow an operator to issue stock and have the figures for the item updated, then Transact will do the job. Formatted masks may be stored on the disc, and called up by name. The password must then be entered before any processing can take place.

Fields may be updated as the operator is prompted by the system. If a disc is created for use in, to quote the manual, "a restricted-access environment", then the other menu options can be removed to prevent alteration of the data.

Re-define allows you re-define or print the file definitions — most useful if you need to change the name of a field or fields without altering the record structure.

Conclusions

- **At £400 DMS on CP/M is certainly good value. The features offered make it a very powerful records-management package.**
- **Although the screens were extremely user-friendly in showing a paragraph or so of instructions, we felt this might have been better replaced with a help facility. This would have avoided filling the screen with what becomes superfluous information as the user learns the system. This is, however, a minor point.**
- **The search facilities are very complex, and when coupled with sorts, file-to-file copies, formatted screen masks, and process options give a very flexible package indeed.**
- **Compsoft Ltd is at Great Tangley Manor Farm, Wonersh, Near Guildford, Surrey. Telephone: 0483 505918/39665. The contact is Heather Kearsley.**

Analysing data

Two contrasting sets of statistics programs are examined in detail by Owen Bishop.

STATISTICAL PROGRAMS are published in two very different forms in the two packages reviewed here. Prentice-Hall offers a series of simple programs as listings in a book, while Ecosoft's Microstat is supplied on a pair of discs.

Basic-pack Statistics Programs for Small Computers is a recent addition to the Prentice-Hall series in personal computing. It contains a selection of 33 programs for statistical analysis of data. Each program is separately documented with a clear description of its purpose, its possible uses and the kind of data for which it is designed. Worked examples and detailed instructions are given, so a relative beginner could pick up the book, key in a program and begin analysis within half an hour.

Most of the programs deal with a single test, though some of the more elementary routines such as mean, variance, standard deviation and standard error are grouped into one program. The programs are typically 100 to 180 lines long.

Since all lines are single statements, and many are taken up by Rems or the single command Print, only a small amount of typing is required to enter a program. However, if you need to carry out several different tests on the same set of data, it is necessary to re-enter the data for each test. With large runs of data this could be tedious and a source of error.

The programs give you full opportunity to correct data that has been entered erroneously. They also inspect the data as it is entered and prevent entry of invalid data, such as negative or out-of-range values.

By looking through the book and finding a worked example that parallels your own set of data, you can find and run a suitable test without having much understanding of the statistical principles involved. For those who do want to get to grips with the principles there are very detailed explanations of each test, which include a description of all the underlying equations and concepts. The explanations are backed up with a list of references to fuller descriptions in the standard American textbooks, some of which are readily available in U.K. Each program is also accompanied by a set of exercises, with answers, thus making the book useful to the student.

Full running instructions are given for each program, together with printout of one or more sample runs. Under the heading "Bugs", the author lists any circumstances under which the program may fail to operate satisfactorily, such as the possibility of overflow when calculating factorials.

Tables of Student's t, the Mann-Whitney U, chi-square, and Fisher's F are given at the back so that the user can estimate probabilities from values of these statistics calculated by the programs. A few of the programs calculate the probabilities directly.

The author comments on the reliability of the algorithms used. Rather tantalisingly, he does not explain the basis of these algorithms, which would interest the more erudite statistician. It is only in these programs that the Basic uses more than the most elementary of operators and functions. The owner of the typical personal computer should be able to key in most programs without much adaptation.

The book begins with a set of 10 programs on descriptive statistics. These include calculation of probabilities under the binomial, Poisson and normal distributions. There are utility programs for sorting and ranking an array of values, and programs based on the t-statistic and on chi-square.

The remainder of the programs, which include the McNemar test and the Median test, reflect the emphasis on non-parametric testing found in this collection. Since non-parametric tests are best for small samples — which is what most of us usually have to deal with — the selection offered will be generally useful. The most notable omissions are analysis of variance and regression analysis.

The book is well produced with large, clearly laid-out pages. In each chapter, the printout of the sample run and the listing of the program are in facsimile to distinguish them from the descriptive text. Unfortunately the original printout and listing appear to have been done on an ancient printer with a worn ribbon. Although legible they are not easy reading. This, however, is a minor criticism of what is generally an excellent work.

The Microstat package from Ecosoft is a product of an entirely different type. It is clearly aimed at the experienced statistician who has a suitably impressive microcomputer on which to run it. The manual states that the minimum system for satisfactory operation should have 32K memory and dual single-density 8in. disc drives.

The package is presented on two discs, one of which is completely filled with programs. The other carries the remainder of the programs, leaving about 280 blocks of free space for the storage of data files. The discs are designed for operating under North Star DOS and Basic. There is provision for establishing certain screen and printer parameters once and for all so that the format of VDU display and printout can be adjusted to the peripherals in the user's system.

The package is based on a data-management sub-system — DMS — in which all data is held in files. There are all the usual facilities for creating, editing, merging and destroying files. The convenience of the DMS is that data needs to be entered only once. It can then be subjected to a variety of statistical procedures as often as required, for as long as it remains on file.

There are also procedures for transforming the data in a file. For example, by a single command every item in a named file can be converted into its reciprocal or its natural or common logarithm, multiplied by a constant factor, incremented or decremented by a fixed amount or transformed in a number of other ways. This is an essential preliminary to several statistical tests and can be helpful when one is looking through a set of data prior to

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analysis. Sets of data can be displayed with all variables in a common format, independent of the format in which they were originally entered.

Access to the package is by means of a sequence of menus. Selection and branching is by single-key entry, with the default being the choice most commonly required. Progress through the stages of a procedures can be very rapid, though the less-experienced user could quite easily become lost.

Unfortunately, there seems to be no way back to the main menu until after the completion of each test. A careless entry during a test can lead to a waste of time, while you plough on through the remainder of the test watching the results of meaningless computations appear on the screen. This package is clearly for the careful and concentrating user.

There is a comprehensive selection of tests, both parametric and non-parametric. These include analysis of variance, regression analysis, time-series analysis, goodness of fit, the runs test and most other standard non-parametric tests. There are programs for calculating factorials, permutations and combinations. These calculate factorials directly for X<=49. Above this limit, approximations are used to eliminate the danger of overflow. The upper limit is factorial 1,000,000.

The manual is well compiled and explicit. It contains clear instructions on how to operate the system, and lists the menus, and the sequence of entries required for performing each of the tests. There is no attempt to make this a statistical handbook. Unlike the Prentice-Hall book, the Microstats manual does not explain the purpose of the tests, nor does it give examples of their use or show what they do and how they do it.

The programs have no provision for preventing a test being performed on invalid data and calculating entirely meaningless results. This is not necessarily a criticism of the programs, for they are clearly intended for experienced users, but the less experienced should not contemplate using the Microstats package without considerable preliminary training.

One aspect of data entry was found to be inconvenient and a cause of frequent mis-keying. The problem arises because data must be entered by cases. For example, when entering a table which lists the weights, ages and response times of a set of persons, the data must be entered person by person. Every figure to be entered has a different format from the figures preceding and following it. You might have to enter a series such as 85.35, 42, 0.0123 for each person, though it would be much easier to enter all the weights, followed by all the ages and all the response times. Keying in a set of values with identical format establishes a rhythm, and is quicker and less error-prone. This facility could have been provided without unduly complicating the program, and would have made data entry more speedy and reliable.

Conclusions

- **The Prentice-Hall book is good for descriptive statistics, and non-parametric testing. It gives clear and full explanations throughout, and is suited to the beginner and student as well as to the more advanced user of statistical testing. It contains short, clearly-written programs which use a fairly elementary Basic set. It is highly recommended as very good value for money at only 33p a program.**
- **The Ecosoft Microstat is a worthwhile package, though only for the expert. You will need to follow its system exactly, so look at the manual before buying the discs, to confirm that the procedures and the range of tests suit your requirements.**
- ***Basic-pack Statistics Programs for Small Computers* by Dennie Van Tassel is published by Prentice-Hall International, price £11; ISBN 13 066381 6.**
- **Microstat is produced by Ecosoft, P.O. Box 68602, Indianapolis, In. 46286, U.S.A., and distributed in the U.K. by Digital Devices Ltd., 134 London Road, Southborough, Tunbridge Wells, Kent; telephone (0892) 37977/9.**

Adaptive programs change their form in the light of their own experience. Embodying adaptive techniques into statement analysis opens up the possibility of a computer which tolerates a wide range of programming errors.

Teaching a computer to learn from your mistakes

CURRENT COMPUTER systems require the users to construct programs in accordance with an extremely strict set of grammatical rules. They would probably be regarded as much too pedantic for practical use in any other sphere of human communication.

It is, consequently, only too common for a program submitted to a computer system to be rejected for trivial reasons such the omission of a closing bracket. As a further aggravation, it is quite possible that the mistakes were not present in the original draft of the program, but were inserted during the transcription of the program into computer-readable form.

by Edward James

The reasons for rejection are described as trivial in the case of those types of mistake where the correct form can be inferred from the incorrect form with a high degree of confidence. For example, a line might be written, incorrectly, as follows:

25IFX>15TENST

Given that the analysing mechanism expects a statement in Basic, we would like it to recognise the incorrectly-written line as equivalent to:

25 IF X>15 THEN STOP

Although to a human reader familiar with Basic the corrections will seem obvious enough, it is a far from trivial exercise for the computer. It is not just a question of finding the "nearest" correct statement in the mathematical sense, but of knowing from previous experience what users generally write.

A system which is capable of showing such a tolerance to inaccuracies has been developed, and in later work at Imperial College we have attempted to deal with more fundamental variations from a correct specification. We also need to improve the efficiency of the analysing process so that it may be employed as a tool for everyday use.

The method of statement analysis used in most computer systems today has become highly standardised and impressively efficient in terms of computer utilisation. This process involves the determination of the structure of incoming statements by matching them against some expression of the structure of all possible statements in the language which is being analysed. Any correct statement will be assigned a unique structure by this process.

The attempted analysis of an incorrect statement is arranged to result in an error exit as soon as possible, and at that stage an *ad hoc* process is invoked. It may simply report the existence of an incorrect statement, or it may make a serious attempt to correct the statement.

Usually the structure of the language to be analysed is implicitly expressed in an algorithm for the analysis. Every statement is analysed individually, independently of other statements in the same program and similar statements in previously-encountered programs. Important strategy decisions such as the order in which different possible analyses should be attempted are fixed once and for all.

The method of dealing with errors is specified in advance. It is based, presumably, on some previous experience of likely errors; there is no possibility of altering the strategy in the light of errors which are encountered in practice.

The adaptive system developed at Imperial College generalises the usual method in several ways. The general principle is that the structure expressing acceptable statements in the language is dynamic rather than static. This structure is provided initially, and is then modified in many different ways as a result of experience gained in the matching process. At any particular time, therefore, the structure of the processor reflects its experience as well as what it was "taught" to start with.

Matching strategy

In our system, the processing of incoming statements in a program language is based on the expectation that the statement to be analysed will not correspond exactly to a particular acceptable statement in the language. This approach can be likened to an attempt to determine what is meant by the statement rather than what it actually says. There is no necessary connection with determining the closest match in any mathematical sense. The system is provided initially with a process for matching all expected statements in the language, but it is possible for some other statement which can be "made sense of", and which occurs frequently enough, to be promoted to "expected" status.

The process of analysis can be viewed as a series of tests on the incoming statement which, if successful, provide increasing confidence that the statement is of the expected pattern. A detailed example is given in figure 1. The matching strategy for correct input is as follows:

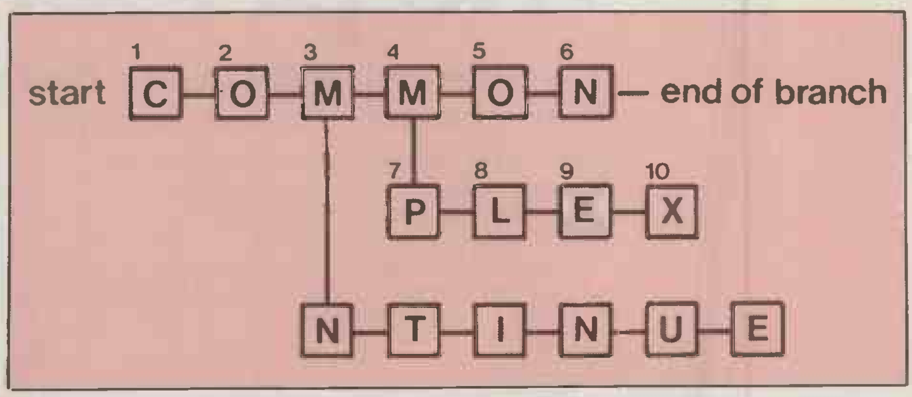

Figure 1. Matching a correct input. The decision tree recognises the three words "common", "complex" and "continue".

Test the next character in the input word against the letter in the box under consideration.

If it agrees, follow the horizontal line to the next box on the right and repeat the process from the beginning.

If it does not agree, follow the vertical line

downwards to the next box and try the test again, but with the same input character.
Continue until there are no more input characters remaining.

If the match is correct the system will have reached the end of a branch of the decision tree, and the word represented by the branch will have been recognised. For example: if the input word is COMPLEX

Take first letter C and match with first box in decision tree; it agrees, so follow horizontal line to box 2.
Match next letter, O, with box 2; it agrees, so go to box 3.
Match next letter M with box 3; it agrees, so go to box 4.
Match next letter P with box 4; it does not agree, so go to box 7.
Stay on same input letter P and match with box 7; it agrees, so go to box 8.
Match next letter L with box 8, etc.
Finally, letter X matches with box 10 and so the match is successful

The matching process is controlled by a decision tree. Each node in the tree specifies a test to be applied to the statement being analysed. In the example, we employ only one type of test. Successive nodes along each branch of the tree specify symbols which are to be matched with successive symbols in the statement to be analysed, working from left to right. Notice that although the example matches from left to right, it is not necessary for successive tests to be applied to successive characters in the input statement.

Changing expectations

The previous example demonstrates the method for dealing with a correct input statement. The matching strategy for incorrect input is of the same form as for correct input. It is modified to take account of one of the following basic types of error:

letter omitted in input,
incorrect letter in input,
superfluous letter in input,

or some combination of these.

For example, if the incorrect word COMLEX is input, the "correct" strategy is in operation at the start of the process. C, O and M are matched correctly. Then the next letter, L, does not match with either of boxes 4 and 7. The "correct" strategy has failed, so "incorrect" strategy 1 is tried. This assumes that a letter has been omitted. It therefore tries to match input L with boxes 5 and 8 in turn. Box 5 does not match but box 8 does, and with this success it returns to the "correct" strategy. Letters E and X are successfully matched with boxes 9 and 10 and the match is complete.

The general principle is that a series of strategies is invoked, each of which presupposes that a particular type of mistake has been made. Each one attempts to force the matching process along until it has got over that part of the input statement which does not fit the expected pattern.

The strategies are applied in the order corresponding to their success in making sense of the input in the past. The strategy which assumes that a perfect fit will be obtained between the input and one of the pre-stored expected patterns — which is the only strategy applied in most other systems — is applied first only as long as the system's experience is that the given statement tends to be correct more often than not.

The initial structure of the tree provided by the analysing algorithm expresses the structure of all "expected" language statements. The force-fit process operates for all unexpected statements, including those involving common imprecisions.

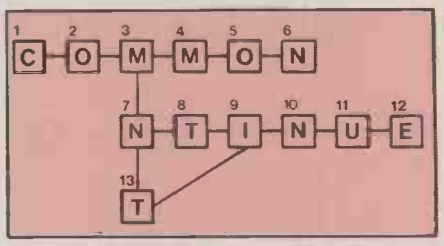

Figure 2. Matching an unexpected error. The decision tree recognises "common", "continue" and its mis-spelling "cotinue".

It is clearly inefficient to invoke continually a lengthy fitting process for a succession of inaccurate statements with identical structures, so the structure of the experience tree can be augmented to incorporate structures which correspond to common mistakes. A successful match of these structures can lead to the same outcome as the corresponding correct structures. The successful match against an incorrect structure will always be faster than the corresponding force fit to the correct structure.

Figure 2 shows this process in operation. If the input is the mis-spelled word COTINUE, it will match correctly with boxes 1, 2 and 13. It is then directed back to that part of the tree which recognises the rest of the correct word CONTINUE. The process ends at box 12 with the same result as if the input word had been CONTINUE.

It is possible to add to the decision tree every inaccurate structure which can be matched. The number of possible mistakes is far larger than that of correct structures, so it is not practical to retain details of infrequent mistakes. The infrequent mistakes must be weeded out from time to time.

If this process is looked on as a pruning of the decision tree, it implies that the tree carries a memory of the frequency of all statements. It is also necessary to take precautions not to prune away statement structures which are correct but seldom used.

Naturally there will always be certain input statements which cannot be made sense of by any of the strategies provided. In some cases the matching process will have to report defeat by returning the undecipherable statement to the user. The problem of determining when to give up an attempt to match an inaccurate statement is a subtle one, similar to that faced in evaluating how many moves to look ahead in chess-playing programs.

The Imperial College system tackles this problem by carrying a number at each stage of the matching process, representing our confidence in obtaining an eventual successful match. Each time the "correct" strategy succeeds, the number is increased, and each time it is necessary to invoke an "incorrect" strategy, the number is decremented. Based on previous experience, a certain confidence level is fixed. If a series of unsuccessful strategies results in the number falling below this level, then the matching process retraces its steps and tries some different strategy, assuming a different pattern of mistakes. If all strategies have been tried, it abandons the process.

The method of learning about common inaccuracies implies that the decision tree will gradually develop a complex and extensive structure. As a result, it will occupy increasing amounts of storage space in the computer. There may even be insufficient space to store all the patterns of correct statements in a language. To help with this problem, we can make use of a process based on the recognition of common sub-trees.

In the example in figure 3, a certain sub-structure is repeated in different parts of the tree. To save space, the sub-tree pattern can be stored in one place only and referenced from each of the relevant positions in the main tree. As long as the referencing mechanism does not take up more space than the original sub-tree, there will be a nett saving in space.

Exploiting redundancy

Trying a large number of alternative strategies is likely to involve a great deal of time as well as space. It is, therefore, important to aim at minimising the number of tests required to process each statement, especially correct ones.

One method of achieving this aim is through a branch-swopping technique. The set of alternative nodes at any point in the tree, representing the set of alternative structures which might be present at a certain point in the input statement, can be re-arranged. Those most frequently relevant are placed nearest to the start of the tree where they are reached most quickly. When a node is transferred in this way, its attachments to nodes further from the start must remain undisturbed.

The re-arrangement of nodes can be continuous in the sense that a node is promoted where possible at every successful match. Alternatively, the analysis of successful match frequencies and the necessary exchange of nodes can be car-

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ried out at intervals of, say, every 10,000 statements processed, assuming that information on how frequently each node is processed is retained in the tree. Figure 4 demonstrates how a particular decision tree can be re-structured.

Another method of reducing the number of tests involved in recognising a statement is simply not to apply all the tests. Instead, a method is used which exploits the redundancy inherent in the formulation of the statement. Figure 5 shows a decision tree which models recognition of the words COMMON, CONTINUE and COMPLEX.

Given that the characters C and O have been matched correctly, there is a strong likelihood that the statement contains one of the three words although it is not possible to say which one. If the characters M and P match, then the keyword is certainly COMPLEX unless both M and P are in error. As the letters L,E,X are encountered in the input, confidence in the correct analysis grows to near certainty.

The confidence-jump method curtails the matching process by inserting at a convenient position — such as box 7 — a special instruction to jump directly to position 11, representing a successful recognition of the word. At the same time, the system counts forward on the input word without checking characters, to the point which should correspond to the end of the word, since a following word may have to be analysed.

The example clearly shows how redundancy in the statement is used since the letters C, O, M, P are sufficient to distinguish the input from any other possibility. It could be suggested that, in using the language, COMP should be written instead of COMPLEX, thereby improving the processing speed. But this ignores the existence of errors.

Notice that the characters L, E and X are not removed from the tree. They are merely ignored in the current process. If the matching process fails later on in the statement which starts with COMPLEX, then it may be sensible to re-trace the analysis to the last confirmed match, P, and check for the presence of L. E and X before applying lengthy error-tolerant analysis procedures to the remainder of the statement. In this case the "redundant" letters provide useful confirmation of a correct analysis of the keyword.

Several of the processes which have already been described involve the re-structuring of the decision tree. These operations are not necessarily, or even conveniently, carried out during the analysis of incoming statements. In fact, it seems that a practical system will require periods of rest from the analysis process, while it carries out the necessary re-structuring.

During these periods it may also prove convenient to attempt the processing of input statements which could not be dealt with previously due to lack of time. We have already developed automatic methods for branch-swopping and the insertion of confidence jumps. The development of an explicit algorithm for recognising common sub-trees and re-structuring to optimise storage space is a very subtle problem which will not be solved rapidly.

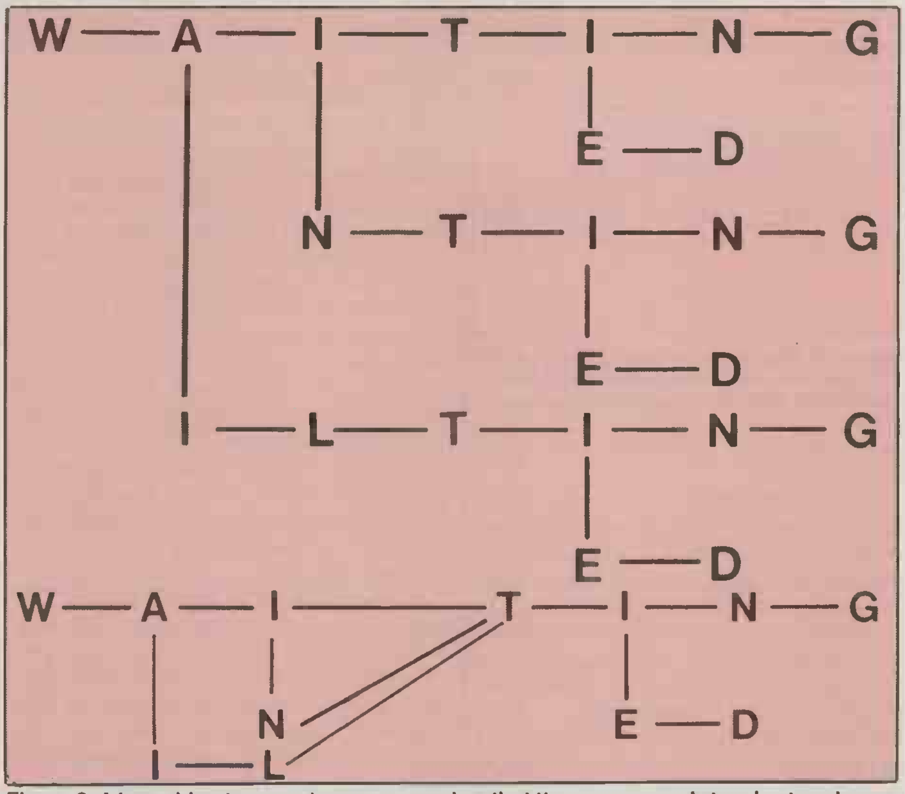


Figure 3. A branching tree can be re-arranged so that the common sub-tree is stored once only.

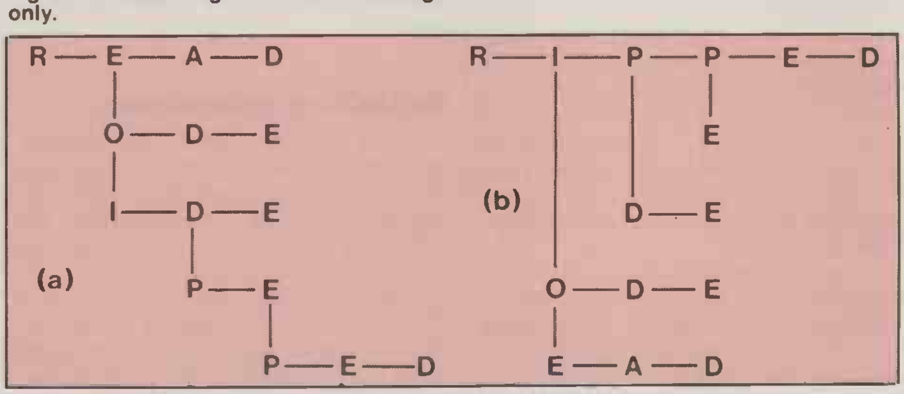
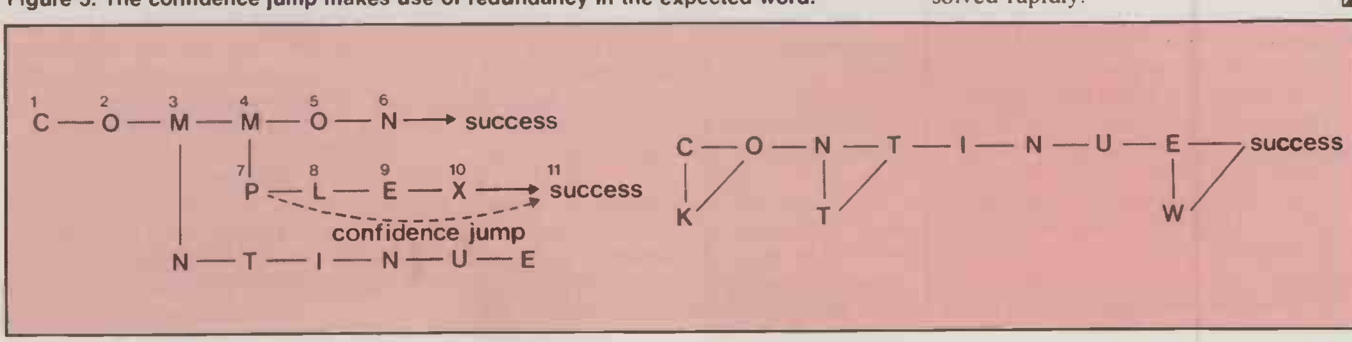
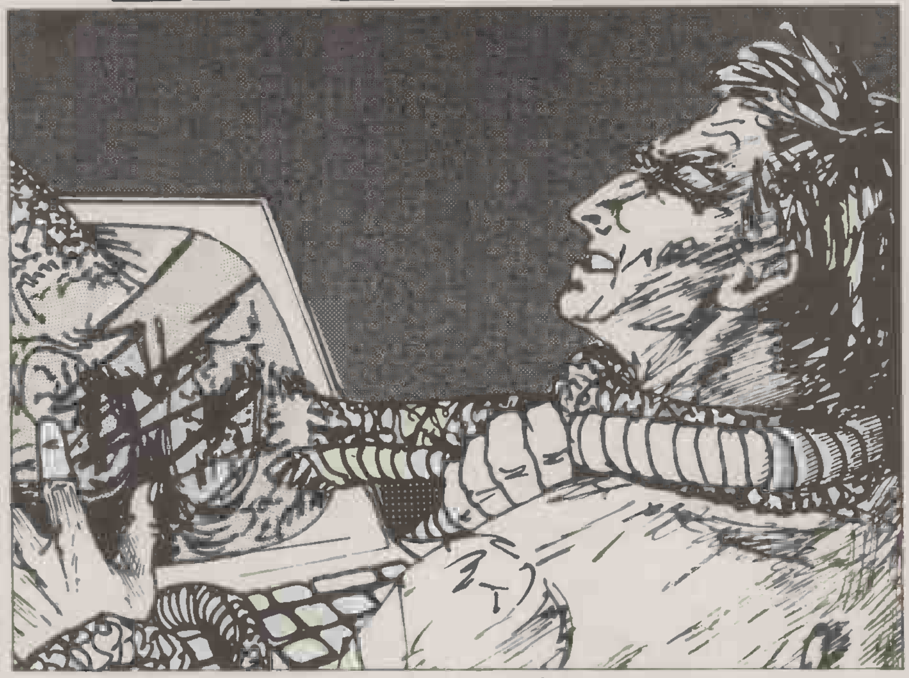


Figure 4. The decision tree (a) matches four words, where "read" is expected to occur more frequently. If "ripped" occurs most frequently in practice, the tree can be re-arranged (b).

Figure 5. The confidence jump makes use of redundancy in the expected word.



LIVE WIRE



by David Mentz

I was sitting in the tiny kitchenette of my flat waiting for the kettle to boil, dreaming of ranks of valves glowing dimly in the sunset. That's right, valves — thermionic tubes — the like of which we shall never see again. I don't mind progress, but silicon chips hold no romance for me; inert-looking, symmetrical black boxes with legs. Creepy really.

The telephone disturbed my reverie, the result of several pints of ale and half a lifetime spent making and mending computers. It was half past eleven at night. No-one had phoned at that hour for a long time, not since the young men with degrees had somehow slid past me on the promotion tree. Lately, I had found myself spending more and more time on the backwater sites, with the difficult customers who did not buy the latest model when the company deemed it was time.

I let it ring, and tried to guess who it could be. Whoever it was, they needed me enough to let the ringing go on for a full minute.

"Hullo, Peter Holland". I was brusque, my eye on the kettle a few paces away.

The voice from down the line was that of an elderly man. I was sure of that as soon as he spoke, by the querulous intonation.

"Hello, is that uh . . . Mr P Holland"? Deaf too, I thought.

"Yes".

"Oh, Good. You probably don't remember me, Mr Holland, Arthur Samson of Samson Mouldings. I got your number from your last address, a young lady gave it to me".

I'll bet she did, hoping you might be trouble, I thought.

"Anyway", he continued "it's about the machine. The one you used to . . . you know, maintain".

It was coming back to me. Samson's Mouldings, a grubby little business in Ell. I dimly remembered a cluttered office and a stuffy computer room. One of my first jobs, all of 12 years ago now. We had fitted them up with a small machine, payroll and stock software, and all the undiscovered bugs therein.

I also remembered some sort of trouble between my then boss and Samson, about the lucrative maintenance contracts we used to impose in those days. All this recollection took very little real time, of course, and I was on to Samson like a flash. I knew what was coming.

"I was wondering if you could take a look at the thing. We've got no red lights or anything on the front, nothing like that, but when I went to do the payroll, it sort of went dead. Funny really, it's been alright all these years".

Samson reeled off this little spiel, while I tried to make up my mind whether to accept his nocturnal commission. For some reason I didn't wonder at the amazing fact that he still had the machine which has been sold or leased to him 12 years ago.

"It'll cost you £15 an hour". I needed the money badly at that moment.

"I'll give you £12.50, maximum three hours, no tea breaks". The quaver was gone, old Samson still had some of his hair left.

"Done. I'll be round in an hour".

Samson's Mouldings stands at the end of half-deserted cul-de-sac: two red-brick storeys which have been stained a sort of streaky black, surrounded by a wall topped with broken, green glass. I was let in by Samson himself, who muttered about the wages he had to fork out for night-watchmen. He led me to the familiar offices on the first floor. The outside wooden stairs showed the passage of 12 years more than anything or anyone else present. They creaked alarmingly as we ascended.

"Here it is", said Samson, opening the door between the office and computer room.

There it was indeed. An IBM 1605, almost a relic from the Ark.

"Good grief, how have you kept it going"?

A sly look came over Samson's face.

"You can always find someone to help if it breaks", he said.

He must have spent a fortune keeping this electronic dinosaur running. It didn't have valves, but it did have discrete transistors, tens of thousands of them, all liable to malfunction. It also had magnetic-core memory, a real core, instead of semi-conductor flip-flops.

I found the maintenance manuals on top of a tin cupboard full of reels of mouldering paper tape, covered by a thick layer of dust.

"Well, what seems to be the trouble"? I asked wearily. I wished I was at home in bed.

The problem Samson explained, was that although everything went as it should while loading the program from paper tape, the machine did not respond at all when the program was started. He brought listings of the program, which he said had been amended by "a lad" he had employed during a long vacation.

It was virtually impossible to read them, even if I had wanted to. I concluded that Samson had hired a charlatan who had done nothing useful. It transpired that he had no computing staff at all, and for the past eight years he had loaded the tapes and run the programs himself, entering data from the keyboard.

"Didn't it take a lot of your time? It would have been cheaper to hire someone, surely".

He explained that business had been declining, and he was always laying off men and losing contracts.

"I've just had to battle on, and do all I could myself. It's no great hardship, and that machine's been a great help. I don't regret spending a bit on the few times it's failed".

This remark took my breath away. That particular model has been called many things, but I will lay long odds that "reliable" was not among them.

"Oh yes, when did it last break"?

"About two, no, three years ago. Needed a new transistor or something, the chap said".

My first reaction was to call the Guinness

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Book of Records. Then I realised that old Samson must be losing his wits after all, and was confused. I didn't think about the layer of dust on the manuals, but I was still certain that the old machine had finally given up, that its bytes were dust. The only problem was how to spend a couple of hours, convincingly trying to revive it, so that I could collect my night-call fee.

"Well, I can but try", I said taking a screwdriver from my case and kneeling by the back plate of the heavy central unit. Samson seemed quite content, and started filling his pipe. So far, so good, I thought.

As the screw began to turn, the typewriter on the console rattled into life. I was so startled I dropped the screwdriver. Samson ignored it.

"What was the last thing you did"? I asked him, without getting up.

"I told you, I loaded the payroll and tried to start the program".

I started at the screw again and had made half a turn before the typewriter machine-gunned again. I got up to look at the console, convinced that the mains was short-circuiting somewhere and that the metal cabinet was not safe to touch.

What I saw on the typewriter roll shocked me more than any high voltage. The word Stop had been sprayed across the page about a dozen times. As my jaw dropped and my hair began to stand on end, the printer typed out a single

Thank You

"What's up"? Samson peered at me through a pall of blue pipe-smoke.

Before I could collect my thoughts, Samson came across and looked at the output.

"Never said that before", he said placidly, "but you've done the trick, I reckon".

He sat in the swivel seat and typed: Hello. The lights on the console showed that something was happening in the CPU.

Hello, Mr Samson

appeared on the roll.

"Yes, that's more like it. You've done it man". He was pleased.

I was pleased too, but not entirely reassured. Never before had the touch of a screwdriver repaired anything for me.

What's more, old Samson had the best interactive system I had ever seen, running on an obsolete machine which by rights shouldn't even work.

I put the screwdriver in the case, watching him chatting away with the program.

"Who wrote that system"? I asked him.

"Came with the machine. You chaps sold me all the programs I've ever had".

I knew that couldn't be true, so I shrugged, feeling a little hurt. But if Samson wanted to keep it a secret, that was alright by me. I could find out some other way.

"Well, I reckon you owe me £12.50", I said, preparing to leave. I was still perplexed at what had happened, but tiredness was finally getting the better of me.

Samson wasn't listening. He was staring at the output as the typewriter chattered urgently.

"Bloody thing's gone mad", he muttered gloomily.

I looked at the output:

Unable to uptake the payroll. Preparing to leave. Need CPU. Need core. Goodbye soon.

"What's all that mean"? It was an odd sort of message alright.

"Blowed if I know, your fellows wrote all this in. It's never done this before. Normally it's quite friendly, just gets on with the job".

I started feeling strange again.

"What does it normally say"?

"You know, 'Hello' and 'What can I do for you'? Sometimes reminds me when I make a mistake".

"How do you do the payroll, for instance"?

"I just write in what's been done, like I used to tell old Binley, the Wages Clerk. I used to write things like: Bill Matthews has done four hours' overtime today".

"You just type that in? Just like that"?

"Just like that. Sometimes it tells me I've done it already, if I have, but mostly it just says O.K. and gets on with it. Does the slips every Friday without being told".

I laughed, though the humour of the situation was fading fast.

"Never. No computer ever does anything it's not been told".

"Well, this one does, maybe it's got a clock. When I load the wages on a Friday it asks 'Shall I do the slips'? And I just say yes".

Something wasn't right. I wanted to go home. Either Samson was crazy or I was.

"Now the bloody thing's gone mad", he continued, almost echoing my thoughts.

"I'll switch it off at the wall. No point in letting it blatter on".

The console bell rang like a fire alarm and the typing redoubled.

No. No. No. Do not switch off. Need power to effect release.

A hot flush came over me as I read these words. Not only did this machine know what day it was, but it also had ears. I felt sick.

Samson's brow creased. It was dawning on him that the machine had referred to something that had not been typed in.

"That's damn clever . . ." he started, his voice fading as he realised just how clever. The typewriter continued:

Do not be alarmed. Thral is a magnetic life order. Thral is in the Ferrite Core. Do not be alarmed. Do not switch off or Thral will die.

We stared at the roll, blank with disbelief. Samson bit the stem of his pipe and looked at me, doubt creeping into his expression. Where did this Thral come from, and where was he going?

Like an echo of the questions, the answers appeared on the teleprinter roll.

Distant galaxy. Thral has found a bigger environment.

The typing stopped. The silence was eerie and I could hear Samson breathing, which reminded me to take in some air. Then a last world rolled across the page.

Goodbye

The lights on the console dimmed, except for the red one that indicated a parity error, which began flashing malevolently.

"Jesus", said Samson.

I'd had enough. I looked at my watch. It was past two o'clock.

"Well, I don't think there's much I can do now, Mr Samson, I'll call you later in the morning". I left him sitting in the swivel chair, puffing reflectively on his pipe, and let myself out.

I tried to forget the spontaneous chattering of that console typewriter as I drove home through the deserted streets. No point in losing sleep over the inexplicable. By the time I fell asleep I had convinced myself that the whole incident had been some sort of trick, played by Samson and programmers unknown to confuse an unsuspecting engineer.

In the mid-morning light, with a cup of coffee in my hand, I chuckled over the messages of the night before. It was certainly possible that an electromagnetic life form could exist. If it did, it might need a medium like the old core memory to sustain it, but it was incredible that such a thing should exist in Samson's old machine.

Before the coffee was finished, I decided to ring Samson, just to check my memory. Perhaps he still had the logs of the extraordinary messages. I wondered what the "bigger environment" of the console message could be. There were no large core memories still operating as far as I knew.

I turned the problem over in my mind, feeling a sense of camaraderie with the thing trapped in only 60 kilobits of core. The more I thought about it, the more plausible it seemed. How else could Samson have continued using an obsolete machine without any software support for so long? He had admitted that the machine hadn't malfunctioned for three years, an impossible feat in the normal run of things.

I looked at the telephone, draining the dregs of the coffee and trying to remember Samson's number. I imagined the telephone system. Miles of wires, connecting millions of switches, relays, stores and all manner of magnetic hardware.

The telephone rang, just as I realised where the "Thral" must have gone. The phone was not ringing in its usual manner, but just gave a long, imperious burst on the bell. I picked up the receiver.

"Hello, Thral", I said.

Tourists on-line to Edith

The O.&M. department at Swansea City Council has developed an on-line tourist-information system, open to members of the public. Martin Hayman reports.

WHAT IS O.&M.? The name has a curiously dated ring to it. It stands, I think, for Operations and Methods — or Means — and is more familiar to the everyday worker as time and motion, or the man with the stopwatch looking over your shoulder.

It is a concept redolent of the days when computers were computers and programming meant Cobol, punched cards and a dedicated priesthood of machine servants.

Yet this is the unlikely seedbed for a useful and creative public viewdata system launched by the City of Swansea for the 1981 tourist season.

Known as Edith — Electronic Display of Information for Tourism and Holidays — this original and very competent system is the first public on-line tourist-information system of which its originators are aware, either in Britain or the world. Edith grew naturally out of the traditional work of the O.&M. Department at Swansea City Council.

What strange hormone caused such an exotic flower to bloom? The answer — as you probably guessed — is the arrival of the micro, which freed O.&M. officer Gareth Simpson from the customary administrative stictures of the mainframe.

It hardly happened all in a rush, though. The story, spread over three years, is one of exemplary flexibility, enthusiasm and application which many would see as more typical of an individual working on his own account, or of a small company, than of a local-government officer.

But first, a punter's-eye view of Edith. It sits on the front desk of Swansea's tourist-information centre in Singleton Street, where decaying, industrial East Swansea gives way to increasingly-affluent West Swansea. Beyond, lies the brilliant Gower coast, a heavily-trafficked but well-preserved area of outstanding natural beauty and a target for outdoor holidaymakers of all tastes. Over the last two decades, Swansea has increasingly had to look to the development of tourism to supplement, or replace, the dying heavy industries of steel-making and docking.

To the uninitiated holidaymaker, arriving from the east, the first views of Swansea are hardly auspicious. Where is this outstanding natural beauty he has heard so much about?

Routed along the ring road directly to the information centre, he will find Edith. To the regular micro-user, it's nothing unusual: a screen and keyboard, with the majority of the keys blanked off to leave just the numeric keypad on the right and a large red button round about where Return should be. This is, in fact, Return. The numeric keys are used to select options from a menu which displays a staggering variety of facts and information which the tourist might need in order to make the most of a stay in the area.

A quick resume — see figure 1 — shows a choice of pubs, pub facilities, restaurants, restaurant menus and prices, bed and breakfasts, hotels, transport, emergency services, attractions, events, self-catering accommodation and camping sites. The whole of Wales is covered, not only Swansea. Each file has its own interrogation program which sets up the required search pattern based on price per night or location.

The system is one of the very few in this country which works under MP/M, on a locally-made Z-80-based micro with 18.5Mbyte of Winchester hard-disc storage. I asked Gareth Simpson how the public had taken to this, one of the first computer systems open for public operation.

"We've had nothing but praise so far", he told me. "One of our fears was that people would be frightened but, on the contrary, it has been used a lot. The hotels file, particularly, has been heavily used this season". So much so, that the information office has gone into the booking

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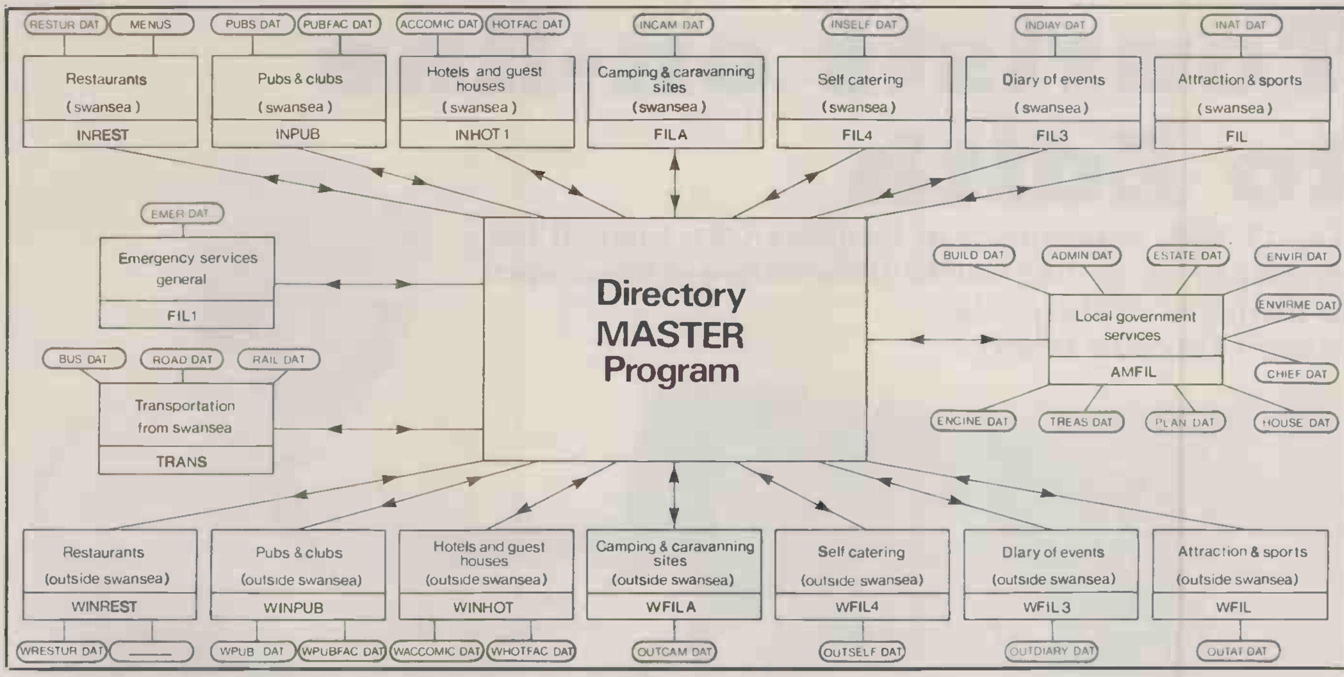

Figure 1. Schematic arrangement of the Edith tourist-information system.

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business on the strength of it. On payment of a 10 percent deposit, it can now assure the holidaymaker of any chosen booking. The information centre keeps the deposit, but the hoteliers seem to be pleased with the arrangement.

So much for the punters' end of things. What will surprise computer people and local-government officials alike, is that the Edith system took only three months to implement, from inception to launch date. This, I must emphasise, is the total time taken, from when the idea was first floated, through the feasibility study, approval, coding of the programs, debugging, ordering, installing and testing of the equipment, and data collection and entry.

Apart from the collection and entering of data, the computing end of things, which includes writing all the programs, was done by Gareth Simpson and his assistant, Reza Muhammed Jalhalian. Simpson notes that during that time he suffered something approaching a nervous breakdown. Edith is a project which was undertaken in addition to his regular workload as O.&M. officer.

Gareth Simpson is not a computer professional, though he admits to having had some limited Basic training on, he thinks, a Ferranti Argus. But that was some time ago, when he worked for British Steel. What really started the ball rolling was the local-government reorganisation of 1974. It was then that Swansea City's mainframe and its staff were taken over by the new West Glamorgan County Council. Swansea subsequently replaced this equipment with an ICL 2960 which unfortunately was incompatible with the paper-tape output of the IBM 3750 telephone switchboard.

One of the duties of the O.&M. department is to monitor telephone calls and charges, which in a big office like Swansea Guildhall can run into six figures each year. Every department gets a breakdown of charges and calls made from each extension and woe betide anyone whose bill shows signs that they have failed to use the self-billing prefixed code for private calls. "Since ours was the only job on paper tape, we had the choice of going magnetic, or of buying a micro", says Gareth Simpson.

The micro won both on purchase and running costs. The third option, to buy time back from the West Glamorgan mainframe, was also eliminated as being far more expensive than the cost of a trainee programmer for one day a month. Cost of the micro was assessed at around £500, and tenders were invited since all local government orders have to go out to tender.

The requirement was for a 64K processor with twin single-sided floppies, a 150cps printer and a paper-tape reader. Total cost was £5,700 from the lowest tenderer, a local firm called Comcen, of De la Beche Street, Swansea. There was the added advantage of maintenance on the doorstep, though apparently this is a factor which may not be taken into account in local-government decision-making.

Simpson brought in a young economics graduate, Andrew Chambers, to write the program for the telephone audit. His task was to code a program to read in IBM format hex, convert to decimal, and to set up a file for each extension. Each file included the number dialled, the distance rate, time of start and end of call. The program also had to calculate the cost of calls, and print out bills for each quarter, one for business and one for personal calls.

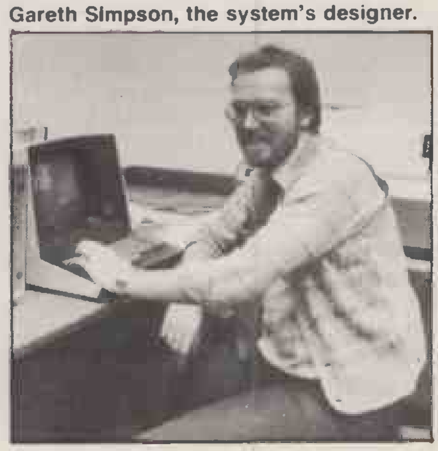
Writing the program took Andrew Chambers four months, including the time taken to teach himself Basic.

Once this system was running, the O.&M. department found that it had a severely under-utilised piece of equipment. The telephone-audit program used only 10 percent of the machine's processing power, and this prompted Simpson to look at other possibilities. "Because we are O.&M. we tend to look at systems from the same point of view as a systems analyst. Normally we would change clerical organisation, but now we had the option of using the micro to ease the clerical effort". In other words, to get the same people to work more productively, or to get fewer people to do the same amount of work.

The first extra that Simpson took on was the computation of bar stocks. Swansea City runs three bars of its own — at its new Leisure Centre, at the Grand Theatre and at the Brangwyn Hall. Stock-control had previously been done by an external auditor at the minimal cost of £4 a month.

Next came private car-mileage allowances, which were already being calculated

Gareth Simpson, the system's designer.



```
                        CITY OF SWANSEA
                 INFORMATION SYSTEM ( EDITH )
                          RESTAURANTS
******************************************************************
  NAME OF THE RESTAURANT -> BROWNE'S
  ADDRESS                -> 31 MARKET STREET MORRISTON
  TEL/NO.                -> 796080
  NAME OF MANAGER/OWNER  -> TERRY BROWNE
  COST OF 3 COURSE MEAL (HIGHEST 10.00) (LOWEST 6.00 )
  NO. OF WINES ON WINE LIST (70 )
  FACILITIES:
  NO. OF TABLES   -> 12       FLOOR SHOW  -> N     DISCO -> Y
  LICENSED        -> Y        PIPED MUSIC -> Y
******************************************************************
 SEC/NO. * 0 *
```

Figure 2. Typical printout from Edith.

on the mainframe. The micro, Simpson says, notably improved turnaround because of the greater flexibility of a small department, and because the user was doing his own file maintenance. West Glamorgan's mainframe staff, he estimates, spend 75 percent of their time on file maintenance. The speed factor may have provided the much-needed breakthrough in popularity for Simpson's department. It meant that private car users got their mileage-allowances cheques sooner, which is bound to go down well.

The success of the microcomputer enterprises of the O.&M. department shot Gareth Simpson into an unusual position. "Inadvertently I had become known as the O.&M. expert on computer applications", he reflects ruefully.

Suddenly Mr Stopwatch found himself with an increased establishment, and a brief to looking at new technologies. In 1979, after Andrew Chambers had left for London to double his salary and more, Simpson took on his first batch of three trainees from the Polytechnic of Wales at Treforest. At the same time, and much to his relief, he shed some of his other duties.

Simpson says he had good luck with the people he took on. Certainly he needed a capable staff for the next project he undertook, which was a more classical local-authority exercise: computerising the building-maintenance section. Swansea has some 20,000 council homes which generate around 50,000 repair jobs a year.

Gareth Simpson's brief was essentially that of an O.&M. adviser. He was to specify a micro-based system, but day-to-day running would be done on contract. The configuration which went out to tender included 13 micros or intelligent terminals, each with 56K, with a Modem link to the mainframe as a file security dump. The package was to include software development, and the aims of the system were fourfold.

The first was to log the jobs and issue work tickets to the tradesmen who went out on the job. The next was to cost each job. This was particularly important, since new rules published by the Department of the Environment mean that from April 1982 direct-labour forces will have to tender against private contractors for maintenance work on council properties. So the job-costing program included a time value, materials value and an overheads cost so that an accurate figure for each kind of job could be ascertained as a future tender value.

Thirdly, the system was intended eventually to take over payroll from the batch-processing done by West Glamorgan. Finally, there would be a stores- and materials-control program.

This is big-league stuff and Simpson found himself with tenders from mini and mainframe manufacturers as well as micro builders. He finally chose a system from BMSL Ltd, a firm based in Harrogate, Yorkshire. It runs on a Dacoll Democrat machine built in Scotland, and the software is written in Cobol. Simpson reckons that it is one of the only "demonstrable housing-maintenance systems in the country".

In December of last year, Swansea's director of trade and industry, Mike Stephens, asked Simpson to "knock him up a system on hotels". The initial idea was to use a micro to retrieve information on hotels and bed-and-breakfast places. Simpson put together a few successful demonstration programs and thereafter the whole idea just grew.

Why not add in all the other facilities, like pubs, clubs, camp-sites and restaurants? At the next meeting, the question came up: Why not put yourself in the tourist's position and imagine what else he might need? So transport and local-government facilities were included too. At this stage, in January, the systems-design work began, with Muhammed Jalhalian sharing the work. The next decision was to include the rest of Wales in the database. For simplicity's sake, a 20-square grid was laid over the map of Wales, and each area given a code — to yield 13 areas.

The straw that nearly broke the camel's back was the decision to go public. Until then, Edith had been conceived of as a terminal which would be run by trained operatives behind the counter. But now Simpson was faced with the task of making a large suite of programs work on as-yet un-ordered equipment, supervising the compilation and entering of all data. There are plenty of sources of reference, and fortunately on a public system there is neither a copyright problem nor any absolute obligation of accuracy. Most importantly, the whole thing had to be idiot-proof. "We didn't want to have anyone pressing Control C"!

Simpson reckoned that by this stage he had enough experience to know exactly what he wanted in the way of hardware: four terminals, two for public access, one for control and for input, and another for word-processing. There would also be a printer for hard copies of information. Once again, the specification went out to tender.

It was Comcen that was successful. Apart from Transdata, Comcen was one of the few firms that Simpson knew which was successfully running MP/M. Of the three or four tenders that were valid, Comcen's was the most competitive and they still held that maintenance advantage — five minutes' walk away is about the right distance to be from a prestige project such as this was destined to be.

With 38 files and more than 6,000 records, each with between six and 28 fields, there would certainly be a premium on screen readability. Muhammed Jalhalian was the best of assistants in this respect: "He's a fanatic for layout and display", says Simpson, who was nevertheless finally responsible for overseeing data input.

Despite the problems, the whole system was written, installed, ready and running by its May launch date. I can confirm that it does work. If, for example, you are looking for a hotel room, as the majority of users are, Edith asks you for a price-per-night parameter and searches for all hotels within that price bracket, usually to within £2 of the keyed-in figure. A further two-digit choice against your hotel reveals full details.

What of the future? Gareth Simpson is keen to upgrade the system from MP/M to CP/Net and add a further three terminals, each with its own dedicated RAM and a link to the Guildhall mainframe. After that, perhaps even going public so that prospective enquirers can call up from all over the country. As a publicity exercise it would be a wonderful boost for Swansea, whose declared intention is to attract more tourists into its area.

System specification

Machine: OEM-4, based on Z-80 microprocessor.
Operating system: MP/M booted up from CP/M Version 2.2. Four partitions: 1 x 48K and 3 x 32K.
Storage: DRI 8in. Winchester rigid disc formatted to 18.5Mbyte. DRI 8in. floppy-disc back-up.
Terminals: Four data type, two customised by Comcen to blank off QWERTY keyboard for public access use. One dedicated to use the WordStar word-processing software.
Printer: MX-80 dot matrix, 80cps.
Supplier: Comcen Microcomputers Ltd, 9 De la Beche Street, Swansea. Tel: (0792) 460023.
Cost: (net of software): approx £12,000.

Finding your bearings with Pet graphics

Using Nigel Harvey's two Pet graphics programs to teach secondary-school pupils three-figure bearings provides an excellent introduction to the subject and an opportunity to put the concepts into practice.

IN THE first of these two programs, the centre of the screen, indicated by a suitable symbol, acts as a fixed reference point from which the compass bearing of a randomly-placed target is to be estimated by the pupil. Initially a circular protractor — or even better, an acetate sheet marked in 10-degree intervals from 000 to 350 — can be placed over the screen to give an accurate measurement, but with a little practice it is usually possible to hit the target by estimation alone.

The program will only accept angles between 000 and 359 and only if three figures are used. A bearing of 90 is rejected; 090 must be used. Once the estimated bearing has been input, a message of commiseration or congratulation is printed, and a missile is fired from the centre of the screen along the selected course, either missing the target or exploding it. The program then returns to the beginning in a continuous loop.

Although only 24 lines long if Rems are omitted, the program contains some interesting graphics techniques; in particular a double-density plotting routine and a realistic explosion, both of which can be incorporated into other programs.

Line 180 contains the Poke codes for the four graphics characters used in the fire-missile routine, putting them in the array C(). CS is the location of the centre of the screen and CF the degrees-to-radians conversion factor.

After Poking the centre of the screen with the compass-point symbols, the target's relative position is set using A to define its angle clockwise from the North. Note that A is a multiple of 10 between 0 and 350 inclusive. T is the Poke location of the target's centre. The input angle B$ is tested for acceptable format, and then rounded to the nearest 10 degrees (B) before being compared to A.

The missile's horizontal and vertical displacements from the centre of the screen are denoted by X and Y which are incremented by S and C respectively in a 20-step For-Next loop. PO and PN are the missile's old and new locations:

F% = Peek (PN)

ensures that no portions of the compass point or targets are inadvertently blown away.

The method to select the correct graphic symbol for the missile makes use of the fact that each relational statement has a numerical value: any true statement has the value –1 and any false statement has the value 0. Type ?3<5 return, and the Pet responds with the answer –1. Type ?6<4, and you will obtain 0. Thus the function

F = 1 –(X – INT(X) <.5) – 2 * (Y – INT(Y) <.5) (see line 450)

takes values from 1 to 4 inclusive according to whether X =INT (X) and Y — INT(Y) are less than or greater than 0.5.

Now X – INT(X) and Y – INT(Y) give the fractional parts of X and Y, so we have a simple method of selecting the correct quarter of each pixel in which to place the missile:

DX <.5 DY >.5 F=2	DX >.5 DY >.5 F=1
DX <.5 DY <.5 F=4	DX >.5 DY <.5 F=3

where DX = X – INT(X)
DY = Y – INT(Y)

So by defining C(1) as the Poke code for ■, C(2) for ■, etc., in line 180, we can Poke the missile into the correct quarter of each square.

The explosion subroutine is a very useful and effective one and can be used in many graphics programs. After Reading

Program 1. Bearings

```
150 REM*** INITIALISE ***
160 :
170 BL$="                                       ":REM** 39 SPACES **
180 C(1)=124:C(2)=126:C(3)=108:C(4)=123:CS=33268:CF=π/180
190 PRINT"■":POKECS,86:POKE33228,93:POKE33308,93:POKE33267,64:POKE33269,64
200 :
210 REM*** SET UP TARGET ***
220 :
230 A=INT(RND(1)*35+.5)*10:T=CS+INT(14*SIN(A*CF))-40*INT(10*COS(A*CF))
240 POKET,170:POKET-41,60:POKET+39,60:POKET-39,62:POKET+41,62
250 :
260 REM*** INPUT ANGLE: TEST FOR CORRECT FORMAT ***
270 :
280 INPUT"■WHAT ANGLE  ■■■■",B$
290 IFVAL(B$)>=0ANDVAL(B$)<360THEN320
300 PRINT"ANGLE BETWEEN 000 AND 359, PLEASE!"
310 FORI=1TO2000:NEXT:PRINT"■"BL$:PRINTBL$:GOTO280
320 IFLEN(B$)=3THEN370
330 PRINT"YOU MUST USE 3 FIGURES!":GOTO310
340 :
350 REM*** TEST FOR HIT/MISS ***
360 :
370 B=10*INT(VAL(B$)/10+.5):IFB=360THENB=0
380 IFA=BTHENPRINT"■ CORRECT ":GOTO410
390 PRINT"SORRY, YOU'VE MISSED!"
400 :
410 REM*** FIRE MISSILE ***
420 :
430 S=.7*SIN(B*CF):C=COS(B*CF)/2:X=0:Y=0:PO=CS:F%=86
440 FORI=1TO20:X=X+S:Y=Y+C:PN=CS+INT(X)-40*INT(Y)
450 POKEPO,F%:F%=PEEK(PN):POKEPN,C(1-(X-INT(X)<.5)-2*(Y-INT(Y)<.5))
460 PO=PN:NEXT:POKEPO,F%:IFB=ATHENGOSUB510
470 FORI=1TO2000:NEXT:GOTO190
480 :
490 REM*** EXPLOSION ***
500 :
510 RESTORE:FORI=1TO10:READE
520 POKET,E:POKET-40,E:POKET-41,E:POKET-2,E:POKET-1,E:POKET+39,E
530 POKET+40,E:POKET+41,E:POKET+1,E:POKET+2,E:POKET-39,E
540 NEXT:RETURN
550 DATA160,32,160,32,160,35,42,43,46,32
```

the Poke code of each character, line 510, the character is Poked into the target area, the map below showing the relative positions of each pixel. T is the centre of the target.

	T–41	T–40	T–39	
T–2	T–1	T	T+1	T+2
	T+39	T+40	T+41	

This produces an explosion covering 11 pixels — clearly, the method can be extended to an area of any size. Experiment with your own characters — the data given in line 550 is only a suggestion.

The second of these two programs designed to give practice in the use of three-figure bearings takes the form of a real-time game in which the player has to guide a sailing boat in a figure-of-eight course around two islands in an estuary.

When the game begins, the boat, represented by a flashing dot on the screen, is due south of the larger island and sailing due east — 090 degrees. As soon as the player wishes to change course, he types in the required bearing. Corrections to the first two digits may be made using the Delete key, but once three digits have been typed, the new course is accepted immediately — provided it lies between 000 and 359.

The time taken is continuously displayed, as is the boat's status — changing from Green to Red if it sails too close to land. As soon as the course is completed, the total time taken is displayed, together with the best time achieved so far. With practice, a time of about 80 seconds is possible — 100 being about average — for the figure-eight course.

The program uses the same double-density graphics technique used in program 1 to achieve the movement of the boat. Line 170 contains the codes for these graphics symbols in C(); BT$ is the best time, CH the cursor-home screen location.

Lines 190 to 420 produce the map, relying mainly on Poking the characters into the appropriate places. For this type of operation, I prefer to use Poke rather than Print, finding reverse-video graphics fiddly and the cursor-control problems associated with 40-character lines tiresome. Provided the map is sketched first on a 40-by-25 grid numbered from 0 to 39 across the top, and 0 to 960 in steps of 40 down the side, it is not difficult to Poke into the required locations. Certainly, you should find it easier to interpret the program listing as it stands rather than the corresponding Print statements. Note that Poke can be entered as P shifted-O; Next as N shifted-E; and so on. Hence the occasional line with more than 80 characters.

Line 460 sets the starting direction, defined by B; S, C, X, Y, PO and PN are used as in program 1. SP is the location of the starting position — which will take a new value each time a new course is set: N is the number of digits of the new course accepted at any stage; B$ the string expression containing these digits; T$ holds the value of TI$ — used in line 750 to check whether a time update is required.

Line 580 scans the keyboard for any potential change of course, any key depression being processed between lines 590 and 660. Corrections to previous digits are made possible by looking for the Delete key in line 600, 20 being the ASCII code for Delete.

Once a suitable three-digit number has been accepted, the course correction is made in lines 700-710. R is a flag to indicate status. R = 0 enables a new position to be calculated — line 810. R being given the value of 1 in line 950 if the status changes to Red.

After updating the time, the boat's new position, PN, is calculated — line 810. The rather elaborate collision check — line 850 — is needed to eliminate the possibility that the new square, PN, is the same as the old — which happens frequently using the double-density plotting technique. If the new position is found to be acceptable, it is plotted, line 900, and the program loops back to 580 to look for a key depression.

The plot — new — position subroutine — lines 1110-1120 — contains two short delay loops

FOR I = 1 TO 100: NEXT

which govern the speed at which the boat moves. By reducing these delays the action can be speeded up if required, but most players will find this satisfactory.

In line 940, Peek(PN) = 58 looks for the finishing line. If not found, the status Red is printed, and the program loops back to line 580. When the finishing line is reached, the program moves into the end routine, lines 990-1070, printing the best time, and giving the option of another game.

Few programs of this type are ever completely finished, and further developments of this game are, of course, possible. One pupil suggested littering the bay with a few wrecks.

On a more serious level, an alternative method of controlling the course of the sailing boat would be to use Input statements to give the direction and magnitude of each leg of the course, thus reinforcing work on vectors.

Program 2. Sail-race.

```
150 REM** INITIALISE & PRINT MAP **
160 :
170 C(1)=124 C(2)=126 C(3)=108:C(4)=123:BT$="10000":CH=32768
180 BL$="                                       ":REM** 39 SPACES **
190 PRINT"⌐":FORI=CHTOCH+9:POKEI,160 NEXT FORI=CH+10TOCH+24 POKEI,99 NEXT
200 POKECH+25,95:FORI=CH+26TOCH+48 POKEI,160 NEXT:POKECH+49,105
210 FORI=CH+66TOCH+86:POKEI,160 NEXT POKECH+87,105:POKECH+108,95 POKECH+109,160
220 POKECH+110,105:POKECH+111,95:FORI=CH+112TOCH+126:POKEI,160:NEXT
230 FORI=CH+152TOCH+166 POKEI,160:NEXT:POKECH+167,223:POKECH+191,233
240 FORI=CH+192TOCH+207 POKEI,160:NEXT:FORI=CH+231TOCH+243:POKEI,160 NEXT
250 POKECH+244,105:POKECH+245,95:POKECH+246,160:POKECH+247,105:POKECH+271,95
260 FORI=CH+272TOCH+283:POKEI,160:NEXT:POKECH+292,233 FORI=CH+293TOCH+295
270 POKEI,160:NEXT:POKECH+296,223:POKECH+314,95 FORI=CH+315TOCH+322 POKEI,160 N
EXT
280 POKECH+323,105:POKECH+337,223:POKECH+357,95:FORI=CH+358TOCH+360 POKEI,160:N
EXT
290 POKECH+361,105:POKECH+372,95:POKECH+376,160:POKECH+377,160:POKECH+399,95
300 POKECH+413,160:POKECH+414,160:POKECH+415,105:POKECH+425,233:POKECH+426,160
310 POKECH+427,160:POKECH+428,223:POKECH+462,233:FORI=CH+463TOCH+469:POKEI,160
NEXT
320 POKECH+470,223 FORI=CH+502TOCH+510:POKEI,160:NEXT:POKECH+542,95 FORI=CH+543
TOCH+550
330 POKEI,160 NEXT POKECH+551,223 FORI=CH+583TOCH+591:POKEI,160 NEXT
340 FORI=CH+623TOCH+626:POKEI,160 NEXT:POKECH+627,105:POKECH+629,95 POKECH+630,
160
350 POKECH+631,105:POKECH+663,95:POKECH+664,160 POKECH+665,105
360 POKECH+400,101:FORI=CH+439TOCH+799STEP40 POKEI,103:POKEI+1,101 NEXT
370 POKECH+839,103 POKECH+840,76:POKECH+879,122:FORI=CH+841TOCH+878:POKEI,100:N
EXT
380 FORI=CH+704TOCH+864STEP40:POKEI,58:NEXT
390 PRINT"M A I N                       L A N D
400 PRINT"                    SMALL      SAM",
410 PRINT"            I G      S A M";
420 PRINT"                    START/FINISH"
430 :
440 REM** WAIT AT START **
450
460 S=.35:X=S C=0 Y=C:PN=CH+785:PO=PN SP=PN N=0 B$="" B=π/2 T$="000000"
470 PRINTTAB(10)"PRESS 'S' TO START"
480 POKESP,C(3):FORI=1TO150:NEXT
490 GETA$:IFA$="S"THEN540
500 POKESP,32:FORI=1TO150:NEXT:GOTO480
510 :
520 REM** START MOVEMENT **
530 :
540 TI$="000000" PRINT"⌐ TIME    0 S.   COURSE 090   STATUS GREEN"
550 :
560 REM** TEST FOR VALID INPUT **
570 :
580 GETA$:IFA$=""THEN750
590 IFVAL(A$)>0ORA$="0"THEN620
600 IFA$<>CHR$(20)ORN=0THEN750
610 PRINT"⌐"TAB(20+N)" ":N=N-1:B$=LEFT$(B$,N):GOTO750
620 N=N+1:IFN=1THENPRINT"⌐"TAB(21)"   "
630 PRINT"⌐"TAB(20+N)A$:B$=B$+A$:IFN<>3THEN750
640 IFVAL(B$)<360THEN700
650 PRINT"  ANGLE BETWEEN 000 AND 359, PLEASE!⌐":FORI=1TO2500:NEXT
660 PRINTBL$"⌐":PRINT"⌐"TAB(21)"   ":N=0:B$="":GOTO750
670 :
680 REM** SET NEW COURSE **
690
700 B=VAL(B$)*π/180 SP=PO N=0 B$="" S=.35*SIN(B):C=COS(B)/4 R=0
710 X=X-INT(X):Y=Y-INT(Y)
720
730 REM** TIME UPDATE **
740 :
750 IFT$=TI$THEN810
760 TA$=STR$(VAL(MID$(TI$,3,2))*60+VAL(RIGHT$(TI$,2)))
770 PRINT"⌐"TAB(9-LEN(TA$))TA$ T$=TI$
780 :
790 REM** CALC NEW POSITION **
800
810 IFR=0THENX=X+S:Y=Y+C:PN=SP+INT(X)-40*INT(Y)
820
830 REM** CHECK FOR COLLISION **
840
850 P=PEEK(PN) IFP<>32ANDP<>124ANDP<>126ANDP<>108ANDP<>123THEN940
860 IFPEEK(33726)=160THENPRINT"⌐"TAB(34)"GREEN"
870
880 REM** PLOT NEW POSITION **
890
900 GOSUB1110 GOTO580
910 :
920 REM** COLLISION **
930 :
940 IFPEEK(PN)=58THENGOSUB1110 GOTO990
950 R=1 PRINT"⌐"TAB(34)" RED ":GOTO580
960 :
970 REM** END ROUTINE **
980 :
990 PRINT"⌐"BL$ PRINTTAB(7-LEN(TA$))"FINISHED! YOU TOOK"TA$" SECONDS.   "
1000 FORI=1TO2500:NEXT
1010 IFVAL(TA$)>VAL(BT$)THEN1070
1020 PRINT" IT IS THE BEST TIME SO FAR. ", BT$=TA$
1030 FORI=1TO2500 NEXT PRINT"AGAIN? Y/N⌐⌐"
1040 GETA$ IFA$<>"Y"ANDA$<>"N"THEN1040
1050 IFA$="N"THENPRINT"⌐" END
1060 PRINTBL$ PRINTBL$"⌐⌐":POKEPO,58 GOTO460
1070 PRINT" THE BEST TIME IS"BT$" SEC.  ", GOTO1030
1080
1090 REM** PLOT NEW POSITION **
1100 :
1110 POKEPO,32 FORI=1TO100 NEXT POKEPN,C(1-(X-INT(X)<.5)-2*(Y-INT(Y)<.5))
1120 FORI=1TO100:NEXT:PO=PN:RETURN
```

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Cassette 1 – Games

For ZX81 (and ZX80 with 8K BASIC ROM)

ORBIT – your space craft's mission is to pick up a very valuable cargo that's in orbit around a star.

SNIPER – you're surrounded by 40 of the enemy. How quickly can you spot and shoot them when they appear?

METEORS – your starship is cruising through space when you meet a meteor storm. How long can you dodge the deadly danger?

LIFE – J. H. Conway's 'Game of Life' has achieved tremendous popularity in the computing world. Study the life, death and evolution patterns of cells.

WOLFPACK – your naval destroyer is on a submarine hunt. The depth charges are armed, but must be fired with precision.

GOLF – what's your handicap? It's a tricky course but you control the strength of your shots.

Cassette 2 – Junior Education: 7-11-year-olds

For ZX81 with 16K RAM pack

CRASH – simple addition – with the added attraction of a car crash if you get it wrong.

MULTIPLY – long multiplication with five levels of difficulty. If the answer's wrong – the solution is explained.

TRAIN – multiplication tests against the computer. The winner's train reaches the station first.

FRACTIONS – fractions explained at three levels of difficulty. A ten-question test completes the program.

ADDSUB – addition and subtraction with three levels of difficulty. Again, wrong answers are followed by an explanation.

DIVISION – with five levels of difficulty. Mistakes are explained graphically, and a running score is displayed.

SPELLING – up to 500 words over five levels of difficulty. You can even change the words yourself.

Cassette 3 – Business and Household

For ZX81 (and ZX80 with 8K BASIC ROM) with 16K RAM pack

TELEPHONE – set up your own computerised telephone directory and address book. Changes, additions and deletions of up to 50 entries are easy.

NOTE PAD – a powerful, easy-to-run system for storing and retrieving everyday information. Use it as a diary, a catalogue, a reminder system, or a directory.

BANK ACCOUNT – a sophisticated financial recording system with comprehensive documentation. Use it at home to keep track of 'where the money goes,' and at work for expenses, departmental budgets, etc.

Cassette 4 – Games

For ZX81 (and ZX80 with 8K BASIC ROM) and 16K RAM pack

LUNAR LANDING – bring the lunar module down from orbit to a soft landing. You control attitude and orbital direction – but watch the fuel gauge! The screen displays your flight status – digitally and graphically.

TWENTYONE – a dice version of Blackjack.

COMBAT – you're on a suicide space mission. You have only 12 missiles but the aliens have unlimited strength. Can you take 12 of them with you?

SUBSTRIKE – on patrol, your frigate detects a pack of 10 enemy subs. Can you depth-charge them before they torpedo you?

CODEBREAKER – the computer thinks of a 4-digit number which you have to guess in up to 10 tries. The logical approach is best!

MAYDAY – in answer to a distress call, you've narrowed down the search area to 343 cubic kilometers of deep space. Can you find the astronaut before his life-support system fails in 10 hours time?

Cassette 5 – Junior Education: 9-11-year-olds

For ZX81 (and ZX80 with 8K BASIC ROM)

MATHS – tests arithmetic with three levels of difficulty, and gives your score out of 10.

BALANCE – tests understanding of levers/fulcrum theory with a series of graphic examples.

VOLUMES – 'yes' or 'no' answers from the computer to a series of cube volume calculations.

AVERAGES – what's the average height of your class? The average shoe size of your family? The average pocket money of your friends? The computer plots a bar chart, and distinguishes MEAN from MEDIAN.

BASES – convert from decimal (base 10) to other bases of your choice in the range 2 to 9.

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— 14 I/O expansion slots as standard
— screen size: 24 lines of 40 characters, Upper and Lower case with optional card expansion to 24 lines of 80 characters.
— 32k byte of RAM standard, on board expandable to 96k byte
— uses the popular 6502 CPU
— bus compatible with the Z80 Firmware Card with CP/M and Microsoft BASIC
— Programming languages including BASIC, Fortran and Cobol etc., are available separately
— full PAL-colour video supplied as standard with sound through TV
— professional keyboard with function keys and number pad
    — Character set with 255 characters in reprogrammable EPROM, delivered standard with Upper and Lower Case characters, Greek and pseudo graphics, and a jumper selectable choise of QWERTY or AZERTY
    — For optional extra's such as an EPROM-programmer, microphone, joystick etc., there is a special lid beside the keyboard for user hardware
    — A sturdy, light weight four-piece moulded case of strong polyurethane in two colours beige/black.

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Standard marks

Combining sets of examination marks with different means can involve hours of laborious calculation. Ian Mercer describes a simple program which can be adapted to standardise any set of statistics.

EDUCATORS often need to find a total for marks for several different subjects, and to compare how well pupils are doing at different subjects at a school.

Using the actual marks can be confusing. For instance, you cannot compare how well someone is doing in mathematics with their English if the maths marks have a mean of 80 and the English marks have a mean of 40. Adding these two sets of marks to obtain a total would give an unfair bias to maths.

To overcome these difficulties the marks can be standardised. This process gives each subject the same mean and standard deviation or SD. Marks from any two subjects can then be totalled or compared fairly. Standardising marks also makes it easier to measure progress — each term's marks will have the same mean and standard deviation.

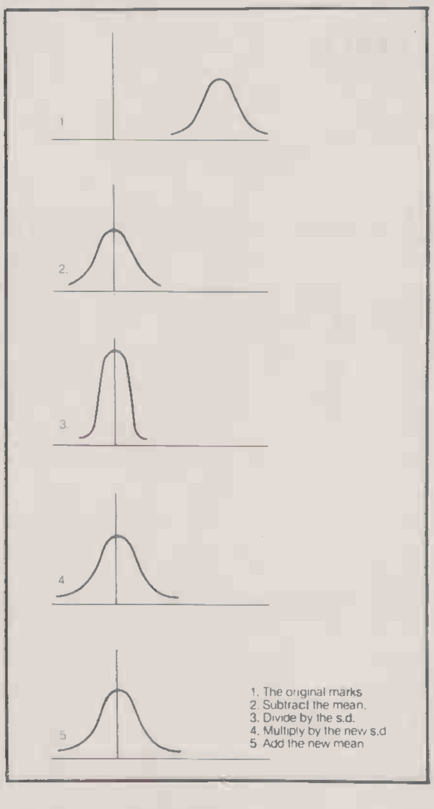
Standardising is a simple process using a computer. First you must calculate the original mean and SD for each subject. Then you take each mark for that subect in turn, subtract the mean, and divide by the SD. This produces a set of marks with mean=0,SD=1. Next you multiply by the new SD and add the new mean. This process takes place in lines 590-610 of the computer program, as shown in figure 1.

The first section of the program inputs marks for the three subjects taken in the entrance exam at my school, Loughborough Grammar. One important tip for Pet users is the use of Input #1 after an Open 1,1,0. This prevents you from accidentally carriage returning and finding yourself back in Basic.

The subroutine at 10000 may look

(continued on next page)

Figure 1. Standardising a normal distribution of marks.




```
10 PRINT"□                    MARKS PROGRAM"
20 PRINT"                     ----- -------"
30 PRINT:PRINT:PRINT:PRINT:PRINT:PRINT:PRINT
40 REM      PROGRAM TO STANDARDISE
50 REM      ENTRANCE EXAM MARKS.
60 REM BY   I.MERCER   9 / 2 / 81
70 REM
80 REM  DATE
90 DA$="FEBRUARY 1981"
100 REM MEAN MARK AFTER STAND.
110 SM=50
120 REM STANDARD DEVIATION AFTER STAND.
130 SS=15
140 REM USE AN INPUT FILE TO PREVENT
141 REM ACCIDENTAL <RETURNS>.
150 OPEN1,0,0
160 REM SUBJECT NAMES
170 SU$(1)="ENGLISH":SU$(2)=" MATHS ":SU$(3)="  I.Q. "
180 P$="SQQQQQQQQQQQQQQQQQQQQQQQ"
190 D$="             ▮▮▮▮▮▮▮▮▮▮▮"
200 REM INPUT NUMBER OF CANDIDATES
210 PRINT"HOW MANY CANDIDATES  :";
220 INPUT#1,N$:N=VAL(N$):PRINT
230 IFN<2THENPRINT"WRONG - TRY AGAIN !":GOTO210
240 IFN<>INT(N)THENPRINT"WHOLE CANDIDATES ONLY !":GOTO210
250 REM DIMENSION THE ARRAY
260 DIM A(N,7),S(2,3)
270 REM A(X,0) = POSITION
280 REM A(X,1) = ENGLISH
290 REM A(X,2) = MATHS
300 REM A(X,3) = I.Q.
310 REM A(X,4) = ENGLISH  STAND.
320 REM A(X,5) = MATHS    STAND.
330 REM A(X,6) = I.Q.     STAND.
340 REM A(X,7) = TOTAL (MATHS + ENGLISH)
350 REM NOW INPUT THE MARKS
360 FORSU=1TO3
370 PRINT"□             INPUT ";SU$(SU);" MARKS"
380 PRINT:PRINT
390 FORX=1TON
400 GOSUB10000
410 NEXT X
420 PRINTP$"IS IT CORRECT ?";D$;
430 INPUT#1,A$:IFLEFT$(A$,1)="Y"THEN510
440 IFLEFT$(A$,1)<>"N"THEN420
450 REM CORRECT A MARK
460 PRINTP$;"WHICH CANDIDATE  :";D$;
470 INPUT#1,A$:X=VAL(A$)
480 IFX<1ORX<>INT(X)ORX>NTHEN420
490 A(0,SU)=A(0,SU)-A(X,SU):A(0,SU+3)=A(0,SU+3)-A(X,SU)*A(X,SU)
500 GOSUB10000:GOTO420
510 NEXT SU
520 REM MARKS INPUT - BEGIN CALCULATIONS
530 FOR SU = 1 TO 3
540 S(1,SU)=A(0,SU)/N
550 S(2,SU)=SQR(A(0,SU+3)/N-S(1,SU)*S(1,SU))
560 NEXT SU
570 FOR X = 1 TO N
580 FOR SU = 1 TO 3
590 A=(A(X,SU)-S(1,SU))/S(2,SU)
600 A=A*SS+SM
610 A(X,SU+3)=INT(A+.5)
620 NEXT SU:A(X,7)=A(X,4)+A(X,5)
630 NEXT X
640 REM    PRINT OUT RESULTS
650 REM OPEN  FILE  TO  PRINTER
660 OPEN 4 , 4
670 PRINT"□QQQQQQQ    LINE PRINTER UP TO TOP OF PAGE"
680 PRINT"            AND PRESS <RETURN>      "
690 GETA$:IFA$<>CHR$(13)THEN690
700 PRINT#4
710 PRINT#4,SPC(20);CHR$(1);"ENTRANCE EXAMINATION"
711 PRINT#4,SPC(20);CHR$(1);"____________________"
720 PRINT#4,SPC(20);CHR$(1);"       RESULTS      "
721 PRINT#4,SPC(20);CHR$(1);"       -------      "
730 PRINT#4,SPC(60);DA$:PRINT#4
740 PRINT#4,"    .———ENGLISH———. .——— MATHS ———. .——— I.Q. ———."
750 PRINT#4," NO. ";
760 FOR TT = 1 TO 3 : PRINT#4," TRUE SCALED POSTN ";:NEXT TT
770 PRINT#4," TOTAL POSITION"
780 PRINT#4
790 REM  NOW PRINT OUT ACTUAL MARKS
800 FOR X = 1 TO N
810 PRINT#4,RIGHT$("    "+STR$(X)+"  ",5);
```

(listing continued on next page)

(continued from previous page)
daunting for non-Pet users, but the cursor commands are only laying out the marks neatly on the screen as they are input. These could be replaced by HTAB and VTAB on the Apple or equivalent, or omitted.

As the marks are input, they are totalled up in the zero element of the array — see line 10050. But remember that if a mark is altered you must correct these totals — see line 490. When all the marks have been input, the program calculates the mean and SD for each subject — see lines 530-560 and stores them in an array S(,). Next it standardises the marks. For this entrance exam the total does not include the IQ paper; line 620 totals the maths and English marks.

Now the results are output to the printer — any printer offering 80 columns or more will do. Extensive formatting in the form of Right$() is used to ensure a neat table with right-justified numbers. The program also calculates the positions in each subject and the overall position.

This section of the program takes the longest to run, but since it is only run once a year I did not think it was worth using machine code, which would have gained speed at the expense of readability of the program.

For reference, the program also prints out the original mean and standard deviation for each subject.

It then calculates a product-moment correlation coefficient. This can take a value from −1 to +1. For exam results it should be positive and above about 0.5.

A sample run using random numbers generated by the Pet is shown in figure 2.

(listing continued from previous page)

```
820 FOR SU = 1 TO 3
830 PRINT#4,RIGHT$("     "+STR$(A(X,SU))+"  ",6);
840 PRINT#4,RIGHT$("     "+STR$(A(X,SU+3))+"  ",6);
850 PX=1:EX=0:MA=A(X,SU)
860 FORT=1TON
870 IFA(T,SU)<MATHEN900
880 IFA(T,SU)>MATHENPX=PX+1:GOTO900
890 EX=EX+1
900 NEXTT
910 PRINT#4,RIGHT$("      "+STR$(PX),4);
920 IFEX>1THENPRINT#4,"=  ";:GOTO940
930 PRINT#4,"   ";
940 NEXTSU
950 PRINT#4,RIGHT$("     "+STR$(A(X,7))+"  ",7);
960 PX=1:EX=0:MA=A(X,7)
970 FORT=1TON
980 IFA(T,7)<MATHEN1010
990 IFA(T,7)>MATHENPX=PX+1:GOTO1010
1000 EX=EX+1
1010 NEXTT
1020 PRINT#4,RIGHT$("       "+STR$(PX),6);
1030 IFEX>1THENPRINT#4,"=";
1040 PRINT#4
1050 NEXT X
1060 FORT=1TO4:PRINT#4:NEXT
1070 PRINT#4,SPC(15);"ORIGINAL MEAN";SPC(17);"ORIGINAL S.D."
1071 PRINT#4,SPC(15);"_____________";SPC(17);"_____________"
1080 FORSU=1TO3
1090 PRINT#4,SPC(5);SU$(SU);SPC(7);LEFT$(STR$(S(1,SU))+"      ",5);
1100 PRINT#4,SPC(25);LEFT$(STR$(S(2,SU))+"      ",5)
1110 NEXT SU
1120 FORT=1TO4:PRINT#4:NEXT
1130 REM NOW CALCULATE THE PRODUCT MOMENT CORRELATION COEFFICIENTS
1140 PRINT#4,SPC(21);"PRODUCT MOMENT CORRELATIONS"
1141 PRINT#4,SPC(21);"___________________________"
1150 FORSU=1TO3
1160 OS=SU+1:IFOS=4THENOS=1
1170 TT=0
1180 FOR T = 1 TO N
1190 TT=TT+(A(T,SU)-S(1,SU))*(A(T,OS)-S(1,OS))
1200 NEXT T
1210 PRINT#4,SPC(21);SU$(SU);" - ";SU$(OS);"  :  ";
1220 PM=TT/N/(S(2,SU)*S(2,OS))
1230 PRINT#4,LEFT$(STR$(PM)+"     ",4)
1240 NEXT SU
1250 FORT=1TO4:PRINT#4,:NEXT
1260 END
10000 PRINTP$"CANDIDATE #";X;"▮    :-";D$;
10010 INPUT#1,N$:J=VAL(N$)
10020 IFJ<1ORJ>200ORJ<>INT(J)THEN10000
10030 PRINT"▮▮";:FORT=1TOX:PRINT"▮▮▮▮";:NEXT:PRINT"▮▮▮▮▮";
10040 PRINTRIGHT$("    "+STR$(J),4);
10050 A(X,SU)=J:A(0,SU)=A(0,SU)+J:A(0,SU+3)=A(0,SU+3)+J*J
10060 RETURN
```

Figure 2. Sample results of program.

ENTRANCE EXAMINATION

RESULTS

FEBRUARY 1981

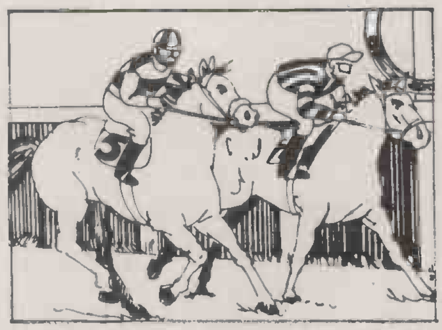
	ENGLISH			MATHS			I.Q.				
NO.	TRUE	SCALED	POSTN	TRUE	SCALED	POSTN	TRUE	SCALED	POSTN	TOTAL	POSITION
1	33	32	9	62	66	2	52	46	6	98	5
2	56	58	4	74	79	1	62	59	4	137	1
3	44	44	7	35	35	8=	50	44	7=	79	8=
4	63	66	2	43	44	7	54	49	5	110	4
5	71	75	1	52	54	4=	50	44	7=	129	2
6	51	52	5=	44	45	6	68	66	2	97	6
7	29	26	10	52	54	4=	72	71	1	80	7
8	51	52	5=	28	27	10	50	44	7=	79	8=
9	36	35	8	35	35	8=	65	62	3	70	10
10	58	60	3	56	59	3	29	15	10	119	3

	ORIGINAL MEAN	ORIGINAL S.D.
ENGLISH	49.1	13.0
MATHS	48.1	13.2
I.Q.	55.1	11.9

PRODUCT MOMENT CORRELATIONS

ENGLISH - MATHS	.08
MATHS - I.Q.	-.02
I.Q. - ENGLISH	-.45

RACE NIGHT



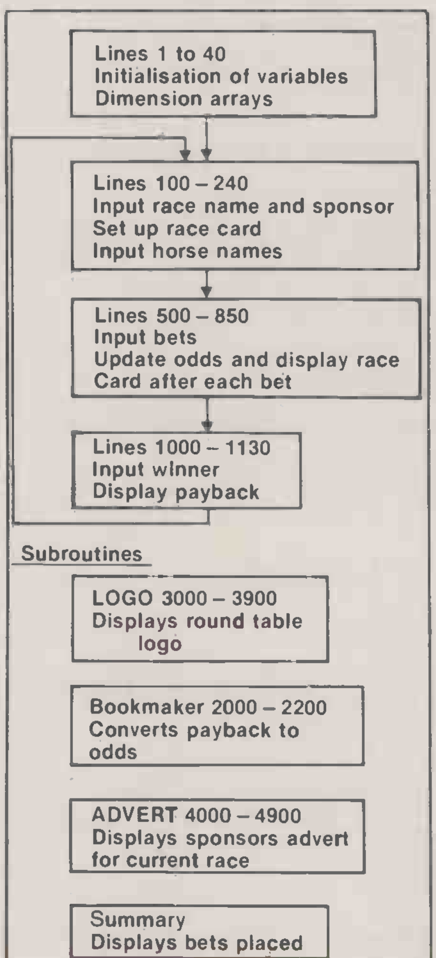
An evening's entertainment, and a good profit for charity are ingredients of a typical race night. This program from Eric Parr removes much of the paperwork and adds to the atmosphere of the occasion.

SIMULATED horse races provide the entertainment at the popular fund-raising events known as race nights. The activity centres round filmed races — often from obscure American or Australian race courses.

After seeing the runners being paraded round the paddock, the punters place their bets. Winnings, amounting to 60 percent of the total staked, are paid out at the end of the race, calculated on the totaliser principle. The remaining 40 percent is retained for charity. Between six and 10 races are normally run in an evening.

The Race Night program was written for Wishaw Round Table to replace most of the tedious paperwork and calculations involved in a normal race night. The system is supported by "bookies' runners" as it was thought advisable to use betting slips to allow manual back-up if the computer crashed.

Figure 1. Block diagram of Race Night program, including subroutines.



The program was tested on several dummy runs, but on the night it performed better than expected. The tote was run successfully by just two people — a typist and a dictator.

The system also added some atmosphere to the night by providing continuously-updated odds. In a normal race night, odds are only available after a race has been run. Odds for the winner of each race were given within seconds of the finish, compared with the 10 to 15 minutes which had been usual on previous race nights.

The essence of the program is quite simple. The payback — P — per bet is given by:

$$\frac{0.6 \times U \times T}{N}$$

where U is the unit bet, T the total number of bets placed and N the total bets placed on the winning horse.

The majority of the program is actually devoted to embellishments, which include a race card displaying the horses' names and current odds, a Round Table logo for "quiet" periods, and a one-page advertisement for each race sponsor between races.

The program falls neatly into four blocks — see figure 1. The first block simply dimensions the arrays used, reserves an area for the string arrays and sets the price of a bet.

The second block inputs the horses' names. These could have been stored in arrays for each race, but in practice most names are sold on the night, and it adds atmosphere to the event if the race card is built up on the VDU screens as horses are sold.

The third, and most important, block inputs the bets. A race card is displayed, with odds — see figure 2. The actual bookmakers' odds are calculated in the subroutine from lines 2000 to 2200. The pay-back per unit bet is given by the simple formula.

RACE 3 WISHAW PRESS STAKES

Number	Name	Approx Odds
1	Heat for Hire	3/2
2	British Steel	5/1
3	Mighty Micro	EVENS
4	Red Revolution	4/1
5	Practical Computing	4/1
6	Chip Chop	6/1

Number of bets? 5
Horse number? 2

Figure 2. Race-card display.

$$P = T/N$$

and includes the original stake.

Bookmakers' odds ingore the original stake, hence we start with

$$BM = P - 1.$$

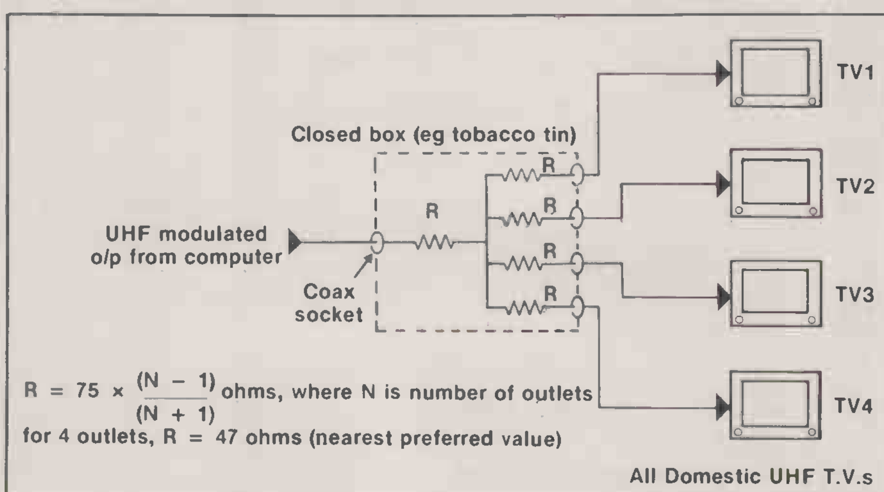
Bookmakers express odds in the form 8/1 or 6/1 or 3/2. The variable J is used as a multiplier and incremented from 1 until the ratio

$$INT (BM*J)/J$$

is within 10 percent of BM. The ratio is then a rough approximation to bookmakers' odds. Line 2005 prints a blank if the odds are less than 1 to 10. Line 2030 simply prints P – 1 for odds greater than 5 to 1. Line 2110 prints "Evens" if the calculated odds are 1 to 1.

(continued on next page)

Figure 3. Signal splitter to drive four UHF televisions.



Arrays	
H$(I)	Horse name
OD(I)	Pay-back/bet should horse win
B(I)	Number of bets on horse
O$(I)	Owner's name
Other variables	
U	Price/bet
RC	Race number
SP$	Sponsor's name
RC$	Race name
K	Number of horses in race
B	Input number of bets
T	Total bets in this race
BM	Bookmakers' odds
J,B1	Value of odds, B1 to J
Q$	Keyboard inputs
A$	Keyboard inputs
A	Numerical version of A$
P	Pay-back

Table 1. Variables used in program.

(continued from previous page)

Bets are given by the runners in the form "four bets on horse 1, six bets on horse 3, etc.". These are entered at lines 620/660. Line 670 deliberately ignores a bet if an invalid horse number is entered. This allows a typing error to be skipped. In addition, negative bets can be entered to correct errors. As each bet is entered, an updated race card is produced on the VDUs.

The final main block gives the winning pay-back. When the winner is announced, the horse number is entered and confirmed upon which the pay-back per bet is given, rounded to 10p.

There are four subroutines. Bookmakers' odds has already been described. The subroutines for the Round Table logo or an advertisement, for the race sponsor, are called when required. They consist of simple Print statements and are not listed here.

The final subroutine, Summary, displays the bets on each horse in cryptic form. It was included to warn the pay-out booth how many claims to expect.

The program was written for a Nascom-2. The UHF-modulated output is used to drive the monitors around the hall, and the 1.5V peak-to-peak video feeds a closed-circuit TV monitor for the keyboard operator. The simple splitter shown in figure 3 allows four TVs to be driven from the UHF output without loss of quality. As the Nascom uses the standard Astec modulator, similar results would probably be achieved with other machines.

The one computer-assisted race night we have held so far was most successful. Only one error was made during the night, and this was later found to have been caused by a forged ticket. In a normal race night an error of plus or minus one ticket per horse is reasonable, so the program was an improvement in this respect. The biggest gains, though, were in the atmosphere created and the general smooth running of the event.

```
1       REMARKABLE RACE NIGHT PROGRAM
2       REMARKABLY WRITTEN FOR WISHAW ROUND TABLE
3       CLS
4       PRINT "Good Evening"
5       INPUT "Bet Unit ";U
6       CLEAR 4000
7       DIM H$ (15),OD(15), B(15), O$(15)
10      CLS
12      INPUT Q$ : IFQ$="LOGO" THEN GO SUB 3000: GOTO10
20      INPUT "Race Number";RC
25      IF RC> 6 OR RC<1 GOTO 20
30      INPUT "Race Name"; RC$
40      INPUT "Sponsor"; SP$
100     REM INPUT HORSES
110     CLS
120     INPUT "Number of Horses";K
130     IF K<4 OR K>12 THEN 110
135     FOR I=1 TO K:H$ (I)=" ": NEXT I
140     CLS: PRINT "Race"; RC; " "; RC$
145     PRINT "Number", "Name"
150     FOR I=1 TO K
160     PRINT I,H$ (I)
170     NEXT I
180     PRINT
190     INPUT"Horse Number";A$:A=VAL (A$)
200     IF A$= "BET" GOTO 500
205     IF A$="ADVERT" THEN GOSUB 4000: GOTO 140
210     IF A>K OR A<1 GOTO 140
220     A=INT (A)
230     INPUT "Name";H$ (A)
235     INPUT "Owner";O$ (A)
240     GOTO 140
500     REM TAKE BETS
502     T=0
504     FOR I=1TOK:B(I)=0:OD (I) = 0: NEXT I
510     CLS
515     PRINT "Race"; RC;" ";RC$:PRINT
520     PRINT "Number   Name"; TAB (35);"APPROX ODDS"
530     FOR I=1 TOK
540     PRINT I; TAB (7);H$ (I);TAB(36);
550     GOSUB 2000
560     NEXT I
600     REM ACTUAL BETS MADE
610     PRINT
620     INPUT "Number of Bets"; Q$
625     IFQ$="LOGO" THEN GOSUB 3000: GOTO 510
630     IFQ$="ADVERT" THEN GOSUB 4000: GOTO 510
635     IFQ$="SUM"THEN GOSUB 5000: GOTO 510
640     IFQ$="RUN" GOTO 1000
650     B=VAL (Q$)
655     IFB>9GOTO 510
660     INPUT"Horse Number";A
670     IFA<1 OR A>K GOTO 510
680     T=T+B:B(A) = B(A)+B
800     REM WORK OUT PAYBACKS
810     P=0.6*T
820     FORI=1 TO K
830     OD(I)=(INT(100*P/B(I)))/100
840     NEXT (I)
850     GOTO 510
1000    REM RESULT OF RACE
1005    CLS
1010    INPUT "Winning Horse No";A
1012    PRINT"Confirm Horse No";A
1014    PRINT"HORSE NAME";H$(A)
1016    INPUT Q$
1018    IFQ$<>"YES" GOTO 1000
1020    CLS:PRINT" Race"; RC;" ";RC$
1025    PRINT:PRINT" Sponsored by "SP$
1026    PRINT
1030    PRINT"   ****WINNER****"
  1040   PRINT
1050    PRINT"Horse Number";A;" ";H$(A)
1060    PRINT "Owner";O$(A)
1070    PRINT
1080    P=0.6*T
1090    OD(A)=(INT((10*(U*P+0.05))/B(A)))/10
1095    PRINT
1100    PRINT"Payback/Bet  ";OD(A)
1110    INPUT Q$
1115    IFQ$="LOGO"THEN GOSUB 3000: GOTO 1110
1120    IFQ$="ADVERT"THEN GOSUB 4000: GOTO 1110
1130    GOTO 10

2000    REM WORK OUT BOOKMAKERS ODDS
2005    IFOD(I)<1.1 THEN PRINT" ":RETURN
2010    BM=OD(I)-1
2020    J=1
2030    IF BM> 5 THEMB1=INT(BM+0.5):GOTO 2100
2040    B1=BM*J
2050    IFABS(B1-INT(B1+0.5))<J/10THENGOTO 2100
2060    J=J+1
2070    GOTO 2040
2100    B1=INT(B1+0.5)
2110    IFB1=1ANDJ=1 THEN PRINT"EVENS":GOTO 2200
2120    PRINT B1;"/";J
2200    RETURN
3000    REM DRAW ROUND TABLE LOGO
3010    REM OMITTED FOR BREVITY
3900    INPUTQ$:RETURN
4000    REM DISPLAY ADVERTS
4010    CLS:PRINT"Race";RC;" ";RC$
4020    PRINT"SPONSORED BY";SP$
4030    ON RC GO SUB 4100;4200;4300;4400;4500;4600
4040    INPUT Q$; RETURN
4100    REM FIRST RACE ADVERT
4102    REM OMITTED FOR BREVITY
4190    RETURN
4200    REM LINES 4200 TO 4690 ADVERTS FOR
4210    REM OTHER RACES. OMITTED FOR BREVITY
5000    REM SUMMARY OF BETS
5010    FOR I=1TOK
5020    PRINT I;BC(I)
5030    NEXT I
5040    PRINT T
5050    INPUTQ$:RETURN
```

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The Twelve computerised Days of Christmas

On the first day of Christmas, my computer gave to me
A glitch on the video screen.

On the second day of Christmas, my computer gave to me
Two keyboard bounces,
And a glitch on the video screen.

On the third day of Christmas, my computer gave to me
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.

On the fourth day of Christmas, my computer gave to me
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.

On the fifth day of Christmas, my computer gave to me
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.

On the sixth day of Christmas, my computer gave to me
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.

On the seventh day of Christmas, my computer gave to me
Seven system re-sets,
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.

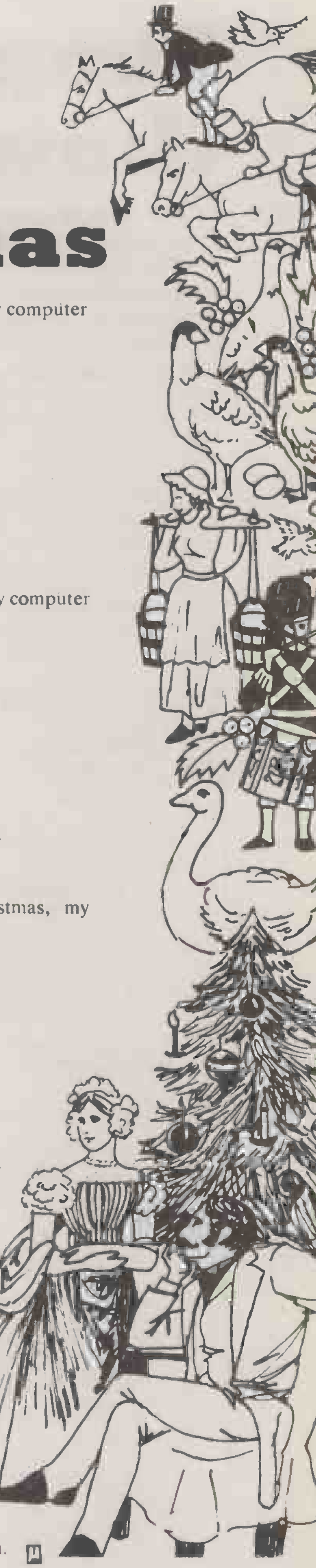
On the eighth day of Christmas, my computer gave to me
Eight worthless printouts,
Seven system re-sets,
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.

On the ninth day of Christmas, my computer gave to me
Nine burnt-out fuses,
Eight worthless printouts,
Seven system re-sets,
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.

On the tenth day of Christmas, my computer gave to me
Ten disc-drive lockouts,
Nine burnt-out fuses,
Eight worthless printouts,
Seven system re-sets,
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.

On the eleventh day of Christmas, my computer gave to me
Eleven damaged diskettes,
Ten disc-drive lockouts,
Nine burnt-out fuses,
Eight worthless printouts,
Seven system re-sets,
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.

On the twelfth day of Christmas, my computer gave to me
Twelve blown-out circuits,
Eleven damaged diskettes,
Ten disc-drive lockouts,
Nine burnt-out fuses,
Eight worthless printouts,
Seven system re-sets,
Six I/O spasms,
Five blank cassettes,
Four garbled Saves,
Three loose plugs,
Two keyboard bounces,
And a glitch on the video screen.



Simple Petpro puts thought into words

Petpro is an uncomplicated word-processing program for the Pet. Although Ian Birnbaum designed it originally for school and college use, it has been applied successfully in a variety of environments.

THIS WORD-processing program has many of the features which are found in larger programs, including right-justification and full editing facilities.

Petpro will run on any large-keyboard Pet. For the 4000 and 8000 series, some small modifications have to be made, and these are mentioned in the text. The program takes up a little over 4K of memory and does not require discs.

The program should be input in lower-case mode so you must Poke 59468,14 before typing it in. For the 4000 and 8000 series

- change the 49 in lines 22, 31 and 48 to 88
- change the 46 in lines 115 and 133 to 85.

Table 1. Design map.

Lines numbers	Function
2-29	Subroutines
	2-4 Wait for ready — "space" response
	5-6 Line printout, editing mode
	7 Prints quotation mark and ↑
	8 Line wipeout
	9 Line-length-exceeded message
	10-11 Memory full in editing mode — common routine
	12-13 Wait for answer Y/N
	14-16 Input-mode option
	17 Re-sets line text variables to zero
	18-20 Tape input/output
	21-22 Tape output
	22 File-closing routine
	23 Pause
	24-25 Memory update in edit mode
	26-29 Search for character/space in justify
	30 Delete line
31-42	Initialisation
43-48	Tape Input
50-76	Keyboard Input
	50-61 Input checks and conversions
	62-63 Character deletion
	64-66 Carriage-return deletion with 8000 series, delete line 64
	67-70 New-line routine
	71-73 Automatic carriage-return routines
	74-76 Tab routine
77-111	Editing Mode
	80-94 Line-listing and option routines
	95-98 Edit
	99-102 Insert
	103-111 Squeeze
112-139	Output mode and options for continuation
	120-124 Justify

With the 8000 series only, line 64 should be deleted.

The program has three specific modes: the input mode, the edit mode and the output mode.

In input mode, text can be input either from the keyboard or from tape. The program allows a variable line-width up to 73 characters. You can set the right-hand margin by making this width smaller. Setting the width at 55 gives a right-hand margin of about 10, assuming that you will later be setting a left-hand margin of 10.

An automatic carriage-return operates no earlier than seven characters before the maximum line width you have set, and no later than two characters after it. It operates as soon as a space is typed, thereby avoiding word breaks. Split words can be amended, if desired, when in edit mode so manual carriage return will rarely have to be used.

Up to 10 tabs are allowed, but if you do not require any type 0. At this stage, if you have chosen tape input, the tape will be read and the program will immediately pass to edit mode.

When inputting from the keyboard, the following points should be noted.

- The Pet keyboard is turned into a normal QWERTY keyboard, so full stops, commas, etc., are in the normal place. The Run/Stop key and all the cursor-movement keys are disabled — touching them will produce no effect.
- You can delete the last character input by the ↑ key or the Delete/Insert key, whether or not the shift-lock is on. It is best to use ↑ since it can be easily touch-typed. You can delete a carriage return in the same way. You should delete only local mistakes; others can be corrected when editing later.
- To obtain the next pre-set Tab, press ←; it will operate whether or not the shift-lock is on. If the last Tab has been passed, or if there are no pre-set Tabs, ← will be ignored.
- Automatic carriage-return will not operate until the absolute maximum line length is reached.

There are two ways to enter editing mode. If you fill up the memory, the computer will enter it automatically, though some room will be reserved for manipulation in this mode. After output, you will be able to return to the keyboard and continue.

With large-memory Pets, garbage collection can appreciably slow up some operations in editing mode. It is, therefore, better not to create too much text before editing. The 4000 and 8000 series Pets do not have this problem. The second way to leave the keyboard is by typing a quotation mark — use ' for quotation marks otherwise.

In editing mode the keyboard once again acts as a normal Pet keyboard, with the full stop in the "wrong" place, and cursor movement allowed. Key ↑ will no longer delete characters and the Delete key must be used. Characters may be inserted by using the Insert, shifted Del/Inst, key.

The lines are displayed in groups of 10.

Name	Function
A	Maximum line length
B	1. File number, tape or printer 2. Character count in squeeze
C	Count for number of lines in text
D	1. Flag set to suppress space on new line 2. Controls memory add/subtract 3. Character pointer in justify
E	1. Flag set if last Tab set 2. Set to 2 if memory close to full
F	Flag set if memory full before end of file on tape input
G	Number of lines output to printer for each piece of text
H	Maximum number of lines per page
I	1. General For/Next counter 2. Device number for tape 3. Unshifted ASCII value of A$
J	1. Secondary address for tape 2. Line number to be edited, etc.
K	1. Counter for line wipe-out 2. Length of next string in squeeze
L	Counter for total number of characters input
M	Maximum number of line possible
N	1. Counter for lines to be printed out during editing mode 2. Length of current string in justify
O	Left-margin length
P	1. Next Tab to be set 2. Length of next string in justify
Q	1. Counter for list of Tabs 2. Length of pause 3. Flag for search in justify
R	1. Counter for pause subroutine 2. Line count in squeeze 3. Flag for character/space found in justify
S	Double-spaced line flag
T	Number of Tabs
U	Set to prevent number of lines output being re-set to zero
V	Set to miss out lines 42-48 when keyboard input follows tape
W	1. Counter for Tab printing 2. Length of current string in squeeze
X	Correct line length pointer
Y	Maximum available memory after null-string pointers set, etc.
Z	Maximum number of lines input prior to editing
T( )	List of Tabs pre-set
A$	1. Character input from keyboard 2. Store for memory full 3. Current string in squeeze 4. Current line in printout
B$	1. Mode of operation, k/t 2. Store for line number in editing mode 3. Flag for justify
C$	Last mode of operation
E$	Next string in squeeze
A$( )	Lines Input from keyboard or tape

Table 2. Variable list

```
1 POKE59468,14:PRINT"▮▮PETPRO#2▮":PRINTSPC(11)"▮(C)I BIRNBAUM 1981▮▮":GOTO31
2 PRINT"▮PRESS 'SPACE' WHEN READY."
3 GETA$:IFA$<>" "THEN3
4 RETURN
5 PRINT"▮▮▮▮";:FORI=0TO9:IFN+I>CTHENRETURN
6 PRINTI;RIGHT$(A$(N+I),LEN(A$(N+I))-1):NEXT:RETURN
7 PRINT"▮▮▮"CHR$(34)CHR$(34)CHR$(20)"▮▮"SPC(A+4)"↑▮▮▮▮";:POKE623,29:POKE158,1:R
ETURN
8 FORK=32768TO32847:POKEK,32:NEXT:RETURN
9 PRINT"▮MAX LINE LENGTH EXCEEDED.":Q=1111:GOSUB23:GOSUB8:RETURN
10 PRINT"▮NO "A$" POSSIBLE: MEMORY FULL."
11 Q=2000:GOSUB23:GOTO81
12 GETA$:IFA$<>"Y"ANDA$<>"N"THEN12
13 RETURN
14 PRINT"▮▮K▮EYBOARD OR ▮T▮APE INPUT?"
15 GETB$:IFB$<>"K"ANDB$<>"T"THEN15
16 RETURN
17 FORI=1TOC:A$(I)="":NEXT:U=1:Y=FRE(0):PRINT"▮":RETURN
18 PRINT"▮NAME OF TAPE FILE (IF NO NAME":INPUT"PRESS 'RETURN'▮▮▮▮▮▮▮";A$
19 IFA$="▮"THENA$=""
20 OPENB,I,J,A$:RETURN
21 B=2:I=F+1:J=1:GOSUB18:FORI=1TOC:PRINT#2,CHR$(34)+A$(I):NEXT
22 CLOSEB:POKE144,49:RETURN
23 FORR=1TOQ:NEXT:RETURN
24 L=L+LEN(A$(N+J))*D:IFL>.7*YORC=MTHENE=2
25 RETURN
26 R=0:D=D+1:IFD>NTHEND=2:IFQ=0THENRETURN
27 IFMID$(A$,D,1)<>" "THENR=1
28 IFR=QTHENRETURN
29 GOTO26
30 D=-1:GOSUB24:C=C-1:FORI=N+JTOC:A$(I)=A$(I+1):NEXT:A$(I)="":RETURN
31 POKE144,49:GOSUB14:C$=B$:PRINT"▮";
32 INPUT"MAX LINE LENGTH (73 OR LESS)";A:IFA>73THENPRINT"▮";:GOTO32
33 IFB$="T"THEN42
34 PRINT"▮AUTOMATIC CARRIAGE RETURN":PRINT"WILL OCCUR BETWEEN CHARACTER"
35 PRINT"POSITIONS"A-7"AND"A+2
36 INPUT"▮HOW MANY TABS (MAX 10)";T:IFT=0THEN41
37 IFT>10THENPRINT"▮";:GOTO36
38 PRINT"▮▮ENTER THEM IN NUMERICAL ORDER"
39 PRINT"COLUMN POSITIONS ARE BETWEEN 1 AND"A:PRINT:FORI=1TOT
40 PRINT"TAB NO.";I;:INPUTT%(I):NEXT
41 IFV=1THEN49
42 M=INT(FRE(0)/A)+10:Z=INT(.9*M):DIMA$(M):Y=FRE(0):IFB$="K"THEN49
43 B=1:I=1:J=0:GOSUB18
44 FORC=1TOZ:INPUT#1,A$(C):L=L+LEN(A$(C))
45 IFST=64THENPRINT"▮END OF FILE":GOSUB22:GOTO78
46 IFL>.7*YTHENGOTO48
47 NEXT:C=C-1
48 F=1:POKE144,49:GOTO77
49 GOSUB2
50 PRINT"▮";:POKE167,0:C=1:D=0:E=0:A$(1)="▮"
```

(listing continued on next page)

Pressing < displays the next 10 lines; pressing > displays the last 10 lines; pressing X allows exit to output mode. Otherwise there are four options:

- Delete a line shown. For example, D7 deletes the line 7 and moves up all the rest. Line 9 becomes the one that would have been first in the next group of 10.
- Edit a line shown. For example, E4 displays line 4 at the top of the screen. Move the cursor to the point where editing is required. Take care not to erase the quotation mark which always precedes the line. When the line is edited to your satisfaction, press Return and the newly-edited line will replace the old one in the displayed group of 10.
- Insert a line before one shown. For example, I3 to insert a line before Line 3. A blank line will appear at the top of the screen, preceded by the quotation mark. It is essential that this mark is not erased. Type in the new line and press Return when finished.

If the last group of lines is being displayed, it is possible to insert one after the last line. Type I followed by any line number greater than the one shown. For example, if seven lines are displayed, typing I7, I8 or I9 will allow an eighth line to be added. In the event of the last group being exactly 10 lines, a line may be added by first inserting a dummy blank line in the group — e.g., by typing I9 and then Return. This shifts line 10 into the next group, which was previously empty, allowing the real line to be added. The dummy line can then be deleted.

- Squeeze up text to a line. For example, S4 moves text so that each line after, and including line 4, will have at most seven characters less than the maximum allowed per line. The squeeze facility continues to squeeze text until it meets a blank line or a line beginning with a space, both of which are signals for new paragraphs.

Combining the four editing functions allows a wide range of changes to be made to text. For example, suppose line 4 reads,

with a few modifications the program can be
used with

and you want to insert the words "very elementary" between "few" and "modifications", while keeping the maximum line length at 55. One way to do this is to type E4, delete all the words after "program" and make the required insertion. Then type I5, and type in the deleted words "can be used with". Finally, by

(continued on next page)

(continued from previous page)
typing S5, all the text will be properly squeezed up.

If you type a wrong letter when choosing an option — e.g., a D instead of an I — you can press Delete to rectify it. Within options E and I, the marker ↑ shows the end of the line. If you exceed the maximum line length, the computer displays a message and allows you to try again.

After you have seen all the text on the screen you can display it again by typing Y when asked. At this stage you may perform further editing if you wish, and you can make several passes through the text before entering output mode.

(listing continued from previous page)
```
51 GETA$:IFA$=""THEN51
52 I=ASC(A$)AND127:IFI=13THEN66
53 IF(D=1ANDA$=" ")ORI=3ORI=17ORI=19ORI=18ORI=29THEN51
54 D=0:IFASC(A$)=34THENPRINT"□";:GOTO78
55 IFA$="▪"THENA$=","
56 IFI=59THENA$="."
57 IFA$=":"THENA$=";"
58 IFA$="┘"THENA$=":"
59 IFI=95THEN74
60 IFI<>20ANDI<>94THENPRINTA$;:GOTO70
61 IFLEN(A$(C))=1THEN63
62 A$(C)=LEFT$(A$(C),LEN(A$(C))-1):PRINTCHR$(20);:GOTO51
63 A$(C)="":C=C-1:L=L-LEN(A$(C))
64 IFLEN(A$(C))>39THENPRINT"■ ▮□";
65 PRINT"■ ▮□"RIGHT$(A$(C),LEN(A$(C))-1) ;:GOTO51
66 IFLEN(A$(C))<=39THENX=225+PEEK(216):POKEX,(PEEK(X)OR128)
67 PRINT"■ "CHR$(13);:E=0:L=L+LEN(A$(C))
68 IFC=ZORL>.8*YTHENPRINT"□":GOTO77
69 C=C+1:A$(C)="▣":GOTO51
70 IFE=0ANDLEN(A$(C))>A-7ANDA$=" "THEN73
71 A$(C)=A$(C)+A$
72 IFLEN(A$(C))<A+3THEN51
73 D=1:GOTO67
74 FORQ=1TOT:IFPEEK(198)>=T%(Q)-1THENNEXT:GOTO51
75 P=T%(Q)-PEEK(198)-1:FORW=1TOP:A$(C)=A$(C)+" ":PRINT" ";:NEXT
76 E=(Q=T)*(T<>1):GOTO51
77 PRINT"□COMPUTER MEMORY FULL,"
78 POKE167,1:PRINT"▣EDIT TEXT IF NECESSARY.":PRINT"▣PRESS "CHR$(34)" WHEN READY
79 GETA$:IFA$<>CHR$(34)THEN79
80 N=1
81 GOSUB5:IFI=0THEN112
82 PRINT"▣D■ELETE ▣E■DIT ▣I■NSERT ▣S■QUEEZE + LINE NUMBER";
83 PRINTSPC(10)"OTHERWISE E▣X■IT ▣>■ ▣<■";
84 GETA$:IF(A$="<"ANDN>10)ORA$=">"THENN=N+10*(A$="<")-10*(A$=">"):GOTO81
85 IFA$="X"THEN112
86 IFA$=""OR(A$<>"D"ANDA$<>"E"ANDA$<>"I"ANDA$<>"S")THEN84
87 PRINTA$;
88 GETB$:IFB$=""THEN88
89 IFASC(B$)=20THENPRINTB$;:GOTO84
90 IFASC(B$)<48ORASC(B$)>57THEN88
91 PRINTB$;:J=VAL(B$):IFJ>ITHENJ=I*(A$<>"E")*-1
92 IFA$="D"THENGOSUB30:GOTO81
93 IFA$="I"THEN99
94 IFA$="S"THEN103
95 IFE=2THENIFFRE(0)<250THENA$="EDITING":GOTO10
96 D=-1:GOSUB24:GOSUB7:PRINTRIGHT$(A$(N+J),LEN(A$(N+J))-1);:INPUT"▣";A$
97 GOSUB8:IFLEN(A$)>A+2THENGOSUB9:GOTO96
98 A$(N+J)="▣"+A$:D=1:GOSUB24:GOTO81
99 IFE=2THENIFFRE(0)<300ORC=MTHENA$="INSERTING":GOTO10
100 FORI=CTON+JSTEP-1:A$(I+1)=A$(I):NEXT:C=C+1
101 GOSUB7:INPUT"▣";A$:GOSUB8:IFLEN(A$)>A+2THENGOSUB9:GOTO101
102 GOTO98
103 FORR=N+JTOC-1:A$=A$(R):E$=A$(R+1):W=LEN(A$):K=LEN(E$):IFK<2ORW=1THEN81
104 IFW>A-7THENNEXT:GOTO81
105 IFMID$(E$,2,1)=" "THEN81
106 IFK<A-6-WTHEN109
107 FORB=A-5-WTOK-1:IFMID$(E$,B,1)=" "ORB>A+3-WTHEN110
108 NEXT
109 A$(R)=A$+" "+RIGHT$(E$,K-1):J=R+1-N:GOSUB30:NEXTR:GOTO81
110 A$(R)=A$+" "+MID$(E$,2,B-2):IFMID$(E$,B+1,1)=" "THENB=B+1
111 A$(R+1)="▣"+RIGHT$(E$,K-B):NEXTR:GOTO81
112 PRINT"□DO YOU WANT TO LOOK AT THIS TEXT":PRINT"AGAIN?":GOSUB12
113 IFA$="Y"THEN80
114 PRINT"□IS THERE A PRINTER ATTACHED?":GOSUB12:IFA$="N"THEN130
115 PRINT"□▣MAKE SURE THE PRINTER IS ON":GOSUB2:POKE144,46:OPEN4,4:IFU=1THEN119
116 G=0:PRINT"▣DO YOU WANT DOUBLE-SPACED LINES?":GOSUB12:S=(A$="Y")
117 PRINT"▣MAXIMUM NUMBER OF ▣TYPED■ LINES PER PAGE":PRINT"(IF NO MAX TYPE 0)";
118 INPUT"▮▮▮▮▮▮";H:INPUT"▣LENGTH OF LEFT HAND MARGIN▮▮▮▮▮▮";O:PRINT#4
119 PRINT"▣JUSTIFY TEXT?":GOSUB12:B$=A$:D=1:FORI=1TOC:A$=A$(I):IFB$="N"ORI=CTHE
N125
120 N=LEN(A$):P=LEN(A$(I+1)):IFP<>1THENIFMID$(A$(I+1),2,1)<>" "ANDN>A-7THEN122
121 GOTO125
122 IFN=A+3THEN125
123 Q=1:GOSUB26:Q=0:GOSUB26:IFD=2THEN123
124 A$=LEFT$(A$,D)+" "+MID$(A$,D+1):N=N+1:GOTO122
125 PRINT#4,SPC(O)A$:G=G+1:IFS=-1THENPRINT#4
126 IFG<>HTHEN128
127 PRINT"□MAX LINES PER PAGE REACHED":PRINT"▣ADJUST PAPER":GOSUB2:G=0:PRINT"□"
128 NEXT:B=4:GOSUB22
129 PRINT"▣PRINT THIS OUT AGAIN?":GOSUB12:IFA$="Y"THEN115
130 PRINT"▣▣SAVE THIS TEXT ON TAPE?":GOSUB12:IFA$="Y"THENGOSUB21
131 PRINT"▣▣EDIT THIS TEXT AGAIN?":GOSUB12:IFA$="Y"THEN80
132 E=0:IFF=1THEN139
133 PRINT"□MORE TEXT TO INPUT?":GOSUB12:IFA$="N"THENPOKE144,46:END
134 PRINT"▣WILL PRINTOUT CARRY":PRINT"STRAIGHT ON?":GOSUB12
135 IFA$="N"THENCLR:GOTO31
136 GOSUB14:IFB$="T"THENGOSUB17:GOTO43
137 IFC$="K"THENGOSUB17:PRINT"O.K. CONTINUE.":Q=555:GOSUB23:GOTO50
138 C$="K":GOSUB17:V=1:GOTO34
139 GOSUB17:PRINT"THERE IS MORE TEXT ON TAPE TO INPUT":L=0:F=0:GOSUB2:GOTO44
```

If a printer is attached, you can obtain a printout of the text with either single or double-spaced lines. If you have specified a maximum number of lines per page, the printing will stop at the relevant time to allow you to change the paper.

Note that with double-spaced lines, each typed line will take up two lines on the page. So for example, if the paper can take 50 lines you should set the maximum number of typed lines at 25.

When you set the left-hand margin, note that the total line length should not exceed 80.

The program will right-justify the text if required. Justification will be to a width of two more than the maximum line width set. If tables are included, which you do not want to justify, precede each line of the table by at least one space. The program will not justify a line if the next line begins with a space, or is blank. Neither will it justify a line shorter than seven characters less than the maximum line width set.

After printout, a number of options are available: you can print out again; you can save the text on tape; or you can edit the text again, which is useful if you want to change just a few parts and then save again. Any or all of these options can be combined.

You will then have the option of continuing text input, either from the keyboard or from tape. Subsequent printout can either carry straight on from the previous text — in which case the number of lines already output will be remembered — or else you can start on a new page.

In tape input mode, it is possible that the tape may contain more than the available memory can take. In this case, if you want to save the text again on tape, you will need to use the second cassette port. The program is designed to inform you of this, and it will also remind you that there is more text on tape to input.

For non-Pet printers you will need to delete coding which relates to the adding on of a cursor-down symbol for each new line of text. This occurs in line 50, 69, 98 and 111. Most references to LEN(A$(C)) will have to be reduced by one. These occur on lines 61, 64, and 66. Also subtract 1 from expressions including A in 7, 35, 70, 72, 97, 101, 103, 107, 120 and 122. Change the MID$ in 110 to Left$ (E$, B-1); D=2 in 26 to D=1; and 2 in 103 and 120 to 1. Finally the Right$ function in lines 6, 65, 96 and 109 can be removed. You may need to add code, specific to your printer in order to give you lower-case facilities.

The overriding design philosophy of the program is that it should work as fast as possible, and be as economical as possible with memory space. Unfortunately, this tends to make the readability of the program difficult, but tables 1 and 2 should help if you wish to make modifications.

sinclair ZX81 PERSONAL COMPUTER

Sinclair ZX81 Personal Comp the heart of a system that grows with you.

1980 saw a genuine breakthrough – the Sinclajr ZX80, world's first complete personal computer for under £100. Not surprisingly, over 50,000 were sold.

In March 1981, the Sinclair lead increased dramatically. For just £69.95 the Sinclair ZX81 offers even more advanced facilities at an even lower price. Initially, even we were surprised by the demand – over 50,000 in the first 3 months!

Today, the Sinclair ZX81 is the heart of a computer system. You can add 16-times more memory with the ZX RAM pack. The ZX Printer offers an unbeatable combination of performance and price. And the ZX Software library is growing every day.

Lower price: higher capability
With the ZX81, it's still very simple to teach yourself computing, but the ZX81 packs even greater working capability than the ZX80.

It uses the same micro-processor, but incorporates a new, more powerful 8K BASIC ROM – the 'trained intelligence' of the computer. This chip works in decimals, handles logs and trig, allows you to plot graphs, and builds up animated displays.

And the ZX81 incorporates other operation refinements – the facility to load and save named programs on cassette, for example, *and* to drive the new ZX Printer.

New BASIC manual

Every ZX81 comes with a comprehensive, specially- written manual – a complete course in BASIC programming, from first principles to complex programs.

Kit: £49.95

Higher specification, lower price – how's it done?
Quite simply, by design. The ZX80 reduced the chips in a working computer from 40 or so, to 21. The ZX81 reduces the 21 to 4!

The secret lies in a totally new master chip. Designed by Sinclair and custom-built in Britain, this unique chip replaces 18 chips from the ZX80!

New, improved specification

- Z80A micro-processor – new faster version of the famous Z80 chip, widely recognised as the best ever made.
- Unique 'one-touch' key word entry: the ZX81 eliminates a great deal of tiresome typing. Key words (RUN, LIST, PRINT, etc.) have their own single-key entry.
- Unique syntax-check and report codes identify programming errors immediately.
- Full range of mathematical and scientific functions accurate to eight decimal places.
- Graph-drawing and animated-display facilities.
- Multi-dimensional string and numerical arrays.
- Up to 26 FOR/NEXT loops.
- Randomise function – useful for games as well as serious applications.
- Cassette LOAD and SAVE with named programs.
- 1K-byte RAM expandable to 16K bytes with Sinclair RAM pack.
- Able to drive the new Sinclair printer.
- Advanced 4-chip design: micro-processor, ROM, RAM, plus master chip – unique, custom-built chip replacing 18 ZX80 chips.

Built: £69.95

Kit or built – it's up to you!
You'll be surprised how easy the ZX81 kit is to build: just four chips to assemble (plus, of course the other discrete components) – a few hours' work with a fine-tipped soldering iron. And you may already have a suitable mains adaptor – 600 mA at 9 V DC nominal unregulated (supplied with built version).

Kit and built versions come complete with all leads to connect to your TV (colour or black and white) and cassette recorder.

ter-

Available now-the ZX Printer for only £49.95

Designed exclusively for use with the ZX81 (and ZX80 with 8K BASIC ROM), the printer offers full alpha-numerics *and* highly sophisticated graphics.

A special feature is COPY, which prints out exactly what is on the whole TV screen without the need for further intructions.

At last you can have a hard copy of your program listings – particularly useful when writing or editing programs.

And of course you can print out your results for permanent records or sending to a friend.

Printing speed is 50 characters per second, with 32 characters per line and 9 lines per vertical inch.

The ZX Printer connects to the rear of your computer – using a stackable connector so you *can* plug in a RAM pack as well. A roll of paper (65 ft long x 4 in wide) is supplied, along with full instructions.

16K-byte RAM pack for massive add-on memory.

Designed as a complete module to fit your Sinclair ZX80 or ZX81, the RAM pack simply plugs into the existing expansion port at the rear of the computer to multiply your data/program storage by 16!

Use it for long and complex programs or as a personal database. Yet it costs as little as half the price of competitive additional memory.

With the RAM pack, you can also run some of the more sophisticated ZX Software – the Business & Household management systems for example.

How to order your ZX81

BY PHONE – Access, Barclaycard or Trustcard holders can call 01-200 0200 for personal attention 24 hours a day, every day.

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	Mains Adaptor(s) (600 mA at 9 V DC nominal unregulated).	10	8.95	
	16K-BYTE RAM pack.	18	49.95	
	Sinclair ZX Printer.	27	49.95	
	8K BASIC ROM to fit ZX80.	17	19.95	
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sinclair ZX81

6 Kings Parade, Cambridge, Cambs., CB2 1SN.
Tel: (0276) 66104 & 21282.

How the ZX81 compares with other personal computers

SYSTEM IDENTIFICATION		ZX81	ZX80	ACORN ATOM	APPLE II PLUS	PET 2001	TRS 80 LEVEL I	TRS 80 LEVEL II
ROM		8K	4K	8K	8K	14K	4K	12K
GUIDE PRICE	Basic unit – inc. VAT	£70	£100	£175	£630	£435	£290	£375
	Unit plus 16K RAM (*12K RAM)	£120	£150	£285*	£630	£530	£360	£375
COMMANDS	LIST, LOAD, NEW, RUN, SAVE	●	●	●	●	●	●	●
STATEMENTS	PRINT, INPUT, LET, GOTO, GOSUB/RETURN, FOR/NEXT IF/THEN	●	●	●	●	●	●	●
	STEP	●		●	●	●	●	●
	TAB	●			●	●	●	●
ARITHMETIC FUNCTIONS	ABS, RND	●	●	●	●	●	●	●
	INT	●			●	●	●	●
	ATN, COS, EXP, LOG, SGN, SIN, SQR, TAN	●			●	●		●
	ARCSIN, ARCOS	●						
STRING FUNCTIONS	CHR$	●	●		●	●		●
	LEN	●		●	●	●		●
	ASC(CODE), STR$, VAL, INKEY$	●				●		●
NUMBERS	FLOATING PT $\pm10^{\pm38}$	●			●	●	●	●
	INTEGERS		●	●	●	●		●
NUMERIC VARIABLES	A-Z			●			●	
	AA-ZØ				●	●		●
	An-Zn, n = any alphanumeric string	●	●					
STRING VARIABLES	A$ & B$						●	
	A$ to Z$	●	●	●				
	An$ to Zn$ n = any alphanumeric character				●	●		●
NUMERIC ARRAYS	SINGLE DIMENSIONAL		●	●			●	
	MULTI DIMENSIONAL	●			●	●		●
DISPLAY	ROWS	24	24	16	24	25	16	16
	COLUMNS	32	32	32	40	40	64	64
	LOW RES GRAPHICS (<7000 pixels)	●	●	●	●	●	●	●
	HI RES GRAPHICS (>40000 pixels)			●	●			
SPECIAL FEATURES	USR (CALL, LINK)	●	●	●	●	●		●
	PEEK, POKE (OR EQUIV)	●	●	●	●	●		●

Sinclair software on cassette.

The unprecedented popularity of the ZX Series of Sinclair Personal Computers has generated a large volume of programs written by users.

Sinclair has undertaken to publish the most elegant of these on pre-recorded cassettes. Each program is carefully vetted for interest and quality, and then grouped with others to form single-subject cassettes.

Software currently available includes games, junior education, and business/household management systems. You'll receive a Sinclair ZX Software catalogue with your ZX81 – or see our separate advertisement in this magazine.

The ultimate course in ZX81 BASIC programming.

Some people prefer to learn their programming from books. For them, the ZX81 BASIC manual is ideal.

But many have expressed a preference to learn *on* the machine, *through* the machine. Hence the new cassette-based ZX81 Learning Lab.

The package comprises a 160-page manual and 8 cassettes. 20 programs, each demonstrating a particular aspect of ZX81 programming, are spread over 6 of the cassettes. The other two are blank practice cassettes.

Full details with your Sinclair ZX81.

If you own a Sinclair ZX80...

The new 8K BASIC ROM used in the Sinclair ZX81 is available to ZX80 owners as a drop-in replacement chip. (Complete with new keyboard template and operating manual.)

With the exception of animated graphics, all the advanced features of the ZX81 are now available on your ZX80 – including the ability to drive the Sinclair ZX Printer.

sinclair
ZX81

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Tel: (0276) 66104 & 21282.

Upgrading your machine from an uncluttered micro to a versatile word processor will probably teach you as much about the abundance of printers available as about your programming strengths and weaknesses. Tina Billett relates her experiences of the subject and presents the word-processing program she wrote to solve the problems.

Justifying Genie

GENIE has been in our home for a little over a year, during which time we have gone from strength to strength in both range and size of the programs devised, or attempted.

My spouse has written a financial program for our own purposes, which does everything except go to the bank, but I have tended by and large to stick to games and other useless time-wasters. Even so, I have attained a kind of working knowledge as to how this beast called Genie thinks.

One of the carrots dangled in front of me when the subject of home micros first cropped up was that of the word processing potential. It is several years since I last worked in an office, so I had never met one of those contraptions face to face, as it were. My knowledge was limited to what I had seen on TV.

Before the arrival of Genie, I had spent most of my spare time writing, and having got over the initial micro-addiction, I returned my attention to the neglected typewriter, niggling all the while at the unfulfilled promise of the glories of word processing which, I had been informed, would "only be a matter of time".

Eventually we saved enough pennies — or so we thought — to venture into the hitherto unknown world of printers. Confusion piled up on confusion.

Establishing requirements

There were so many available, but so few of those we could afford had what I considered to be a suitable type-face. Editors are peculiar creatures at the best of times, and the thought of presenting a typescript with characters made up of dots to such elevated persons made me shudder.

We perused the pages of appropriate publications endlessly, but the advertised prices, contrary to hopes of miracles, did not diminish with subsequent readings. After much heart searching we decided to try to obtain a second-hand machine, keep our fingers crossed and hope nothing drastic would go wrong — in which case we could have little or no recourse to the vendor.

We tracked down a supplier of re-conditioned Termi-printers and went along to have a look. After trying the poor man's patience to the limit with endless and seemingly stupid questions, we went to have lunch with a promise to think about it. The price was comparable to a new dot-matrix printer, but I had already made up my mind that however good the latter was professed to be by sales chat, it was not good enough for my purposes. My difficulty was to convince the bread-winner of the family that I could find space for the enormous object I was trying to talk him into purchasing.

Finally I won, and we returned home the proud owners of our first peripheral. The next step was to interface the printer to Genie. We had several choices, but because we want a disc drive eventually, we opted for an expansion box on the grounds that doing it on the cheap would be a false economy.

We had to dig deep into pockets and bank accounts to do this, but reasoned that unless the roof caved in we could probably survive until next pay-day.

After many trials and tribulations we finally had all the necessary hardware, but lacked the software — a word-processing program. As the coffers by now were well and truly empty, I set about writing my own.

To start with I had to decide exactly what my requirements were, balance these against what facilities were available, my programming capabilities, and come up with something both simple and adequate. The resulting effort makes no pretence of being perfect, so the producers of commercial word-processing software need not fear the competition. On the other hand, home micro buffs may find it useful for all manner of things.

There are three major areas of creative writing in which I am engaged — letters, magazine articles, and a weekly newsletter. This program is geared to all three, but hopefully the following notes will enable individuals to select which features to adopt and which to ignore, although a user will be limited if his printer has less than 100 characters per line.

As the words are contained in strings there is a Clear 7500 on line 30, after which the program jumps to options on lines 360 to 400. Elsewhere the listing follows a sequence so there are no subroutines. There are very few Rems in the listing, contrary to the demands of conventional programs, but this is largely due to preserving memory for more important functions.

The constants N and Y are of prime importance, because the whole program revolves around them. The basic function of the program is to enable the user to compile, then either save or print one page of text, a page being either a single column of 60 characters or two columns of 45 characters each. This option is determined by the input of Y on line 60 and any deviation from this, either from choice or necessity, must be amended on lines 460, 470, 1460-1480, and 1500.

The number of required lines per page is input on line 50. This can be anything at all so long as it is borne in mind that the double-column option — Y=45 — requires twice the number of lines for a full printed page, and preferably an even number. The value of SS, on lines 480, 1530 and 1540 is also dependent on the size of pager used.

On printers which have a form-feed facility, these could probably be dispensed with altogether. User's address should replace the blurb on lines 1460-1480, and if addressed heading is required then this should be taken into account when determining the value of N. If I have forgotten to mention any other idiosyncrasies of the listing, no doubt you will find out for yourself.

Program features

Lines 80-340. Text input. There are several items worth noting in this section.

Line 130. This is an optional extra for the ex-typist, for the printer bleeps to remind one that the end of the line is looming, enabling insertion of hyphen if the current word is longish. It all depends on how fussy one is on full justification. In any case this can be modified during editing — see instructions for use.

Line 200. For new paragraph, I use the unshifted ESC key, as a matter of convenience, this being in a similar position to the Tab key on my typewriter. Any other key would do the same with modification to this line.

Lines 220-230. The Genie being a peculiar creature, lower-case characters, although not displayed on the VDU, are present as an output to printer.

Unfortunately capitals are unshifted and unless one wishes to hold down the shift key for lower-case throughout, some means has to be found to reverse the normal procedure. These lines do that.

When the required number of lines are complete, no further text is accepted. Only the insertion of * lets the program proceed. The options displayed then are self-explanatory.

Line 460. On the assumption — see note — that the printer is pre-settable for left-hand margin, and that this has been

(continued on page 104)

```
10 CLS: PRINT@338,"WORD PROCESSING PROGRAMME
"
15 REM (C) T.BILLETT 1981
20 PRINT@470,"BY TINA BILLETT": PRINT : PRIN
T : PRINT
30 CLEAR 7500: GOTO 360
50 CLS: INPUT "HOW MANY LINES PER PAGE"; N
60 INPUT "HOW MANY CHARACTERS PER LINE"; Y
70 DIM A$(N+1),B$(N+1)
80 PRINT "READY TO START"
90 PRINT CHR$(14);
100 X=X+1: IF X=N+1 THEN 350
110 A$(X)=""
120 I$=INKEY$: IF I$="" THEN 120
130 IF LEN(A$(X))=Y-7 THEN LPRINT CHR$(7)
140 IF I$=CHR$(8) AND LEN(A$(X))>0 THEN A$(X
)=LEFT$(A$(X),LEN(A$(X))-1): PRINT I$; : GOT
O 260
150 IF I$=CHR$(8) THEN I$="": GOTO 120
160 IF I$=CHR$(13) THEN PRINT I$: GOTO 100
170 IF I$=CHR$(44) THEN I$=","
180 IF I$=CHR$(45) THEN I$="-"
200 IF I$=CHR$(91) THEN I$="     ": PRINT I$
; : A$(X)=I$: GOTO 120
220 T=ASC(I$): IF T>64 AND T<91 THEN I$=CHR$
(T+32): GOTO 240
230 IF T>96 AND T<123 THEN I$=CHR$(T-32)
240 PRINT I$;
250 A$(X)=A$(X)+I$
260 IF LEN(A$(X))<Y+1 THEN 120
270 IF LEN(A$(X))=Y+1 AND RIGHT$(A$(X),1)="
" THEN PRINT : GOTO 100
280 J=1
290 IF MID$(A$(X),(LEN(A$(X))-J),1)<>" " THE
N J=J+1: GOTO 290
300 B$=RIGHT$(A$(X),J): A$(X)=LEFT$(A$(X),(L
EN(A$(X))-J))
310 FOR I=1 TO J: PRINT CHR$(8); : NEXT
320 IF LEFT$(B$,1)=" " THEN B$=RIGHT$(B$,(LE
N(B$)-1))
330 PRINT : PRINT B$;
340 X=X+1: IF X=N+1 THEN 350:ELSEA$(X)=B$: B
$="": GOTO 120
350 PRINT : PRINT : PRINT N; " LINES COMPLET
E. ": PRINT
360 PRINT : PRINT "PRESS  *  TO CONTINUE";
370 M$=INKEY$: IF M$<>"*" THEN 370
380 CLS: D=0: PRINT "OPTIONS": PRINT : PRINT
 "1 - OUT TO PRINTER": PRINT "2 - REVIEW LIN
ES": PRINT "3 - NEW PAGE": PRINT "4 - STOP":
 PRINT "5 - EDIT": PRINT "6 - JUSTIFY"
385 PRINT "7 - SAVE DATA TO TAPE": PRINT "8
- INPUT DATA FROM TAPE": PRINT: PRINT "ENTER
 CHOICE"; : INPUT D
390 ON D GOTO 460, 410, 440, 450, 570, 910,
1660, 1880
400 GOTO 380
410 FOR Q=1 TO N: PRINT Q; A$(Q)
420 NEXTQ
430 GOTO 360
440 IF A$(1)<>"" THEN INPUT "ARE YOU SURE";
S$
442 IF LEFT$(S$,1)="N" THEN 380
444 RUN 50
450 END
460 IF Y=45 THEN FOR Q=1 TO N/2: LPRINT A$(Q
); : SP=Y-LEN(A$(Q))+10: FOR A=1 TO SP: LPRI
NT CHR$(32); : NEXTA: LPRINT A$(Q+N/2): NEXT
Q
470 IF Y>45 THEN 1420
480 SS=67-(N/2): FOR P=1 TO SS: LPRINT : NEX
T
490 IF C=0 THEN 530
500 B=B+1
510 IF B<C THEN 460
520 IF B=C THEN C=0: B=0: GOTO 380
530 INPUT "DO YOU WANT MORE COPIES"; V$
540 IF LEFT$(V$,1)<>"Y" THEN 380
550 INPUT "HOW MANY"; C
560 GOTO 460
570 INPUT "EDIT - WHICH LINE - ENTER NUMBER"
; O
575 IF O>N THEN 570
580 A$=A$(O): P=1
590 PRINT CHR$(14);
600 K1$=INKEY$: IF K1$="" THEN 600
610 IF K1$=CHR$(8) AND P>1 THEN PRINT K1$; :
 P=P-1: K1$="": GOTO 600
620 IF K1$=CHR$(8) THEN K1$="": GOTO 600
630 IF K1$=" "PRINT MID$(A$,P,1); : P=P+1: G
OTO 600
640 IF K1$<>CHR$(13) THEN 670
650 IF P=>LEN(A$) THEN PRINT K1$: A$(O)=A$:
A$="": GOTO 360
660 IF P>1 THEN PRINT RIGHT$(A$,((LEN(A$)-P)
+1)): A$(O)=A$: A$="": GOTO 360:ELSEIF P=1 T
HEN PRINT A$: A$(O)=A$: A$="": GOTO 360
670 IF K1$<>"D" THEN 710
680 IF P=1 THEN A$=RIGHT$(A$,(LEN(A$)-1)): G
OTO 600
690 IF P=>LEN(A$) THEN A$=LEFT$(A$,(LEN(A$)-
1)): GOTO 600
700 F$=LEFT$(A$,P-1)+RIGHT$(A$,LEN(A$)-P): A
$=F$: GOTO 600
710 IF K1$<>"I" THEN 820
720 TP$=INKEY$: IF TP$="" THEN 720
730 IF TP$=CHR$(27) THEN 600
740 IF TP$=CHR$(13) THEN TP$="": GOTO 720
750 IF TP$=CHR$(8) AND P>1 THEN P=P-1: PRINT
 TP$: F$=LEFT$(A$,P-1)+RIGHT$(A$,(LEN(A$)-P)
): A$=F$: F$="": GOTO 720
760 IF TP$=CHR$(8) THEN 720
770 T=ASC(TP$): IF T>64 AND T<91 THEN TP$=CH
R$(T+32): GOTO 790
780 IF T>95 AND T<123 THEN TP$=CHR$(T-32)
790 IF P=1 THEN F$=TP$+A$: P=P+1: PRINT TP$;
 : TP$="": A$=F$: F$="": GOTO 720
800 IF P=>LEN(A$) THEN F$=A$+TP$: P=P+1: PRI
NT TP$; : TP$="": A$=F$: F$="": GOTO 720
810 F$=LEFT$(A$,P-1)+TP$+RIGHT$(A$,LEN(A$)-P
+1): P=P+1: PRINT TP$; : TP$="": A$=F$: F$="
": GOTO 720
820 IF K1$<>"C" THEN 600
830 TP$=INKEY$: IF TP$="" THEN 830
840 T=ASC(TP$): IF T>64 AND T<91 THEN TP$=CH
R$(T+32): GOTO 860
850 IF T>95 AND T<123 THEN TP$=CHR$(T-32)
860 IF P=1 THEN F$=TP$+RIGHT$(A$,(LEN(A$)-1)
): A$=F$: GOTO 890
870 IF P=LEN(A$) THEN F$=LEFT$(A$,(LEN(A$)-1
))+TP$: A$=F$: GOTO 890
880 A$=LEFT$(A$,P-1)+TP$+RIGHT$(A$,LEN(A$)-P
)
890 PRINT TP$; : P=P+1: TP$="": GOTO 600
900 GOTO 600
910 FOR Q=1 TO N
920 L$=INKEY$: IF L$="*" THEN 360
930 IF A$(Q)="" THEN 1380
940 IF LEFT$(A$(Q),5)="     " THEN 960
950 IF LEFT$(A$(Q),1)=" " THEN A$(Q)=RIGHT$(
A$(Q),(LEN(A$(Q))-1)): GOTO 950
960 IF RIGHT$(A$(Q),1)=" " THEN A$(Q)=LEFT$(
A$(Q),(LEN(A$(Q))-1)): GOTO 960
970 IF LEN(A$(Q))=Y THEN PRINT Q; A$(Q): NEX
T: GOTO 360
980 IF LEN(A$(Q))<Y THEN 1120
990 IF LEFT$(A$(Q),5)="     " THEN S=6: V=0:
 GOTO 1010
1000 S=1: V=0
1010 IF MID$(A$(Q),S,2)="  " THEN V=V+1
1020 IF V=1 THEN A$(Q)=LEFT$(A$(Q),S-1)+RIGH
T$(A$(Q),(LEN(A$(Q))-S)): GOTO 970
```

(continued on next page)

(listing continued from previous page)

```
1030 S=S+1: IF S>LEN(A$(Q)) THEN 1050
1040 GOTO 1010
1050 J=1
1060 IF MID$(A$(Q),(LEN(A$(Q))-J),1)<>" " TH
EN J=J+1; GOTO 1060
1070 F$=LEFT$(A$(Q),(LEN(A$(Q))-J))
1080 B$=RIGHT$(A$(Q),J): A$(Q)=F$: F$=""
1090 IF Q=N THEN B$="": GOTO 930
1100 IF LEFT$(A$(Q+1),1)=" " THEN 1330
1110 A$(Q+1)=B$+" "+A$(Q+1): GOTO 930
1120 IF Q=N THEN 1210
1130 IF LEFT$(A$(X),5)="     " THEN J=6: GOT
O 1150
1140 J=1
1150 IF MID$(A$(Q+1),J,1)<>" " THEN J=J+1: I
F J<LEN(A$(Q+1)) THEN 1150
1160 IF J>Y-LEN(A$(Q)) THEN 1210
1170 IF LEFT$(A$(Q+1),5)="     " THEN PRINT
Q; A$(Q): NEXT: GOTO 360
1180 IF A$(Q+1)="" THEN PRINT Q; A$(Q): NEXT
: GOTO 360
1190 B$=LEFT$(A$(Q+1),J): F$=A$(Q)+" "+B$: G
$=RIGHT$(A$(Q+1),(LEN(A$(Q+1))-J)): A$(Q)=F$
: A$(Q+1)=G$: F$="": G$=""
1200 GOTO 930
1210 S=1: V=0
1220 IF MID$(A$(Q),S,1)<>" " AND MID$(A$(Q),
S+1,1)=" " AND MID$(A$(Q),S+2,1)<>" " THEN V
=V+1
1230 IF S<LEN(A$(Q)) THEN S=S+1: GOTO 1220
1240 IF V=0 THEN PRINT Q, A$(Q): NEXT. GOTO
360
1250 IF V<(Y-LEN(A$(Q))) THEN PRINT Q; A$(Q)
: NEXT: GOTO 360
1260 IF LEFT$(A$(Q),2)="  " THEN S=6  GOTO 1
280
1270 S=1
1280 IF MID$(A$(Q),S,1)<>" " THEN S=S+1  GOT
O 1280
1290 IF MID$(A$(Q),S,1)=" " AND MID$(A$(Q),(
S+1),1)<>" " THEN TP$=" ": F$=LEFT$(A$(Q),S)
+TP$+RIGHT$(A$(Q),(LEN(A$(Q))-S)): A$(Q)=F$
 F$=""
1300 IF LEN(A$(Q))=Y THEN PRINT Q; A$(Q)  NE
XT: GOTO 360
1310 S=S+2: GOTO 1280
1320 GOTO 360
1330 K=Q+2: FOR M=K TO N: B$(M)=A$(M-1)  NEX
T
1340 A$(Q+1)=B$
1350 FOR M=K TO N: A$(M)=B$(M): B$(M)="". NE
XT
1360 A$(N+1)="". B$=""
1370 GOTO 930
1380 K=Q: FOR M=K TO N: B$(M)=A$(M+1): NEXT
1390 FOR M=K TO N: A$(M)=B$(M). B$(M)="" NE
XT
1400 IF Q=>N THEN PRINT Q; A$(Q). GOTO 360
1410 GOTO 930
1420 INPUT "DO YOU WANT ADDRESSED HEADING",
X$
1430 IF LEFT$(X$,1)<>"Y" THEN G=1  GOTO 1520
1440 INPUT "DATE"; D$
1450 G=2
1460 LPRINT TAB(40), "999, ANYSTREET"
1470 LPRINT TAB(40); "ANY TOWN"
1480 LPRINT TAB(40); "ANY COUNTY"
1490 LPRINT
1500 LPRINT TAB(40); D$
1510 FOR E=1 TO  3: LPRINT : NEXT
1520 FOR Z=1 TO N: LPRINT A$(Z). NEXT
1530 IF G=1 THEN SS=67-N
1540 IF G=2 THEN SS=67-(N+8)
1550 FOR P=1 TO SS: LPRINT . NEXT
1560 IF C=0 THEN 1600
1570 B=B+1
1580 IF B=C THEN C=0: B=0: G=0. GOTO 380
1590 IF B<C THEN 1630
1600 INPUT "DO YOU WANT COPIES"; X$
1610 IF LEFT$(X$,1)<>"Y" THEN C=0: B=0  G=0
 GOTO 380
1620 INPUT "HOW MANY"; C
1630 ONGGOTO 1520,1460
1660 INPUT "TITLE"; T$
1670 INPUT "DATE"; D$
1680 INPUT "SUBJECT", S$
1690 INPUT "OUTPUT TAPE READY", Z$
1700 FOR X=1 TO N: IF LEFT$(A$(X),5)="     "
  THEN A$(X)="!    "+RIGHT$(A$(X),LEN(A$(X))
-5)
1730 J=1
1740 IF MID$(A$(X),J,1)="," THEN A$(X)=LEFT$
(A$(X),J-1)+CHR$(191)+RIGHT$(A$(X),LEN(A$(X)
)-J)
1742 IF MID$(A$(X),J,1)=":  " THEN A$(X)=LEFT
$(A$(X),J-1)+CHR$(140)+RIGHT$(A$(X),LEN(A$(X
))-J)
1744 IF MID$(A$(X),J,1)=";  " THEN A$(X)=LEFT
$(A$(X),J-1)+CHR$(162)+RIGHT$(A$(X),LEN(A$(X
))-J)
1750 IF MID$(A$(X),J,1)=CHR$(34) THEN A$(X)=
LEFT$(A$(X),J-1)+CHR$(188)+RIGHT$(A$(X),LEN(
A$(X))-J)
1760 IF J=LEN(A$(X)) THEN 1775
1770 J=J+1. GOTO 1740
1775 PRINT X, A$(X)
1780 NEXT
1790 PRINT #-1,N,T$,D$,S$,Y
1800 D1=INT(N/4): D2=N-D1*4
1810 FOR R=1 TO D1. PRINT #-1,A$(R),A$(R+D1)
,A$(R+(D1*2)),A$(R+(D1*3)). NEXT
1820 DD=D1*4: IF DD=N THEN 2000:ELSED3=N-DD
1830 IF D3=1 THEN PRINT #-1,A$(DD+1)
1840 IF D3=2 THEN PRINT #-1,A$(DD+1),A$(DD+2
)
1850 IF D3=3 THEN PRINT #-1,A$(DD+1),A$(DD+2
),A$(DD+3)
1860 GOTO 2000
1880 INPUT "INPUT TAPE READY"; V$
1890 INPUT #-1,N,T$,D$,S$,Y
1900 PRINT "TITLE "; T$: PRINT D$. PRINT "SU
BJECT "; S$: PRINT : PRINT N, " LINES   ", Y
; " CHARS PER LINE". PRINT
1910 INPUT "CONTINUE "; Y$
1920 IF LEFT$(Y$,1)<>"Y" THEN 380
1930 DIMA$(N+1),B$(N+1)
1940 D1=INT(N/4): D2=N-D1*4
1950 FOR R=1 TO D1  INPUT #-1,A$(R),A$(R+D1)
,A$(R+(D1*2)),A$(R+(D1*3))  NEXT
1960 DD=D1*4: IF DD=N THEN 2000 ELSED3=N-DD
1970 IF D3=1 THEN INPUT #-1,A$(DD+1)
1980 IF D3=2 THEN INPUT #-1,A$(DD+1),A$(DD+2
)
1990 IF D3=3 THEN INPUT #-1,A$(DD+1),A$(DD+2
),A$(DD+3)
2000 FOR X=1 TO N. IF LEFT$(A$(X),5)="!    "
 THEN A$(X)="     "+RIGHT$(A$(X),LEN(A$(X))-
5)
2030 J=1
2040 IF MID$(A$(X),J,1)=CHR$(191) THEN A$(X)
=LEFT$(A$(X),J-1)+","+RIGHT$(A$(X),LEN(A$(X)
)-J)
2042 IF MID$(A$(X),J,1)=CHR$(140) THEN A$(X)
=LEFT$(A$(X),J-1)+CHR$(58)+RIGHT$(A$(X),LEN(
A$(X))-J)
2044 IF MID$(A$(X),J,1)=CHR$(162) THEN A$(X)
=LEFT$(A$(X),J,1)+CHR$(59)+RIGHT$(A$(X),LEN(
A$(X))-J)
2050 IF MID$(A$(X),J,1)=CHR$(188) THEN A$(X)
=LEFT$(A$(X),J-1)+CHR$(34)+RIGHT$(A$(X),LEN(
A$(X))-J)
2060 IF J=LEN(A$(X)) THEN 2075
2070 J=J+1: GOTO 2040
2075 PRINT X; A$(X)
2080 NEXT
2090 GOTO 380
```

(continued from page 101)

done, then two columns of text are printed from top to bottom of page.

Lines 480-560. Any number of copies obtainable.

Lines 570-900. Editing text. For further details, see Instructions for use.

Lines 910-1410. Justification — ditto.

Lines 1420-1630. Print out, and copy for 60 characters per line, single column — letters or straight text.

Lines 1660-1860. Saving text to tape. This procedure is a trifle long-winded as paragraph indents, commas and quotation marks have to be replaced by other symbols in order to be correctly recorded as data. After recording, the procedure is reversed to enable further editing, printing, etc.

Lines 1880-2090. Input previously-recorded data from tape. Again this takes time, not only the actual input, but also reversing symbols back into intelligible text.

Instructions for use. This program makes no pretence of being perfect, yet with the observance of a few simple rules no great problems should arise, and even if they do, all is not lost. By the simple process of pressing Break and entering

GOTO 380

the program can be re-entered without loss of text.

Let us assume that the user has correctly keyed in the program. When offered Options, enter 3 — for new page. Answer the questions concerning lines and characters per line in accordance with desire — and hopefully accurate modifications. If all is well, Ready To Start and cursor will appear.

All usual characters are permitted, including the back-space. If everything grinds to a halt towards the end of the line, check that the expansion-box/printer is plugged in and switched on unless, of course line 130 has been omitted, in which case you are on your own.

But how do you know in advance how many lines you are going to need? Set the number of lines to the maximum for the page size. When the text is complete, press Break enter GOTO 380, select 2, Review Lines, and the text will rapidly scroll up the VDU. Have your fingers poised over Shift and @. The line, $ number will be displayed at the left-hand side. Note the number of the last line of text, press Break, and enter

N= (number of lines), GOTO 380.

Editing. The facilities for editing text may not be comparable to other word processing programs, but I find them adequate. I have tried to make the commands compatible with the Genie's program editing commands. D will delete one character; C will change one character; I enables the user to insert as many characters as required up to a total of 250 which is the maximum string length.

To escape from insert mode, use shifted ESC as usual — New Line will not work. Make sure you allow time for each inserted character to be digested, and hold shifted ESC for at least three seconds, or peculiar things may happen. Also try not to back-space during insert mode. Re-Edit lines if necessary. A line may be deleted completely by

Break A$ (Line No) ="" : GOTO 380.

Justify. As this is rather slow, I find that I can read the text easily, and if editing is necessary simply press Shift and *, hold and wait. At a convenient time Press *. To Continue will appear. Again, the line number is displayed. This should be noted for editing purposes.

Depending on how important the communication is, full justification is possible where the first word of the next line is too long to be moved up, by inserting a hyphen at an appropriate position during initial input. This will automatically justify all lines. Where extensive editing has taken place some adjustment may be necessary. If at any time an FC Error occurs, enter Goto 380; then review lines, and make whatever adjustment is necessary.

The program is relatively simple and should be easily modified to suit most needs.

Note. I believe that the facility for setting left-hand margins is the exception rather than the rule. In this case lines 460 and 1520 could be modified to read

PRINT TAB (n); etc.

n being the required margin.

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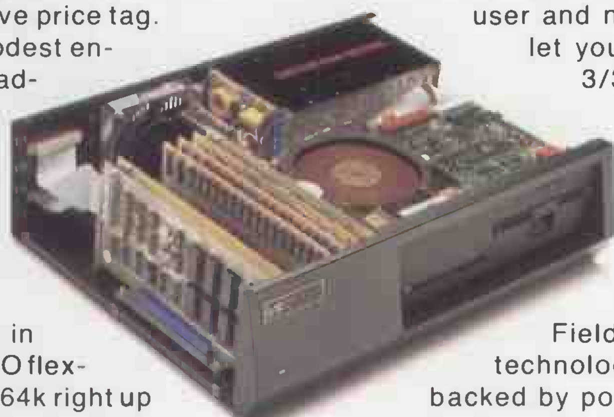

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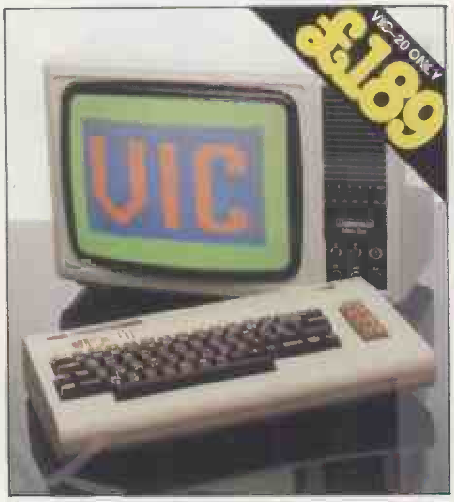

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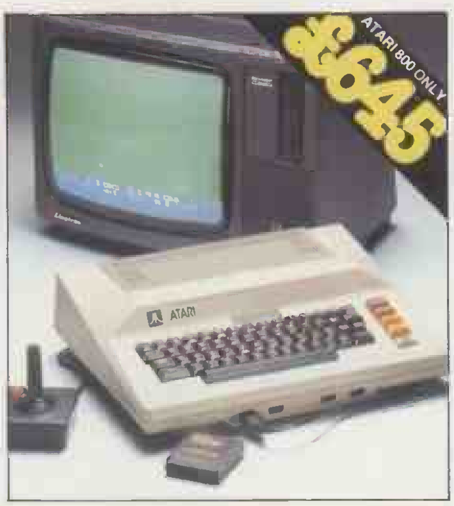

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Programmers can have a readable text to write and can edit machine-code programs by using the medium of an assembly language. Taking the Commodore Assembler as an example, Mike Gross Niklaus gives a detailed explanation of how you can put an assembler to work on your programming problems.

Assembler programs

BASIC PROGRAMMERS moving on to machine code often find the assembly process long and complicated, which is a pity because an assembler package is an excellent tool for creating machine-code programs. This article guides you through the assembly process using the Commodore assembler package.

The 6502 processor, like any other, works using pulses of electricity which operate electronic gates placed on the various electrical paths within it. A particular pattern of pulses, called an instruction, causes the microprocessor to carry out a particular operation. These instructions, together with the data on which they are to operate, are held in memory as electrical charges. The pulses are either on or off, the charges are either present or absent, and so one way of representing the instructions and data on paper is as a series of ones and zeros.

The question then arises, "How does a programmer transform these patterns on paper into electrical patterns in the memory"? Early computer programs were punched as holes on cards, with a hole representing a one or pulse, and lack of a hole representing a zero or no pulse. A card reader sensed the holes and created the appropriate electrical pattern.

While cards solved the entry problem, programmers were left with the awful task of writing their instructions as ones and zeros. If that chore failed to turn them cross-eyed, then trying to read these patterns a week or two later, and amending them to get rid of errors or to enhance the program was enough to floor all but the most dedicated. If it was someone else's program, then it was quicker to start from scratch. Editing and patching programs frequently caused new errors to be created as fast as the old ones were corrected.

Soon the ones and zeros were replaced by hexadecimal representations. Programs could then be written using the 16 symbols 0 to 9 and A to F. Hexadecimal is much easier to read than rows of ones and zeros, but the editing problem remained.

Assembler language was invented to overcome this problem. It allows the programmer to write and edit machine-code programs using a quite readable text, and including as much annotation and as many named variables as may be needed. This text can be saved away, pulled back, changed, edited in any way you like and re-saved, using an editor program. This text is called the source code.

You use an assembler program to process the source code. It ignores all the annotation, converts all the variables' names into actual memory addresses, and produces and saves a hexadecimal code version of the program called the object code.

Simple problem

Finally you use a loader program to read the object code, translate it into ones and zeros and place the patterns in memory. Provided the machine-code program works correctly, you can save it using the normal monitor facilities, which enable you to save away any specified chunk of memory, and later read it back into position. So from then on you need only load this memory version without going through the assembly process.

Usually there will be errors, so you will have to re-load the editor, get back your source code, edit it and go through the assembly process again. Newcomers to assembler code, particularly those of you used to Basic alone, will get frustrated on many occasions, complaining of this long-winded process. All I can say is, "You cannot imagine the hassle we had before assemblers came along", and "Wasn't it nice of the folks at Dartmouth to develop Basic".

The outline of the assembly process is shown in figure 1. We can follow it through with a very simple programming problem: placing the initial letters of the words "personal computing" in the top left-hand corner of the screen.

In Basic, you could achieve this by a couple of Poke instructions along the following lines:

```
POKE 32768, 16 : REM 32768 IS T/L SCREEN
POKE 32769,3 : REM 16 AND 3 ARE P AND C
```

The machine-code program works in a similar way. The first step is to write the source code on paper. Using the 6502 op-code mnemonics and addressing modes, which are specified in the MOS 6502 programming manual and used by the Commodore assembler, you could write:

```
LDA #16
STA 32768
LDA #3
STA 32769
RTS
```

You have to decide where this program is to sit in memory, and then tell the assembler. The Commodore assembler has a set of directives which are instructions written in the source code. They are not 6502 codes but instructions to the assembler program itself. One of these — * = — can be used to specify where the final program should reside. Another — ; — is used in exactly the same way as a Basic Rem statement.

The assembler also has the ability to translate symbolic names into actual values and even perform simple calculations on symbols to establish final values for assembly. For example, you can represent the screen locations 32768 and 32769 by SCRTOP and SCRTOP + 1. At some point in the source code, normally the start, you need to define the value of SCRTOP.

Like Basic, source-code lines must be numbered to allow listing, line deletion, etc. A source-code listing for our problem might look like:

```
1000 ; TOPLEFT PC
1010 ; M.J.G-N
1020 ;
1030 SCRTOP=32768
1040 ;
1050 * = 826                ; ASSEMBLE IN
1060 ;                      2ND CAS BUFF
1070 LDA #16                ; CODE FOR 'P'
1080 STA SCRTOP             ; SCR T/L
1090 LDA #3                 ; CODE FOR 'C'
1100 STA SCRTOP+1           ; LOC 32769
1200 RTS                    ; TO BASIC
1210 ;
1220 .END
```

The final line — End — is another directive to the assembler telling it that there is nothing further to assemble.

Transfer to disc

The next step is to transfer this source code from paper to a disc file ready for the assembler to process. This is done using the editor program to create text in memory, much as you do for a Basic program. In the Commodore package there are versions for both 16K and 32K machines.

Suppose you are using a 32K machine, you type

```
LOAD "EDITOR32K", 8
```

Since it is a machine-code program which resides at the top of memory, you cannot Run the program but must enter it with a Sys call. The call for the 32K version is

```
SYS 28672
```

You will get a message announcing the editor and Ready and a flashing cursor.

The editor is now operational, and you can enter source-code lines in exactly the same way as you do lines of Basic. But be warned: although line deletion, insertion, cursor movement, character overtype, deletion and insertion all work as for the

(continued on page 111)

(continued from page 109)

Basic editor, the assembler editor does not encode Basic keywords. Consequently, text created with this editor cannot be run as a Basic program. By way of a recompense, it does give you some useful editing facilities: Auto Line Numbering, Repeat Keys, Find String, Change String, Delete Lines, and so on.

Once you have entered the source code correctly, the next step is to store it as a disc file ready for the assembler to read and process. One reason why it is stored on disc rather than left in memory is that a large machine-code program can then be assembled from several source-code texts linked together, which in total would take up more store space than is available.

The editor provides a command, Put, which stores the text as a sequential file. You must specify the drive, but the editor assumes you mean device 8 unless you say otherwise. So to store the source code for this problem, you would type

PUT "0:TOPLEFTPC.S"

The .S is not obligatory, but it is best to differentiate source-code files from object-code files and so on. Some programmers use .SRC and .OBJ.

To recover the text to do some editing, the editor provides a Get command — not to be confused with the Basic Get, which you cannot perform directly anyhow. This one reads back a source file from disc. To get back the text you have just stored, you will type

GET "0: TOPLEFTPC.S"

Once re-editing is complete, you can Store and Replace using the @ symbol

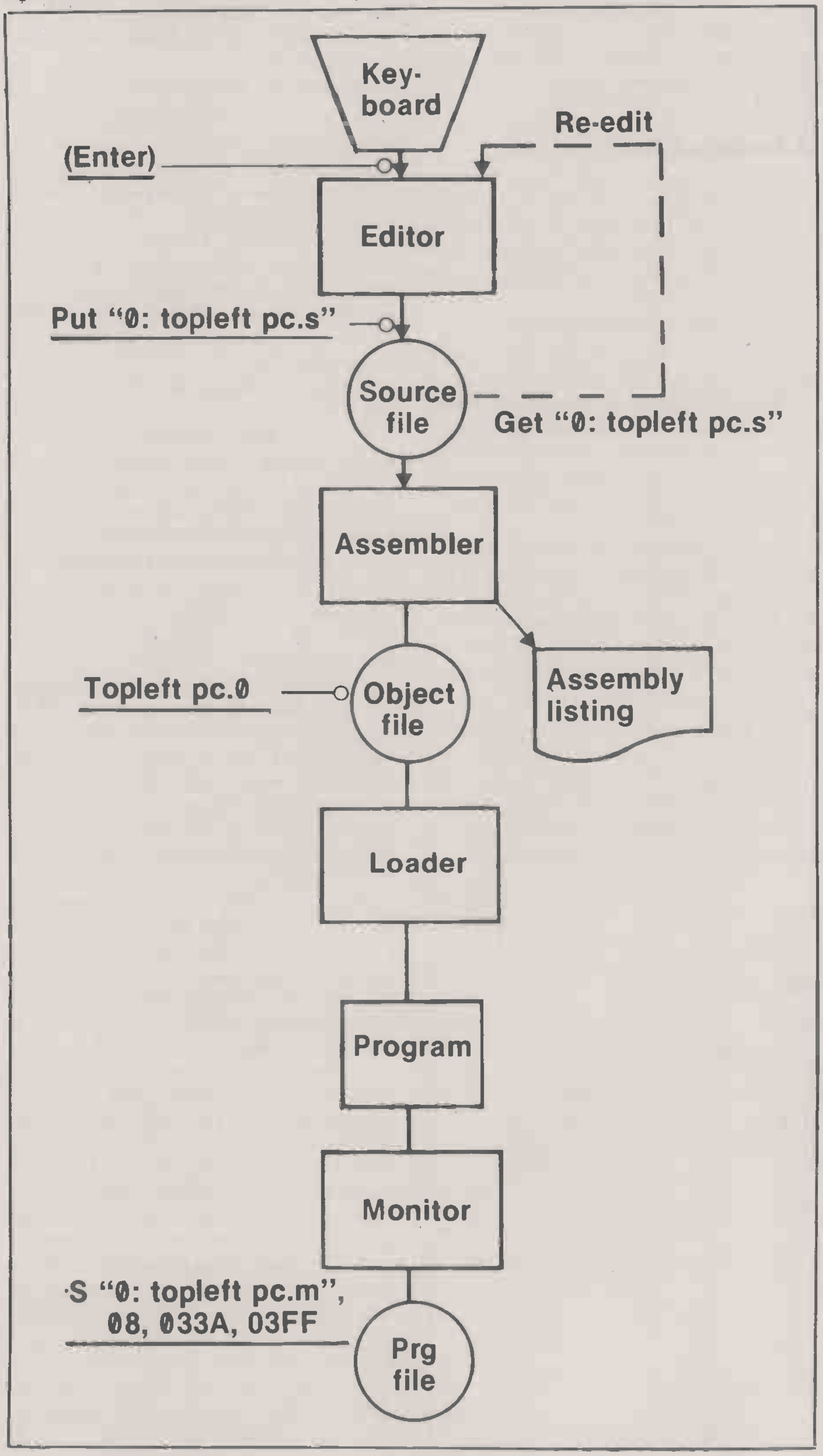
PUT"@0:TOPLEFTPC.S"

The assembler is also a machine-code program, but occupies the lower end of user RAM, so the same version does for both 16K and 32K machines. However, two versions are included for 66-line paper and 72-line paper. This seems to be a very roundabout way of tackling the problem of different page lengths, and is one of very few gripes I have with the Commodore assembler package. Assuming you are using 66-line paper you load the assembler program as follows

LOAD "ASM66",8

Although the assembler is a machine-code program, it has a short Basic routine latched on the front, so you Run.

Figure 1. Outline of the assembler process.



Assembler printout

After an identity and copyright announcement, you are asked for the object-code file name. Get into the habit of using the same generic name for source, object and machine-code files, with an appropriate descriptor — e.g., .OBJ or .O — tagged on the end. In this case you might reply

0:TOPLEFTPC.O

You are then asked if you require the assembly listing to be printed, as opposed to being displayed on the screen. You reply Y Return if you want the listing printed, or N Return if you do not. The program then asks you if an IEEE-488 protocol printer is being used. What it really means is "Does your printer understand Commodore's version of ASCII or standard ASCII"? If you have a Commodore printer, reply Y Return, otherwise reply N Return.

As a final question, the program asks for the name of the source-code file. In this case you would reply 0:TopLeftPC.S. As soon as you press the Return key the assembler bounds into action, producing a printout — figure 2.

The source code is shown on the right. The left-hand column is the assembly listing line number, the next is the location in memory of the instruction displayed in hexadecimal, and the third column shows the instruction — both op code and zero-, one- or two-byte operand — again in hexadecimal.

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The assembler works by converting all the op-code mnemonics into hexadecimal, evaluating all the symbols and expressions and turning them into hexadecimal as well. In order to deal with the symbols properly, it reads the source code right through, creating a table of symbols and values for the symbols. It then reads the source code a second time, replacing symbols by values, sending the resultant hexadecimal to an object-code file, with the name you specified at the start of the run. At the same time it produces the assembler listing.

Any errors are highlighted with rows of asterisks and an upward arrow pointing to the place in the source code line where the error was detected. The total number of errors is printed at the end of the assembly listing. The final part of the listing is a printout of the symbol table already described, together with their hexadecimal values.

If you do have errors, you can Get back your source code — the editor is still present and active — correct it, and restore it, load the assembler again — remember that source text and assembler occupy the area of user RAM — and reassemble the program.

We can now assume that you have assembled your program without error, and have on disc an object-code sequential file consisting of the hexadecimal representations of the machine-code program, preceded by pointers showing where these values are to be placed in the memory of the machine. To load these values into RAM requires a loader program.

Since you might want to put your machine-code routine in exactly the area of RAM occupied by the loader program, Commodore has provided three versions. The first loads into the bottom of user RAM, i.e., where Basic text, source text and the assembler program are placed. The other two load to the top of 16K and 32K memory respectively.

There appears to be some kind of clash over re-direction of operating-system vectors when using the high loader immediately after using the editor. You have to do a cold start before loading and running it. Later versions of the editor provide the Cold command to do just this, but on earlier versions you have to use Sys 64721 — Basic 2 — or switch the machine off and on again. You then load Hi-Load16 or Hi-Load32, and enter with the appropriate Sys command — Sys 28672 for Hi-Load32.

Advanced facility

Our example program, however, is to be placed in the second cassette buffer at location 826. It is clear of user RAM, which is why it is often used for short routines. You can use the low loader with no vector troubles:

```
LOAD "LOADER",8 : RUN
```

The Loader program first asks you if there is to be any offset. This is an advanced facility of limited use, allowing you to offset the loading position of the object code from the area specified in the source code. Unless you know exactly what you are doing, press Return alone to ignore the facility.

The next and final question asks you for the name of the object file. Get into the habit of specifying the drive number, as the 8032 version of the assembler loader requires it. You reply with the same name as you used during the assembly run

```
0:TOPLEFTPC.O
```

The hexadecimal symbols representing loader pointers, op codes and operands appear on the screen to confirm that your machine-code program has been loaded.

Drawing a deep breath, you type Sys to whatever location your program starts at, or include the Sys call in a Basic program. In our example you use

```
SYS 826
```

At this point, a broad smile should break out on your face as P and C appear at the top left of the screen.

Assuming that you are happy with the result, you can save it on to disc as a program, using the facilities of the Pet resident monitor. From then on, a Load command from Basic, or from the monitor, will load the program without the hassle of calling up the loader and reading the object file.

To enter the monitor, type

```
SYS 1024 RETURN
```

or if the editor is still active you can type Break. You will see a hexadecimal report on the condition of various registers of the 6502 and the flashing cursor sitting to the right of a full stop. The Save command in monitor is .S followed by the normal string specifying drive and file name, followed by device number, start and end location +1 for your program — all three in hexadecimal.

For small programs in buffer 2 I tend to specify

```
$033A TO $03FF
```

to save having to discover the actual end — you can look this up on the assembler listing if you want. So for our example, the Save command will look like this:

```
.S "0:TOPLEFTPC.M",08,033A,03FF
```

The .M is my personal way of describing a machine-code module saved from memory. A more common convention is .Bin for binary.

Having read this far, you are probably thinking that you have an awful lot to learn. But the many people who attend the courses I run on machine code with assembler, write their first successful machine-code program within an hour of starting the course. After three days they can rattle through the procedures without a second thought.

There are several assembler packages on the market which may vary slightly in procedure from the Commodore package. Some assemble into store, others use different addressing representations from those recommended as a standard by MOS Technology.

Putting aside my connection with Commodore, as an independent machine-code programmer I recommend the Commodore package. For £30, you not only have the editor, assembler and loaders, but also the disc-support program, a re-locator utility and the very useful Extramon which contains numerous diagnostic and trace aids, a mini assembler and a disassembler. The diskette in the package also contains the source-code listings for the editor, loader and re-locator. Apart from showing how to use many useful entry points in the Pet's ROMs, they provide excellent examples of assembly-language technique and layout.

```
LINE# LOC   CODE      LINE

0001  0000            ;TOPLEFT PC
0002  0000            ;M.J.G-N
0003  0000            ;
0004  0000            SCRTOP=32768
0005  0000            ;
0006  0000                   *=826          ;ASSEMBLE IN
0007  033A            ;            2ND CAS BUFF
0008  033A  A9 10            LDA #16        ;CODE FOR 'P'
0009  033C  8D 00 80         STA SCRTOP     ;SCREEN T/L
0010  033F  A9 03            LDA #3         ;CODE FOR 'C'
0011  0341  8D 01 80         STA SCRTOP+1   ;LOC 32769
0012  0344  60               RTS            ;TO BASIC
0013  0345            ;
0014  0345                    .END

ERRORS = 0000
SYMBOL TABLE

SYMBOL VALUE
 SCRTOP   8000

END OF ASSEMBLY
```

Figure 2. Assembler printout.

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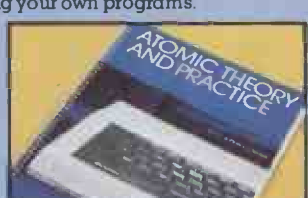

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The question of perfect answers

Just before she died, Gertrude Stein asked: "What is the answer"? No answer came. She laughed and said: "In that case, what is the question"? Then she died. Boris Allan picks up where Gertrude Stein left off, and offers some intriguing answers to the question of programming perfection.

A PROGRAM is no more than an answer to a question, and a bug-free program is a perfectly correct answer to the question. But what is the question that is being answered?

Study this bug-free Basic program:

```
10 REM PROGRAM 1
20 INPUT A
30 B = SQR(A)
40 PRINT A,B
50 END
```

It will work every time, unless a negative number is entered — there is no defined square root of a negative number in Basic.

The next attempt to write a bug-free Basic program could be:

```
10 REM PROGRAM 2
20 INPUT A
30 IF A < 0 THEN 70
40 B = SQR(A)
50 PRINT A,B
60 END
70 PRINT "ERROR : NEGATIVE NUMBER"
80 END
```

Program 2 will work every time, unless a letter or incorrectly-formed number is entered, for example, £.&.

A further attempt to write a bug-free Basic program might take the form:

```
10 REM PROGRAM 3
20 INPUT A$
30 GOSUB 1000
40 IF E = 1 THEN 80
50 B = SQR(A)
60 PRINT A,B
70 END
80 PRINT "ERROR : INCORRECTLY
   FORMED NUMBER"
90 END
1000 REM ERROR HANDLING ROUTINES
1010 REM IF ERROR E = 1, OTHERWISE E
     = 0
1100 RETURN
```

Of course, Program 3 will perform perfectly, unless . . . As James Stephens writes in *The Crock of Gold:* "Nothing is perfect. There are lumps in it".

Program 1 is, in one sense, bug-free because the program logic was a perfect answer to the logic implied in the question "How can one write a Basic program to enter a number, calculate its square root, and output its value"? The answer was perfectly admissible — and there would be many equally admissible answers — as long as the range of values to be entered was positive, and not too large.

Possibly some automated procedure for deciding program correctness could have isolated the potential problem to do with ranges of admissible values, and the procedure may have given solutions such as programs 2 and 3. The decision procedure would need to have been set up in such a way that the range problem could be recognised; but to set up a general decision procedure to check total program correctness would be impossible.

It is clear that there are levels of program correctness. The most trivial level is the translation of a set of instructions, for example,

Enter a number;
Output the number and its square root;

into statements in a programming language. Program 1 is the answer to the question "How is this set of instructions to be translated into statements in the programming language"?

Some answers are more accurate than others. Program 1 is bug-free — i.e., perfect — if it is seen as the answer to the question put by the given set of instructions, but the question is inadequately formulated since the instructions are not very comprehensive. The question to which program 3 is an answer is also inadequately formulated: it would certainly be possible to beat the system in some way, for example, there is no such thing as a completely un-copyable disc.

Consider the original question to which program 3 is the ultimate answer: "How can I get the computer to calculate square roots for me"? To go from this question to another question — the set of instructions — is a process of formulation, and can be a highly creative activity.

Once you have formulated the answer, which is in itself an implicit question, there now becomes necessary a process of integration. The language, operating-system characteristics, the relationship of this program with other programs, and many other problems — such as the square root of minus numbers — need to be considered.

Following this is the process of translation from the answer provided by the formulation and integration to the final answer, the program.

The process I have called formulation, together with much of integration, corresponds to what is normally termed systems analysis. The rest of integration, together with translation, corresponds to programming. In real life there is a continous interplay between formulation and integration; and lately, translation has not been left to a separate person either. All three interact.

Perfection can only really be assured in the translation process. This is what is usually meant by claims to bug-free programs. If the questions to which answers are required are greatly restricted in scope, perfection — or fewer errors — is easier to claim. If the environment for the integration process is restricted — e.g., by using only one language, or only files of a certain form — then the likelihood of error is reduced.

If perfection is possible in certain restricted senses, then the claim to a procedure to generate bug-free programs may be accurate, even though the range of application is very narrow. The price you pay for automatic perfection is a limitation on what you can do, and emphasis on translation at the expense of formulation and integration.

A program to write programs must, if it is to work, only answer a very restricted set of questions. Even then, it will only be able to implement the translation process, which is the only easily-implemented automatic procedure and could quite possibly produce bug-free programs.

Limited application

Any automated procedure which works will be able to claim to generate totally bug-free — i.e., perfect — programs. Yet there will still be bugs in the formulation and integration of answers to the original question — unless the user has superior analytical and creative faculties — so the perfection of the program written by the program generator will always be in question. The same can be said of the perfection of any program, including the program generator.

How can this doubtful perfection be resolved? One probable strategy by the promoters of any program generator will be to restrict its range of application — paying the price for automatic perfection by limiting what you can do. Some restrictions which come to mind concerning integration are:

using only one language;
having a fixed operating system;
only allowing restricted types of files;
minimising the types of mathematics one can use.

These restrictions are probably the least number that will appear in any program generator. Some of them you will be told about, others will come to light when you find that you cannot do what you want to do.

At the level of formulation, any program generator must restrict its range of

(continued on next page)

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application to a very limited area, e.g., financial management, simulation or matrix mathematics. Programs already exist which translate programs written in one language, say, Algol 60, to programs written in another language, say, PL/1.

For any computer to run a program there must be another program — the compiler — which translates the first program into machine instructions. One would suspect, therefore, that the overall shape and flow of any program outline must be very carefully defined, in great detail, before any program generator can operate.

Such a program generator would not be new, because what normally happens is that the source generated is not listed, but merely compiled. In the Genesys system for use by civil and structural engineers, programs written in a language called Gentran are converted into Fortran source. The source is not usually listed as it is compiled into object code.

Creative imagination

If a program generator did provide all the programs the user needed, then the user would only be doing a restricted set of tasks, i.e., asking a very restricted set of questions. To claim perfection of the resulting programs — i.e., no bugs — might be justified, but errors in logic, i.e., in formulation, are far more devastating and need creative imagination to solve. The response of the promoters of such generators to programs which did not work would probably be to blame the user's program logic though perhaps the logic would go astray mainly because the user has to modify his own logic to accommodate the generator, with resulting confusion.

Rather than talk in the abstract about what might happen if a generator of bug-free programs were to be produced, consider a different variety of bug-free program generator, a program generator which has been available for many years.

At the 1981 conference of the British Computer Society, C A R Hoare claimed that if programmers used certain standard techniques for program writing it should be possible to produce software with no bugs at all. In other words, the claim is that:

either there is a general decision procedure to check total program correctness and produce perfect programs,
or there are means available to generate correct programs at the translation stage, with probable restrictions on formulation and integration.

Hoare is one of the prime promoters of Pascal, and it would seem reasonable to suppose that Pascal embodies the standard techniques for program writing implied in Hoare's claim. Therefore, we need only study Pascal to learn these techniques.

To write a perfect — bug-free — program is of little value if the formulation and integration aspects are flawed. I have already described several possible restrictions concerning integration for a program generator. Pascal obviously is restricted in being a single language and having a fixed type of file: the only type of file allowed in standard Pascal is the sequential file.

Pascal also has many restrictions on mathematical operations. There are silly rules for matrices, and it is impossible to bring real numbers into their axiomatic system — the axiomatic system upon which is based the assertions concerning perfection. A possible reason for this problem with real numbers is that Pascal Types, apart from the Real, are based on the idea of a Set Of. However, when one considers real numbers on the computer, the sets have an infinite number of elements. The list of such restrictions could be extended.

In formulation, any program generator must restrict its range of application, unless the program generator is human. Pascal was originally designed to teach students computer programming, and when attempts are made to use Pascal for answering questions outside this particular application, the logic becomes increasingly devious. Pascal is useless for serious mathematical and scientific work in a communal environment with libraries of applications procedures.

It is claimed that Pascal has a great utility in compiler writing, partly due to its reputation for ease of bug-free translation. Yet Richard Bornat in his book *Understanding and Writing Compilers* (Macmillan, 1979) clearly asserts that he would have used Pascal more extensively for compiler writing were it not for the fact that its lack of block structure, lack of conditional expressions and lack of a simple "union-type" convention forces an obscure programming style.

What the advocates of Pascal promise is a bug-free program generator called Pascal, which will take many years to master in its program-proving aspects. Due to the necessary limitations on formulation and integration, this language will not be as flexible as many other languages in answering questions. Similarly, any future bug-free program generator will, due to the necessary limitations on formulation and generation, not be as flexible as most programmers in answering questions.

Bug-free programs can be written, in that perfect translations can be made of the logic which appears after formulation and integration of an answer. But surely the emphasis should be placed not on this perfection in preference to the perfection of formulation and integration. You may wonder whether translation is emphasised because it is the most routine of the aspects of creating a program. The emphasis on creation seems to be sadly lacking in the playing down of the imagination needed in formulation.

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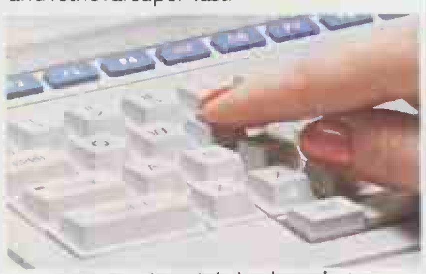

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Tennis and interface

THIS GAME has been written in Basic for the Nascom 2 computer, but it should be relatively easy to modify for use on other computers with similar graphics facilities, writes Adrian Dickens of Cambridge. My original version produced sound effects whenever the ball bounced off the bats or a wall. I have put Rem statements by all of the instructions related to the generation of sound, so that the routines can be modified, or if necessary removed from the program.

My sound effects were simply a constant tone with an envelope on the amplitude. This simulates the sound produced by conventional TV games very well. I used a home-brew sound generator with an AY-3-8910 sound chip.

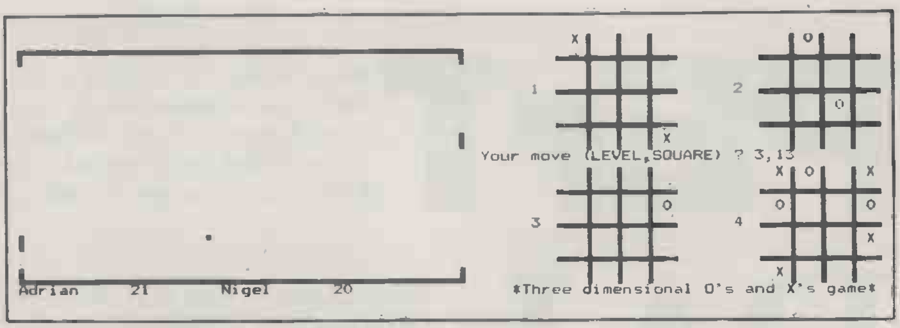
The machine-code subroutine is used to take a character from the keyboard while the program is running. The character codes from the Nascom keyboard cursor keys are 17,18,19,20. These give each of the two players an up and a down key to control the movements of their bats. The aim of the game is to stop as many balls from passing by the bat as possible.

If a ball does go by one player's end, his opponent's score is incremented by one. When the game is initially run, the relative speed of play for each player can be assigned. Play starts when a ball appears at random in the court, moving in a random direction.

The second program, which is an interface between the Nascom 2 and the Epson printer, comprises three routines, designed to be used together. The major advantage of this printer interface with the Nascom is that all of the Nascom block graphics are printed. As anyone who has already bought an Epson printer will realise, while all of the block-graphic characters produced by the Nascom can also be produced by the Epson, the character codes are not compatible.

I carefully analysed the two graphics sets, and found that Nascom graphic codes could be converted into Epson codes by changing four bits, using the look-up table, and using a few more instructions to convert the remaining high-order bits.

This method of conversion is considerably better than using a look-up table for all of the block graphics, because it uses up far less memory space. The successful results of the programs can be seen in the sample printouts, one from the computer tennis game, and the other from my three-dimensional noughts and crosses game.



Sample printouts of tennis and noughts and crosses.

The first routine, Init, must always be called before either of the other routines. This routine sets up the parallel I/O ports into the correct modes. The printer should be connected to the Nascom as directed in the source listing. Init also loads the address of Out into Nas-Sys workspace, so that output can be directed to the printer by the Nas-Sys "U" command.

Routine Out is used to output the byte stored in the A register to the printer. If a block-graphics character is encountered, it is converted to the Epson code before printing. If one of the Nascom special graphics characters is encountered, a space is printed so that the relevant character can be filled in by hand later if required.

Routine Dump is especially useful for use with Basic, because it enables an exact copy of the Nascom screen to be down loaded on to paper. Both of the printouts from my games were produced using this routine. To use this routine, put the address of Dump into memory at 1004H — low byte — and 1005H — high byte — and enter X = USR(0) under Basic. The printer will then print out an exact copy of the Nascom screen.

Computertennis: Adrian Dickens' program.

```
10 REM****************************************
20 REM
30 REM  COMPUTER TENNIS GAME FOR THE NASCOM 2
40 REM
50 REM              by A C Dickens
60 REM
70 REM          Copyright September 1981
80 REM
90 REM****************************************
100 CLS
110 X=A=B=A1=B1=0
120 REM INITIALISE SOUND GENERATOR:GOSUB11031
130 PRINT"***** COMPUTENNIS CHAMPIONSHIPS *****"
140 PRINT
150 PRINT"Each player has control of a racket."
160 PRINT"This is moved up & down with the ";
170 PRINT"cursor keys "
180 PRINT
190 INPUT"Name of player 1 ";N1$
200 PRINT"Speed for ";N1$;" 0 is fastest ";
210 INPUTS1
220 PRINT
230 INPUT"Name of player 2 ";N2$
240 PRINT"Speed for ";N2$;" 0 is fastest ";
250 INPUTS2
260 H1=7:H2=7
270 C1$=CHR$(199):C2$=CHR$(248)
280 CLS
290 FORX=4TO91
300 SET(X,0):SET(X,41):NEXTX
310 FORX=4TO91STEP87
320 SET(X,1):SET(X,2):SET(X,39):SET(X,40)
330 NEXTX
340 SCREEN3,15:PRINTN1$;
350 SCREEN23,15:PRINTN2$;
360 REM THIS SETS UP THE USR FUNCTION SO THAT
370 REM CHARACTERS CAN BE INPUT FROM THE
380 REM KEYBOARD WITHOUT TEMPORARILY HALTING
390 REM EXECUTION OF PROGRAM.THE USR FUNCTION
400 REM OPERATES LIKE GET$ ON OTHER COMPUTERS.
410 DOKE3200,25311
420 DOKE3202,312
430 DOKE3204,18351
440 DOKE3206,10927
450 DOKE3208,-8179
460 POKE3210,233
470 DOKE4100,3200
480 REM Main loop
490 X=21-USR(0)
500 ONXGOSUB 560,600,640,680
510 GOSUB720
520 GOSUB830
530 GOSUB920
540 GOSUB960
550 GOTO480
560 SCREEN46,H2:PRINT" "
570 IFH2<13THENH2=H2+1
580 SCREEN46,H2:PRINTC2$
590 RETURN
600 SCREEN3,H1:PRINT" "
610 IFH1>2THENH1=H1-1
620 SCREEN3,H1:PRINTC1$
630 RETURN
640 SCREEN46,H2:PRINT" "
650 IFH2>2THENH2=H2-1
660 SCREEN46,H2:PRINTC2$
670 RETURN
680 SCREEN3,H1:PRINT" "
690 IFH1<13THENH1=H1+1
700 SCREEN3,H1:PRINTC1$
710 RETURN
720 IFS=1THENRETURN
730 D=RND(0)*1000
740 FORE=0TOD:NEXT
750 A=INT(RND(0)*40)+1
```

(continued on page 127)

(continued from page 125)

```
760 B=42
770 A1=INT(RND(2)*5)-2
780 B1=1
790 IFRND(5)<.5THENB1=-1
800 IFABS(A1)<2THENB1=B1*2
810 S=1
820 RETURN
830 IFA>2ANDA<39ANDB>6ANDB<89THENRETURN
840 IFA=1THENA1=ABS(A1):REM*SOUND*:GOSUB8000
850 IFA=2ANDA1=-2THENA1=ABS(A1):REM*SOUND*:GOSUB1160
860 IFA=40THENA1=-ABS(A1):REM*SOUND*:GOSUB1160
870 IFA=39ANDA1=2THENA1=-ABS(A1):REM*SOUND*:GOSUB1160
880 IFB<6ORB>89THENB1=-B1:RETURN
890 IFB=6ANDABS(B1)=2THENB1=B1/2:RETURN
900 IFB=89ANDABS(B1)=2THENB1=B1/2:RETURN
910 RETURN
920 RESET(B,A):A=A+A1:B=B+B1:SET(B,A)
930 IFB1=-1ORB1=-2THEN950
940 FORX=0TOS2:NEXT:RETURN
950 FORX=0TOS1:NEXT:RETURN
960 IFB>5ANDB<90THENRETURN
970 IFB=5ANDH1=INT(A/3+1)THEN1100
980 IFB=90ANDH2=INT(A/3+1)THEN1100
990 Z=0
1000 IFA=1ORA=2ORA=39ORA=40THENZ=1
1010 REM *SOUND*:GOSUB8000
1020 IFZ=1THENA1=INT(RND(2)*5-2)
1030 IFZ=1THENRETURN
1040 RESET(B,A)
1050 IFB=5THENC2=C2+1
1060 IFB=90THENC1=C1+1
1070 SCREEN13,15:PRINTC1;
1080 SCREEN33,15:PRINTC2;:S=0
1090 RETURN
1100 REM BALL REBOUNDS FROM BAT SOUND:GOSUB17000
1110 A1=INT(RND(7)*5-2)
1120 IFABS(A1)<2THENH=1
1130 IFH=1ANDABS(B1)=1THENB1=B1*2
1140 H=0
1150 RETURN
1160 REM REBOUND OFF SIDE 'WALLS' SOUND
1170 IF(A=1ORA=40)ANDA1=0THENRETURN
1180 POKEA2,0:POKED2,240
1190 POKEA2,13:POKED2,0
1200 RETURN
1210 REM THE NEXT 4 LINES INITIALISE MY SOUND
1220 REM GENERATOR.
1230 A2=-28608:D2=-28607
1240 POKEA2,7:POKED2,254
1250 POKEA2,12:POKED2,9
1260 POKEA2,8:POKED2,16
1270 RETURN
1280 REM BALL OFF BATS SOUND
1290 POKEA2,0
1300 IFB=5THENPOKED2,255
1310 IFB=90THENPOKED2,225
1320 POKEA2,13:POKED2,0
1330 RETURN
Ok
```

The Nascom 2 to Epson printer interface.

```
ZEAP Z80 Assembler - Source Listing

             0010 ;**********************************************
             0020 ;
             0030 ;      EPSON MX80 PRINTER INTERFACE WITH
             0040 ;          A NASCOM 2 MICROCOMPUTER.
             0050 ;
             0060 ;          Copyright by A.C.Dickens
             0070 ;               September 1981
             0080 ;
             0090 ;**********************************************
             0100 ;Connections to the Nascom 2 I/O ports
             0110 ;
             0120 ;B0 - B7 to printer DATA IN lines D0 - D7
             0130 ;A0 to printer BUSY line
             0140 ;A1 to printer STROBE line
             0150 ;A2 to printer INITIALISE line
             0160 ;
             0170 ;Routine INIT sets up the Nascom ports for
             0180 ;use with the EPSON,and selects routine
             0190 ;OUT for use with NAS-SYS user output
             0200 ;option.The printer is turned ON by the
             0210 ;'U' command in NAS-SYS,and turned OFF by
             0220 ;the 'N' command.
             0230 ;SET UP PORT B FOR BYTE OUTPUT
8000         0240        ORG  0B000H
8000 3E0F    0250 INIT   LD   A,15
8002 D307    0260        OUT  (7),A
             0270 ;SET UP PORT A
             0280 ;A0 = BUSY
             0290 ;A1 = STROBE
             0300 ;A2 = INITIALISE
8004 3EFF    0310        LD   A,£FF
8006 D306    0320        OUT  (6),A
8008 D304    0330        OUT  (4),A
800A 3EF9    0340        LD   A,£F9
800C D306    0350        OUT  (6),A
800E 211580  0360        LD   HL,OUT;SET USER OUTPUT ADDRESS
8011 22780C  0370        LD   (0C78H),HL;FOR USE BY NAS-SYS
8014 C9      0380        RET
             0390 ;PRINTER OUTPUT ROUTINE
             0400 ;CHARACTER FOR PRINTING IS IN A REGISTER
8015 F5      0410 OUT    PUSH AF
             0420 ;TEST FOR A GRAPHICS CHARACTER
8016 CB7F    0430        BIT  7,A
8018 281E    0440        JR   Z,PRINT
             0450 ;SELECT BLOCK GRAPHICS ONLY
             0460 ;PRINT A SPACE IF IT IS NOT A BLOCK
801A CB77    0470        BIT  6,A
801C 2004    0480        JR   NZ,GRAPIC
801E 3E20    0490        LD   A,32 ;SPACE CODE
8020 1816    0500        JR   PRINT
             0510 ;CORRECT BITS 5 & 6 OF THE CODE FOR EPSON
8022 D620    0520 GRAPIC SUB  32
8024 4F      0530        LD   C,A
             0540 ;CORRECT BITS 1,2,3,4 OF CODE FOR EPSON
8025 E61E    0550        AND  1EH
8027 CB3F    0560        SRL  A
8029 114A80  0570        LD   DE,TABLE
802C 8B      0580        ADC  A,E
802D 5F      0590        LD   E,A
802E 7A      0600        LD   A,D
802F CE00    0610        ADC  A,0
8031 57      0620        LD   D,A
8032 1A      0630        LD   A,(DE)
8033 57      0640        LD   D,A
8034 79      0650        LD   A,C
8035 E6E1    0660        AND  0E1H  ;1110 0001
8037 B2      0670        OR   D
             0680 ;GRAPHICS CODE NOW CONVERTED FOR PRINTING
             0690 ;LOAD CHARACTER TO BE PRINTED ONTO PORT
8038 D305    0700 PRINT  OUT  (5),A
             0710 ;WAIT UNTIL THE BUSY LINE GOES LOW
803A DB04    0720 LOOP   IN   A,(4)
803C CB47    0730        BIT  0,A
803E 20FA    0740        JR   NZ,LOOP
             0750 ;STROBE DATA INTO PRINTER
8040 3EFD    0760        LD   A,£FD
8042 D304    0770        OUT  (4),A
8044 3EFF    0780        LD   A,£FF
8046 D304    0790        OUT  (4),A
8048 F1      0800 END    POP  AF
8049 C9      0810        RET
             0820 ;TABLE FOR GRAPHICS CONVERSION
804A 00      0830 TABLE  DEFB 00H
804B 04      0840        DEFB 04H
804C 10      0850        DEFB 10H
804D 14      0860        DEFB 14H
804E 02      0870        DEFB 02H
804F 06      0880        DEFB 06H
8050 12      0890        DEFB 12H
8051 16      0900        DEFB 16H
8052 08      0910        DEFB 08H
8053 0C      0920        DEFB 0CH
8054 18      0930        DEFB 18H
8055 1C      0940        DEFB 1CH
8056 0A      0950        DEFB 0AH
8057 0E      0960        DEFB 0EH
8058 1A      0970        DEFB 1AH
8059 1E      0980        DEFB 1EH
             0990 ;END OF TABLE
             1000 ;ROUTINE DUMP PRINTS OUT AN EXACT COPY OF
             1010 ;THE NASCOM SCREEN,EXCEPT FOR SPECIAL
             1020 ;GRAPHICS CHARACTERS,WHICH ARE PRINTED AS
             1030 ;BLOCK GRAPHICS.
             1040 ;LOAD HL WITH START POSITION ON SCREEN
805A 210A08  1050 DUMP   LD   HL,080AH
             1060 ;SET THE LINE LENGTH TO 48 CHARACTERS
805D 0630    1070 LINE   LD   B,30H
             1080 ;GET CHARACTER IN A REGISTER
805F 7E      1090 COLUM  LD   A,(HL)
             1100 ;PRINT THE CHARACTER
8060 CD1580  1110        CALL OUT
8063 23      1120        INC  HL
             1130 ;HL NOW POINTS TO NEXT SCREEN POSITION
8064 10F9    1140        DJNZ COLUM
8066 111000  1150        LD   DE,10H
8069 19      1160        ADD  HL,DE
             1170 ;DO A CARRIAGE RETURN
806A 3E0D    1180        LD   A,13
806C CD1580  1190        CALL OUT
             1200 ;DO A LINE FEED
806F 3E0A    1210        LD   A,0AH
8071 CD1580  1220        CALL OUT
             1230 ;LAST LINE ?
8074 7C      1240        LD   A,H
8075 FE0C    1250        CP   0CH
8077 20E4    1260        JR   NZ,LINE *
8079 C9      1270        RET
             1280 ;THE END
```

Subtle Scroll Stopper

I WAS interested by Scroll Stopper in the July 6502 Special as I have been using a similar program for some time now, writes Derek Aston of Spennymoor, County Durham. I am sending you my version, as there is a subtle difference between the two.

I have found the program so useful that I have managed to patch it into my Mon02 Monitor ROM by shortening the start-up message. There is also a disassembly from my monitor for the benefit of anyone with PROM programming facilities.

Scroll Stopper

```
10 REM Controlled LIST for UK101 by D.Aston
12 :
14 REM for UK101, Mon02
16 REM Program resides at HEX 029B to 02BA
18 REM TO INVOKE, POKE 541,2
20 REM To DISABLE, POKE 541,255
22 REM To LIST, type LIST, hit RETURN
24 REM            then push SPACE BAR
26 REM To Quit LIST command, hit 'Q'
28 REM To EDIT, enter LINE NUMBER, hit RETURN
30 REM            then push SPACE BAR
32 :
34 REM for UK101, Mon01
36 REM Program resides at HEX 0269 to 0288
38 REM Change 155 in line No.54 to 105
40 REM Change 667 In line No.56 to 617
42 REM TO INVOKE, POKE 539,2
44 REM TO DISABLE, POKE 539,255
46 :
48 DATA173,5,2,208,20,165,19,201,153
50 DATA208,14,169,253,141,0,223,173,0
52 DATA223,73,255,240,244,48,3,76
54 DATA155,255,24,76,79,166
56 A=667:FORN=0TO31:READD:POKEA+N,D:NEXT
```

Monitor disassembly

```
FEF4 7F   ;Was 9B  Re-route Control C
FEF5 FC   ;Was FF  Vector on RESET

FC78 20      ; Start-up message
FC79 4D 'M
FC7A 2C ',
FC7B 43 'C
FC7C 2C ',
FC7D 57 'W
FC7E 00      ;Message terminator
FC7F AD0502 LDA $0205 ;Test SAVE FLAG
FC82 D019   BNE $FC9D
FC84 AD1102 LDA $0211 ;Test PRINTER FLAG
FC87 D014   BNE $FC9D
FC89 A513   LDA $13   ;Was last
FC8B C999   CMP #$99  ;command LIST
FC8D D00E   BNE $FC9D
FC8F A9FD   LDA #$FD
FC91 8D00DF STA $DF00 ;Mask Keyboard
FC94 AD00DF LDA $DF00 ;Get Keyboard
FC97 49FF   EOR #$FF  ;Complement
FC99 F0F4   BEQ $FC8F ;Wait for command
FC9B 3003   BMI $FCA0 ;Q=Quit
FC9D 4C9BFF JMP $FF9B ;Continue LISTing
FCA0 18     CLC
FCA1 4C4FA6 JMP $A64F ;Abort LIST command
```

Spreading Life

THE GAME of Life is a mathematical simulation of the evolution of a colony of cells, writes Simon Cogle of Carshalton, Surrey. In this version, the grid is 32 cells by 16 cells with wrap-round at all edges. Each cell is either white — indicating maturity — grey — indicating new-born — or black — indicating empty. The rules for deriving the next generation are:

- A mature cell with less than two mature neighbours dies of loneliness.
- A mature cell with more than three mature neighbours dies of overcrowding.
- A cell is born in an empty cell if it is adjacent to exactly three mature neighbours.

This program produces the next generation in two stages. New cells are born, then some of the mature cells die and the new-born cells mature. The program begins in Input mode. You may input your colony of cells using the following keys: ↑ , move cursor up; ↓ , move cursor down; ⟶, move cursor right; lock, move cursor left; space, to kill a live cell; and copy, to create a live cell.

Once you have entered your colony, key "R" and the program begins generating new colonies based on the rules. Each generation takes about 1.5 seconds — including a one-second wait.

While the program is in Run mode you may use the following keys: Control, to make the program pause at the end of the current generation; Shift, to resume after Control is used; and Repeat, to return to Input mode, e.g., to amend the colony.

The Break or Escape key may be used to exit from the program at any time.

The program uses direct cursor addressing — DE_{16} and DF_{16} contain the cursor row and EO_{16} contains the cursor column.

You will soon discover that a colony need not be large to produce interesting results. For example, the pattern I call the spinner, because it produces an intermediate which is a twisted version of the original, is only five cells:

X		
X		X
X	X	

The spinner moves diagonally across the grid at a speed of one-quarter, i.e., a one-cell movement every four generations. This is the fastest moving group I have found so far, can you find a flyer?

```
10 REM LIFE V5.1
15 DIM KK(5),K(0)
20 G=#A0;B=#FF;D=#20;E=#7F;S=#8000;F=0
21P.$21;FOR J=0 TO 1;DIM P(-1)
22[;:KK0 LDY @#3B;CLC;LDA @#20;LDX @10;BIT #B001;BEQ P+10
23 INC #B000;DEY;DEX;BNE P-10;LSRA;PHP;PHA;LDA #B000
24 AND @#F0;STA #B000;PLA;PLP;BNE P-27;STY K;RTS;
25:KK1 LDA @31;STA #80;:KK2 LDA @15;STA #81;:KK3 LDX @0
26 LDA @31;STA #83;:KK4 LDA @15;STA #84;:KK5 LDA @#80;STA #86
27 LDA #81;CLC;ADC #84;AND @#F;ASLA;ASLA;ASLA;ASLA;ASLA
28 BCC P+4;INC #86;STA #85
29 LDA #80;CLC;ADC #83;AND @#1F;TAY
30 LDA @G;CMP (#85),Y;BNE P+3;INX
31 LDA @E;CMP (#85),Y;BNE P+3;INX
32 INC #84;LDA #84;CMP @18;BNE KK5
33 INC #83;LDA #83;CMP @34;BNE KK4
34 LDA @#80;STA #86
35 LDA #81;ASLA;ASLA;ASLA;ASLA;ASLA
36 BCC P+4;INC #86;STA #85;LDY #80
37 LDA @D;CMP (#85),Y;BNE P+10;CPX @3;BNE P+6;LDA @B
38 STA (#85),Y
39 LDA @G;CMP (#85),Y;BNE P+14;CPX @3;BEQ P+10;CPX @4;BEQ P+6
40 LDA @E;STA (#85),Y
41 DEC #81;BPL KK3;DEC #80;BMI P+5;JMP KK2
46 RTS;]
47 NEXT J;P.$6,$12
48jLINK KK0
49 Z=!#DE&#FFFF:?#E0
50 IF ?K=4 P.$11
60 IF ?K=7 AND Z<#81E0 THEN P.$10
70 IF ?K=5 P.$8
75 IF Z=#81FF GOTO n
80 IF ?K=6 P.$9
90 IF ?K=0 P.$D
100 IF ?K=14 P.$#80
110nIF ?K<>50 GOTO j
120 ?Z=?Z:#80
130gFOR J=1 TO 60;WAIT;NEXT J
140 LINK KK1
270 FOR O=#8000 TO #81FF
280 ?O=?O&G
290 NEXT O
300wIF ?#B002&#40=0 THEN ?#E1=0;P.$30;?#E1=#80;?S=?S:#80;G.j
310 IF ?#B001&#40=0 F=1
320 IF ?#B001&#80=0 F=0
330 IF F GOTO w
340 GOTO g
```

Atom fractions

THIS PROGRAM for the Acorn Atom enables it to calculate fractions, writes Brian Lloyd of Witham, Essex. It will cancel down, add, subtract, divide and multiply pairs of fractions.

```
5 REM "FRACTIONS"
10 IN.A;IN.B;IN.C;IN.D
20 G.2010
30 P."1=ADD"';P."2=MINUS"';P."3=DIVIDE"';P."4=MULTIPLY"'
40 IN.G
50 IF G=1 G.100
60 IF G=2 G.200
70 IF G=3 G.400
80 IF G=4 G.500
100 F=A+C;G=B
110 P.$12;P.F';P."      ----"';P.G
115 IF G<F GOS.3000
120 G.10
200 F=A-C;G=B
210 P.$12;P.F';P."      ----"';P.G
215 IF G<F GOS.3000
220 G.10
400 F=A*B;G=B*C
410 P.$12;P.F';P."      ----"';P.G
415 IF G<F GOS.3000
420 G.10
500 F=A*C;G=B*B
510 P.$12;P.F';P."      ----"';P.G
515 IF G<F GOS.3000
520 G.10
2000 END
2010 IF B<>D A=A*D
2020 IF B<>D C=C*B
2030 IF B<>D B=B*D
2040 P.A" OVER "B';P.C" OVER "B'
2050 G.30
3000 P.$12;P.F/G;P." AND "';P.F%G;P."
3050 P."    ----"'
3060 P.G'
3100 R.
```

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Flying ducks

DUCK SHOOT is an interactive graphics game by Simon Williams from Tealby, Lincs. The player tries to pot 10 ducks which flap individually across the screen. They appear randomly to left and right at five different heights, with two ducks at each height in the course of a game.

The player controls the hunter with the keys 1, 2 and 3 which direct the shots left, overhead and right, respectively. A shot is fired by pressing the space bar. When a duck has been hit, a score is displayed which depends on its height and how far it has travelled.

Each score is added to the player's total, which is displayed at the bottom of the screen. When all 10 ducks have flown, the total score is compared with the three best previous scores, and an updated score card is displayed. The game then repeats with another 10 ducks, if required.

The program is written for a TRS-80 with level-2 Basic. It uses no Poke statements and should, therefore, be straightforward to convert to other machines with reasonable graphics capabilities. The graphics characters are loaded into strings in lines 300 to 400 and are Printed at various locations on the screen to obtain the desired effects.

To speed the running of the program, the main sections are listed at the beginning and much use is made of multi-statement lines. A further modification to increase speed would be to remove all Rem statements and spaces in lines 19 to 100.

```
10 GOTO 290
19 '*** DUCK FLIGHT
20 IF DC<1 OR DC>59 PRINT@DR+DC,B$;: GOTO 160
30 BS=BS-1: IF G$=G1$ G$=G2$ ELSE G$=G1$
40 IF PEEK(P+DR+DC+(5*D+3)/2)=136 H=1
50 PRINT@DR+DC,B$;: DC=DC+D: PRINT@DR+DC,G$;
60 IF H=1 GOTO 110
69 '*** HUNTER MOVEMENT AND SHOOT
70 I$=INKEY$: I=VAL(I$): IF I>0 AND I<4 PRINT@796,H$(I);: SD=66-I
80 IF I$=" " AND S=0 SM=SD: S=926-3*SD: PRINT@S,S$;: GOTO 20
90 IF S=0 GOTO 20 ELSE IF S<45 PRINT@S," ";: S=0: GOTO 20
100 IF PEEK(P+S-SM)=32 PRINT@S," ";: S=S-SM: PRINT@S,S$;: GOTO 20
109 '*** DUCK FALL AND RETRIEVE
110 PRINT@S," ";: PT=INT(100-20*DR/64+BS/4): PRINT@DR+DC," "PT" ";: FOR N=1 TO
    500: NEXT
120 TP=TP+PT: PRINT@1014,TP;: PRINT@DR+DC,DF$;: FOR N=1 TO 20: NEXT: DF=DR+DC
130 IF DF<896 PRINT@DF,B$;: DF=DF+SD-1: PRINT@DF,DF$;: FOR N=1 TO 20: NEXT:
    GOTO 130
140 FOR M=918 TO DF STEP-1: PRINT@M,R2$;: FOR N=1 TO 20: NEXT N,M: S=0
150 FOR M=DF TO 918: PRINT@M,R3$;: FOR N=1 TO 20: NEXT N,M: PRINT@918,R1$;
159 '*** NEW DUCK
160 IF T=10 GOTO 190 ELSE T=T+1: H=0: D=RND(2)*2-3: BS=59
170 IF D=1 G1$=D3$: G2$=D4$: DC=1 ELSE G1$=D1$: G2$=D2$: DC=59
180 R=RND(10): DR=DS(R): IF DR=0 GOTO 180 ELSE DR=DR-64: DS(R)=0: GOTO 20
189 '*** END OF GAME AND RERUN
190 GOSUB 480: FOR N=1 TO 11: PRINT: NEXT: PRINT@340,"YOUR SCORE IS"TP"POINTS"
200 IF TP<TP(2) PRINT: PRINT TAB(23)"TODAY'S TOP THREE": GOTO 260
210 PRINT TAB(16)"AND IS ONE OF TODAY'S TOP THREE": PRINT
220 PRINT TAB(16)"ENTER YOUR INITIALS (3 MAX)";: INPUT TP$: PRINT@304,: PRINT
230 IF LEN(TP$)>3 THEN TP$=LEFT$(TP$,3)
240 IF TP>=TP(0) THEN TP(2)=TP(1): TP(1)=TP(0): TP(0)=TP: TP$(2)=TP$(1): TP$(1)=
    TP$(0): TP$(0)=TP$: GOTO 260
250 IF TP>=TP(1) THEN TP(2)=TP(1): TP(1)=TP: TP$(2)=TP$(1): TP$(1)=TP$ ELSE
    TP(2)=TP: TP$(2)=TP$
260 FOR N=0 TO 2: PRINT TAB(20)N+1TAB(30)TP$(N)TAB(40)TP(N): NEXT
270 PRINT: PRINT TAB(20)"PRESS SPACE BAR TO PLAY"
280 I$=INKEY$: IF I$<>" " GOTO 280 ELSE TP=0: T=0: GOTO 410
289 '*** INITIALISE
290 CLEAR 100: DEFINT A-Z: P=15360: S$=CHR$(136): B$="^^^^^"
300 D1$=CHR$(131)+CHR$(142)+CHR$(141)+CHR$(129): DIM TP(2),TP$(2),H$(3)
310 D2$=CHR$(131)+CHR$(172)+CHR$(156)+CHR$(129)
320 D3$=CHR$(130)+CHR$(142)+CHR$(141)+CHR$(131)
330 D4$=CHR$(130)+CHR$(172)+CHR$(156)+CHR$(131)
340 DF$=CHR$(130)+CHR$(164)+CHR$(156)+CHR$(129)+" "
350 H$(1)=CHR$(137)+CHR$(176)+CHR$(188)+CHR$(148)+"^^^"
360 H$(2)="^^^"+CHR$(190)+CHR$(148)+"^^^"
370 H$(3)="^^^"+CHR$(188)+CHR$(180)+CHR$(152)+CHR$(129)
380 R1$="^^^^^"+CHR$(171)+CHR$(173)+CHR$(152)
390 R2$=" "+CHR$(130)+CHR$(175)+CHR$(140)+CHR$(172)+CHR$(134)+" "
400 R3$=" "+CHR$(137)+CHR$(156)+CHR$(140)+CHR$(159)+CHR$(137)+CHR$(148)
409 '*** TITLE AND INSTRUCTIONS
410 GOSUB 480: PRINT TAB(19)"COPYRIGHT 1981, S.WILLIAMS": PRINT
420 PRINT"^^^^PRESS SPACE BAR TO SHOOT AT DUCKS. KEYS '1', '2' AND '3'1
         ^^^^AIM LEFT, OVERHEAD AND RIGHT RESPECTIVELY. EACH DUCK IS1
         ^^^^WORTH BETWEEN TWENTY AND ONE HUNDRED POINTS, DEPENDING1
         ^^^^^^ON ITS HEIGHT. TEN DUCKS PER GAME. PRESS SPACE BAR"
430 PRINT: PRINT: PRINT
440 I$=INKEY$: IF I$<>" " GOTO 450 ELSE CLS: PRINT@796,H$(2);
450 FOR N=861 TO 864: READ D,D1: PRINT@N,CHR$(D);: PRINT@N+64,CHR$(D1);: NEXT
460 FOR N=960 TO 1022: PRINT@N,CHR$(191);: NEXT: SD=64
470 PRINT@918,R1$;: PRINT@1000,"POINTS SCORE:"TP;: GOTO 160
480 RESTORE: CLS: FOR N=978 TO 1005: READ D: PRINT@N,CHR$(D);: NEXT: PRINT@960,
490 FOR N=978 TO 1005: READ D: PRINT@N,CHR$(D);: NEXT: PRINT
500 FOR N=1 TO 5: DS(N)=N*64: NEXT: FOR N=6 TO 10: D$(N)=(N-5)*64: NEXT: RETURN
510 DATA 151,131,164,32,32,32,32,32,32,170,32,144,32,32,166,179,147,170,32,32,
    32,32,32,32,32,32,174,132
520 DATA 181,176,134,138,176,154,136,179,179,170,32144,32,32,176,176,154,170,
    131,169,136,179,153,136,179,153,170,176
530 DATA 171,160,191,149,191,181,129,32
```

Printed calendar

A PROGRAM to print out a calendar for any year from 1916 onwards, comes from K C Baldrey of Portsmouth. When Run is entered, the program halts and asks for which year the calendar is to be printed.

Line 15 calculates the number of years' difference. Line 20 calculates the number of leap years. Line 25 calculates the total number of days to be added.

Lines 35 to 42 are a loop based on the maximum number of leap years — 30 — possible before the year 2000 or thereabouts, and calculate the actual number of days to be added for one week to give the start day for January. Monday is day zero.

When the number is less than seven, the program jumps out of the Z loop to line 60 which reads the month data, ready to start generating the calendar. Line 65 sorts out whether or not it is a leap year, and gives D a value of 29 for February. Lines 75 to 180 generate the calendar format.

Line 185 calculates the start day of the months February to December. It is put in this position so that the previous month's data D is available for the calculation of S for the present month. Lines 195 to 255 are the month data.

A subroutine at line 1000 is used to generate the lines between weeks, etc., which is needed a large number of times. Line 1020 advances the paper at the end of the calendar ready for tearing.

This program takes leap years into account. It should run, without amendment, on most computer/printer combinations.

```
1 REM *** PROGRAM TO PRINT CALENDAR FOR ANY YEAR FROM 1916 ***
2 REM *** DEVISED BY K.C.BALDREY. ***
3 REM *** 28 th. MARCH 1981 ***
4 REM *** FOR USE ON THE TRS-80 LEVEL 2 MICRO-COMPUTER. ***
5 REM *** IN CONJUNCTION WITH THE EPSON MX 80 PRINTER ***"
6 CLS
10 INPUT"ENTER YEAR TO BE PRINTED.";Y
15 D=Y-1900
20 L = INT (D/4)
25 S = D + L
35 FOR Z = 1 TO 30
40 IF S>=7 THEN S=S-7
42 IF S < 7 GOTO 60
45 NEXT Z
60 FOR X = 1 TO 12: READ M$,D
65 IF Y/4 - INT(Y/4) = 0 AND M$="FEBRUARY" THEN D=29
70 GOSUB 1000
75 LPRINT"I                              ";M$;TAB(45);Y;TAB(56)"I"
80 GOSUB 1000
85 LPRINT"I  MON   I   TUE   I   WED   I   THU   I   FRI   I   SAT   I   SUN   I":
90 GOSUB 1000
95 LET C = 0
96 IF S= 0 THEN 120
100 FOR K = 1 TO S
105 LPRINT"I        ";
110 LET C = C + 1
115 NEXT K
120 FOR J = 1 TO D
125 LPRINT USING"I    ##   ";J;
130 LET C = C + 1
135 IF C <> 7 GOTO 155
140 LPRINT"I"
145 GOSUB 1000
150 LET C = 0
155 NEXT J
160 FOR K = 1 TO 7-C
165 LPRINT"I        ";
170 NEXT K
175 LPRINT"I"
180 GOSUB 1000
185 S = S + D - 28: IF S >=7 THEN S = S - 7
190 NEXT X
195 GOTO 9999
200 DATAJANUARY,31
205 DATAFEBRUARY,28
210 DATAMARCH,31
215 DATAAPRIL,30
220 DATAMAY,31
225 DATAJUNE,30
230 DATAJULY,31
235 DATAAUGUST,31
240 DATASEPTEMBER,30
245 DATAOCTOBER,31
250 DATANOVEMBER,30
255 DATADECEMBER,31
1000 FOR V = 1 TO 57: LPRINT"-";
1005 NEXT V:LPRINT""
1010 RETURN
1020 FOR X = 1 TO 40 :LPRINT"":NEXT X
9999 END
```

Additional functions

HERE IS a program for the ZX-81 which will imitate the Read, Data, and Restore functions of more powerful computers, writes Stephen Carson-Rowland of Hinckley, Leicestershire.

The data is stored in a Rem statement in exactly the same way as in a proper Data statement, but to distinguish between data and ordinary Rem statements a "□" character CHR$ (8) should be used immediately after the Rem statement, e.g..

```
10 REM □234,34,456,98,56
```

The data Rems give the best effect if they are at the beginning of the program because they are read more quickly. I usually start the program with

```
1 LET READ=9000
2 LET RESTORE=8000
```

and use Gosub Read and Gosub Restore, because they make the program more understandable. Yet, with only 1K of memory there is little space for the actual program, so subroutine Restore should be deleted, and instead of

```
(line number) GOSUB RESTORE
(line number) LET PC=16509
```

The program is written to accept numerical data, but if string data is required as well, line 9060 should be changed to

```
LET A$=A$+CHR$ PEEK PC,
```

line 9000 to

```
LET A$="".
```

and line 909 deleted. Numerical data can then be taken as well using the Val function. To the best of my knowledge this program will run on a ZX-80 without any modification.

```
SUBROUTINE RESTORE
8000    LET PC = 16513
8010    RETURN

SUBROUTINE READ
9000    LET A=0
9010    IF PEEK PC=26 THEN GO TO 9070
9020    IF PEEK PC=234 AND PEEK (PC+1)=8 THEN GO TO 9050
9030    LET PC=PC+1
9040    GO TO 9020
9050    LET PC=PC+2
9060    LET A=A+PEEK PC-28
9070    LET PC=PC+1
9080    IF PEEK PC=118 OR PEEK PC=26 THEN RETURN
9090    LET A=A*10
9100    GO TO 9060
```

Error bug

I HAVE found what I believe to be a bug in ZX-80 4K Basic, writes D J Crawford of Edinburgh. If this program is run, it yields error code 2/200 which is inconsistent with the program as no line 200 exists.

```
100 IF NOT A=1 THEN GOTO 200
```

A clue to understanding this is given when this program is run:

```
100 IF A=1 THEN GOTO 200
```

The error code given is 2/100 as one would expect. It would appear that the ZX-80 checks the condition and finds that the undefined A is not equal to 1 and so proceeds and only notices the error once this has been executed.

More memory economy

JOHN BLOXHAM'S memory-saving routine, ZX-80/81 Line-up August 1981, although interesting in itself as a feature of the machine, will not save money, writes Matthew Wright of Sale, Cheshire.

If, instead, one were to enter the following:

```
10 IF 1 = 1 THEN PRINT "20"
20 PRINT "30"
```

then by adopting Eric Deeson's suggestion in the July 1981 edition, one could omit the quotation marks as well. Obviously, the same change will produce the same result.

Big characters

I WAS interested in the program to produce big characters on a 1K ZX-80, printed in ZX-80/81 Line-up on page 119/121 of the September 1981 issue, writes Roy Eastwood, of Romford, Essex.

I have converted the program to run on a 1K ZX-81 and also taken the opportunity to include a machine-code routine to display the characters on the screen, which gives an acceptable speed when run in Slow mode. The program prints the four characters entered in response to the prompt on line 30 eight times normal size.

The program is as follows: first, make space for the 32 bytes of machine code by typing line 10 as follows:

```
10 REM ................................ (32 full stops)
```

Then, using the following temporary program, Poke the machine code into the Rem line:

```
20 PRINT AT 21,0;
30 FOR N=16514 TO 16545
40 SCROLL
50 PRINT N;" ";
60 INPUT M
70 POKE N,M
80 PRINT M
90 NEXT M
```

Then type Run, enter the codes followed by the program proper. In response to the prompt, enter any four characters. The characters may be made to appear grey by Poking 8 into address 16532.

(continued on page 136)

Big characters — codes.

At address	enter	meaning
16514	42	)
16515	14	) LD HL, (16398)
16516	64	)
16517	58	)
16518	123	) LD A,(16507)
16519	64	)
16520	79	) LD C,A
16521	6	) LD B,8
16522	8	)
16523	203	) RIC C
16524	1	)
16525	56	) JR C,+4
16526	4	)
16527	22	) LD D,0
16528	0	)
16529	24	) JR+2
16530	2	)
16531	22	) LD D,128
16532	128	)
16533	126	) LD A,(HL)
16534	254	) CP 118
16535	118	)
16536	40	) JR Z,5
16537	5	)
16538	114	) LD (HL), D
16539	35	) INC HL
16540	16	) DJNZ,-19
16541	237	)
16542	201	) RET
16543	35	) INC HL
16544	24	) JR -8
16545	248	)

Big characters — main program.

```
20 DIM D(4)
30 INPUT U$
40 FOR S=1 TO 4
50 LET D(S)=CODE U$ (S)
60 NEXT S
70 FOR Q=0 TO 7
80 PRINT AT Q,Q;"  (32 spaces)"
90 FOR S=1 TO 4
100 PRINT AT Q, (S-1) *8;
110 POKE 16507, PEEK (D(S)*8+7680+Q)
120 RAND USR 16514
130 NEXT S
140 NEXT Q
150 GOTO 30
```

(continued from page 135)

Storable screen display

THIS PROGRAM demonstrates the use of a subroutine which converts the display file into a character string, on an expanded ZX-81, writes John Bloxham of Stratford upon Avon, Warwickshire. The idea is to allow a display, e.g., a game board, to be retained and recalled when necessary, or Saved on to tape. Assuming you have enough memory, two or more displays may be stored and recalled in rapid succession, giving an animation effect.

Line 10 initialises D$ — it will eventually contain the display. Lines 100-120 generate a simple test display. Line 200 hands over to the subroutine which loops through the display file and adds the characters into D$. On returning from the subroutine, the display is cleared and the program stops. The previous display is now stored in D$ and may be instantly recalled with a Print D$.

This appears to be a fast way of printing a screenful of anything, but because the display is in a string, it may be processed by the string-handling commands. For example, add the following lines:

```
300 FOR X=1 TO 673 STEP 32
310 PRINT AT 0,0;D$(X TO)
320 NEXT X
```

Then Goto 300 — do not use Run — scrolls the display upwards. Change line 300 to:

```
300 FOR X=673 TO 1 STEP —32
```

and the display scrolls downwards. Now if the display is changed and the subroutine called again, further pictures may be tacked on to D$. Each display adds 704 bytes to the string. Program a loop to print chunks of D$ 704 bytes long and you have animation. Finally, if the program is Saved on to tape then D$ is Saved as well — though do not forget to re-start with a Goto after Loading.

```
10    LET D$ = ""
100   FOR X = 0 TO 20
110   PRINT AT X, X;"SCREEN TEST"
120   NEXT X
200   GOSUB 1000
210   CLS
900   STOP
1000  REM STRING ROUTINE
1010  LET A=PEEK 16396+256*PEEK 16397
1020  FAST
1030  FOR B=1 TO 726
1040  IF PEEK (A+B) =118 THEN GOTO 1060
1050  LET D$=D$+CHR$ PEEK (A+B)
1060  NEXT B
1070  SLOW
1080  RETURN


300   FOR X=1 TO 673 STEP 32
310   PRINT AT 0,0;D$(X TO)
320   NEXT X


300 FOR  X=673 TO 1 STEP -32
```

Self-running program

I OWN a ZX-80 with the new 8K ROM, writes R Emery of Harrow, Middlesex. While experimenting one day, I put a line at the very beginning of the program which would Save it under a certain name. I started my tape recorder to record and pressed Run, Newline. The program then started to Save itself and once it had finished, it stopped where it started Saving.

The next time I wanted to load it, I went through the normal procedure, and was astonished to see that the program had run itself. This is quite useful for some programs and I hope useful to other readers. For example

```
SAVE "PROGRAM 1"
10 PRINT "THE PROGRAM RUNS ITSELF"
20 GOTO 10
```

This works with the 8K ROM so it should work with the ZX-81 and might also work with the ZX-80 with 4K ROM.

Inspecting the RAM

AFTER USING a CBM micro with 16K Basic, I found the Sinclair ZX-81 Basic deficient in certain respects, writes Christopher Clarke of Colchester, Essex. One shortcoming which is easily rectified is that of not knowing how much memory remains for program/variables/screen use. The following short machine-code subroutine may be placed above RAM-Top or, as I prefer, inside a Rem statement using the Basic loader.

```
10     REM AAAAAAAAAAAAAAAAAA
20     LET A = 16514
30     INPUT B
40     IF B = -1 THEN END
50     POKE A,B
60     LET A = A+1
70     GOTO 30
```

Enter these numbers:

```
237, 115, 54, 64    ld  (nn), sp
42,  54 , 64        ld   hl ,(nn)
237, 75,  28, 64    ld   bc, (nn)
237, 66             sbc  hl,  bc
pairs.
68,                 ld    b,  h
77,                 ld    c,  l
201 ,               ret

(-1 to end loader)
```

Now delete all lines except line 10 and put:

```
20 let bc = usr 16514
30 print bc
```

Simultaneous equations

I WROTE this code listing for the ZX-81 for solving simultaneous equations, writes John Allen of London SE18. The program asks for the number of rows and then the number of columns. Then the complete problem is entered in a row at a time and element by element in the row.

I do not know the size of the program but I feel that with a 16K RAM pack, it can solve up to 60 simultaneous equations with 60 variables. I have only been able to test the program with nine variables and nine equations and I found that the program took less than 30 seconds to solve the problem.

$$X_1 + 2X_2 = 4$$
$$X_1 - 2X_2 = 8$$

In this problem, there are two rows and three columns. When the number of rows and columns are input into the program, the data is input row by row.

```
5       DIM AUTHOR JOHN ALLEN
10      PRINT "SIMULTANEOUS EQUATIONS"
20      PRINT "INPUT NO OF ROWS"
30      INPUT R
40      PRINT "INPUT NO OF COLUMNS"
50      INPUT C
60      DIM A (R,C)
70      FOR H = 1 TO R
80      LET Y = A (H,H)
90      FOR I = 1 TO C
100     LET A (H,I) = A (H,I)/Y
105     NEXT I
110     FOR I = 1 TO R
120     IF I = H OR A (I,H)= 0 THEN GOTO 160
130     IF A (I,H) = 1 OR A (I,H) = - 1
140     IF A (I,H) > - 1 AND A (I,H) < 1 THEN GOSUB 3000
150     IF A (I,H) < - 1 OR A (I,H) > 1 THEN GOSUB 3000
160     NEXT I
170     NEXT H
500     FOR J = I TO R
510     PRINT "X"; J; "="; A (J,C)
520     NEXT J
530     STOP
1000    LET D = 1
1010    IF A(I,H) < 0 THEN LET D =-1
1020    FOR J = 1 TO C
1030    LET A (I,J) = A (I,J) - A (H,J) * D
1040    NEXT J
1050    RETURN
2000    IF A (I,H) = 0 THEN GOTO 2050
2005    LET Y = A (H,H) / A (I,H)
2010    FOR J = 1 TO C
2020    LET A (I,J) = (I,J) - A (H,J) / Y
2030    NEXT J
2040    RETURN
3000    LET Y = A (I,H)
3010    FOR J = 1 TO C
3020    LET A (I,J) = A (I,J) - A (H,J) * Y
3030    NEXT J
3040    RETURN
4000    FOR I = 1 TO R
4005    PRINT "INPUT ROW"
4010    FOR I = 1 TO R
4020    FOR J = 1 TO C
4030    INPUT A (I,J)
4040    CLS
4050    PRINT A (I,J)
4060    NEXT J
4070    NEXT I
4080    CLS
4090    RETURN
```

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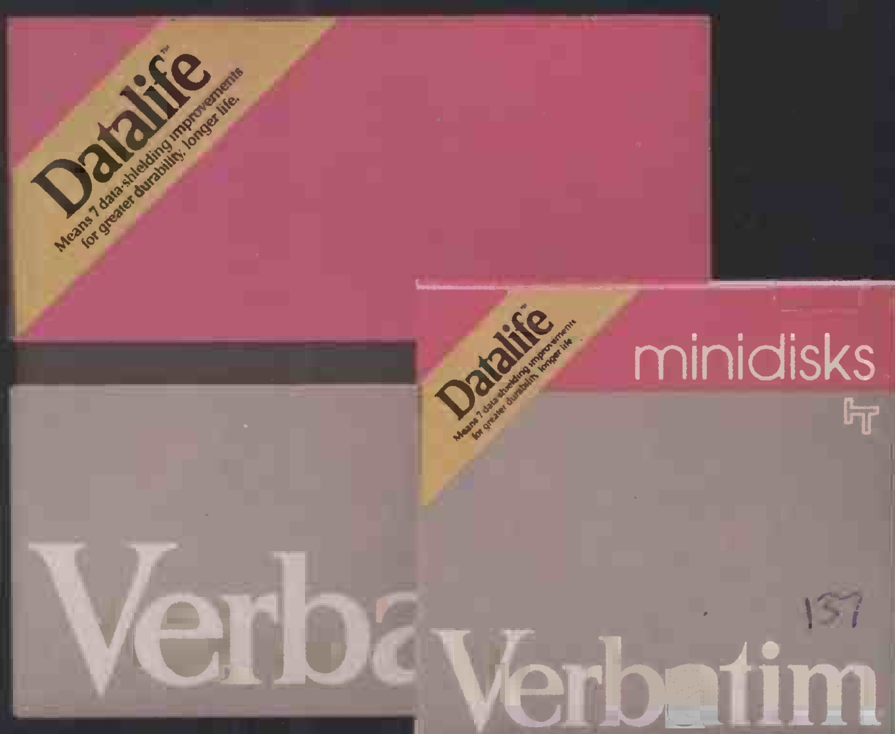

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Racing game

RACE IS a car-racing game from Nicholas Lloyd of Rottingdean, near Brighton. The aim is to complete one lap of the course as fast as possible without crashing.

To control the car you use the 8,2,4 and 6 keys to make the car go up, down, left and right respectively. The 5 key may be used as an accelerator. If you first press a key for the direction followed by 5, the car will proceed at an increased rate.

If you have a 3016 Pet then try Poke 59458,62, which has the effect of speeding up the program; to return to the normal speed, type Poke 59458,30. Do not use this on the 4032, as the only result will be to reduce the screen size to about four rows.

```
40 PRINT"]":POKE59468,14
50 PRINT"****************************************"
60 PRINT"***       **********          ******"
70 PRINT"**         *******             *****"
80 PRINT"*    *    *******    ********    ****"
90 PRINT"*    **     ****    **          ***"
100 PRINT"*     ***     ***    ***    ***********"
110 PRINT"*     ****    *    ****             **"
120 PRINT"*     ***    *    **************     *"
140 PRINT"*     **    **    **         ****    *"
150 PRINT"*     **    **    *           ***    *"
160 PRINT"*     **    **                  *    *"
170 PRINT "*      ***    *         *       *     *"
180 PRINT"*     ****    **    *** ****    *    *"
190 PRINT"*    ****    ********    ****   *    *"
200 PRINT"*     ***     ****    *         *    *"
210 PRINT"*     ****          ***         *    *"
220 PRINT"*      ****        *****        *    *"
230 PRINT"*       *************************    *"
240 PRINT"**        *******    π               *"
250 PRINT"***        *****     π              **"
260 PRINT"****        ***      π             ***"
270 PRINT"*****                π            ****"
280 PRINT"****************************************"
282 PRINT"          ▼RESS A ⁄EY■"
283 GETW$:IFW$=""THEN283
284 PRINT"]                              "
290 TIM$="000000"
300 A=33585
310 POKEA,35
320 IFPEEK(151)=42ANDPEEK(A-1)=42THEN400
330 IFPEEK(151)=42ANDPEEK(A-1)=32THENPOKEA-1,35:POKEA,32:A=A-1:B=-1:GOTO370
335 IFPEEK(151)=41ANDPEEK(A+1)=42THEN400
340 IFPEEK(151)=41ANDPEEK(A+1)=32THENPOKEA+1,35:POKEA,32:A=A+1:B=1:GOTO370
345 IFPEEK(151)=50ANDPEEK(A-40)=42THEN400
350 IFPEEK(151)=50ANDPEEK(A-40)=32THENPOKEA-40,35:POKEA,32:A=A-40:B=-40:GOTO370
355 IFPEEK(151)=18ANDPEEK(A+40)=42THEN400
360 IFPEEK(151)=18ANDPEEK(A+40)=32THENPOKEA+40,35:POKEA,32:A=A+40:B=40:GOTO370
370 IFPEEK(A-1)=94THEN390
372 IFPEEK(151)=34THEN374
373 GOTO320
374 IFPEEK(A+B)=42THEN400
375 IFPEEK(A-1)=94THEN390
376 POKEA+B,35:POKEA,32:A=A+B
377 IFPEEK(151)<>34THEN320
378 GOTO374
390 PRINT"]■IME■":PRINTMID$(TIME$,3,2);" \INS ";RIGHT$(TIME$,2);" ●ECONDS"
395 POKE158,0:END
400 POKE59468,12
405 PRINT"]■\                   |                   /"
406 PRINT" \                   |                 /"
407 PRINT"  \                  |                /"
408 PRINT"   \                 |               /"
409 PRINT"    \                |              /"
410 PRINT"     \               |             /"
411 PRINT"      \              |            /"
412 PRINT"       \             |           /"
420 PRINT"■     ▒▒▒▒  ▒   ▒   ▒▒▒   ▒▒▒▒  ▒   ▒ "
421 PRINT"     ▒      ▒▒ ▒▒   ▒   ▒  ▒      ▒   ▒"
422 PRINT"     ▒▒▒▒   ▒ ▒ ▒   ▒▒▒▒▒  ▒▒▒▒   ▒▒▒▒▒ "
423 PRINT"        ▒   ▒   ▒   ▒   ▒     ▒   ▒   ▒"
424 PRINT"     ▒▒▒▒   ▒   ▒   ▒   ▒  ▒▒▒▒   ▒   ▒ "
425 PRINT"■       /            |            \"
426 PRINT"       /             |            \"
427 PRINT"      /              |             \"
428 PRINT"     /               |              \"
429 PRINT"    /                |               \"
430 PRINT"   /                 |                \"
431 POKE158,0:FORG=1TO800:NEXTG:PRINT"]■■■■■■DO YOU WANT ANOTHER GO"
432 GETR$:IFR$=""THEN432
433 IFR$="Y"THEN40
```

Upgrading from Basic 3

CBM HAS released a new DOS for the Pet disc, DOS 2.1, which is fitted as standard to the 4040 disc. The 2040/3040 units can be upgraded by a retrofit set of ROMs which cost about £40. The upgrade is useful since it clears many of the problems associated with the original DOS. The relative file facility allows more flexible direct access without the problems of block commands and descriptor files. However, the Pet would need to be upgraded to DOS 4 to realise this facility. The price of this retrofit is the same as for the disc.

There are two ways to upgrade a new-ROM Pet with Basic 3, writes M J Valentine from Rotherham. There is the official ROM set and an independent manufacturer's ROM.

The official Commodore retrofit allows a Basic-3 machine to be upgraded to Basic 4. The main features of Basic 4 allow faster running and disc access without the use of DOS support or print#.

The shifted Run/stop allows a properly retrofitted system to load the first program from Drive 0 and Run. Basic 4 allows handling of relative files, which is mandatory with DOS 2.1. The snags of the retrofit upgrade are mainly due to changes in the main subroutine entry points.

The zero-page locations are similar to Basic 3, but the values are different in many cases, e.g.

Stop key disable	Enable
Basic 3 Poke 144,49	Poke 144,46
Basic 4 Poke 144,88	Poke 144,85

All Basic-3 programs will run on Basic-4 machines, but some modifications will be needed to Poke, USR and Sys. The Run/stop disable is the best example.

The big problems come with machine-code programs, e.g., Wordcraft, Invaders, Microchess, etc. which will not run. A Basic-4 version will have to be purchased at more expense. Toolkit and other system chips will have to be replaced.

Open4,4:CMD4:Sys1024 will not allow Tim to be directed to the printer. You must use

OPEN4,4: CMD4:SYS 54395

since Tim's location has been shifted. The upgrade to DOS 2.1 and Basic 4 therefore calls for re-purchase of a Toolkit and other firmware.

The second alternative to Basic 4 is to use a ROM which works by intercepting a command before Basic 3. Disk-o-Pro is one such ROM, but costs more than the official CBM retrofit set.

Disk-o-Pro has the advantage of allowing the use of all Basic-3 software, including Wordcraft, Toolkit and Invaders, and does not require re-purchase as the official kit does. All Basic-4 disc commands can be used if DOS 2.1 is retrofitted. Also included are extra commands, e.g., Print Using, which should have been included in CBM Basic.

For £57 you receive a chip which plugs into the $9000 ROM expansion socket. If a VisiCalc chip is present, then ROM expanders are available to allow several chips to be used. On power-up, the Disk-o-Pro chip must be called by Sys36864 to display

DISK-O-PRO (C) 1980 ROB CHANG
(C) 1979 PAICS

Toolkit is called automatically, if present. All the commands are available as well as the Basic 4. Disc commands include an execute command — the same as !0: program of DOS support — and scroll, which is very useful when dealing with program listings.

Kill will leave the Pet without Disk-o-Pro which is incompatible with other programs using the Chartgot area. However, all the commands may be in program or direct mode so that Disk-o-Pro may be activated by a Basic program.

(continued on page 143)

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142

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```
100 REM*     M  VALENTINE  16.6.81
110 REM
120 REM*     WORKS LIKE "D1=0" COMMAND TO DISK
130 REM
140 REM*     BLOCK 19 ON TRACK 18-24 CANNOT BE
150 REM
160 REM*     COPIED AND IS DUMPED ONTO PRINTER
170 REM
180 REM*     DO NOT USE THIS PROGRAMME TO COPY
190 REM
200 REM*     FILES WITH A DIRECTORY ENTRY
210 REM
220 REM*     USE FOR RANDOM ACCESS FILES
230 REM
240 REM*     ERROR # 22 READ ERROR WILL OCCUR IF
250 REM
260 REM*     DATA HAS NOT BEEN WRITTEN TO THE BLOCK
270 REM
280 REM*     THIS SHOULD BE IGNORED
290 REM
300 PRINT"   COPY DIRECT ACCESS FILES FROM 2040/3040 TO 4040 FORMAT"
310 PRINT
320 PRINT"PLACE DESTINATION DISK IN DRIVE 1"
330 PRINT
340 PRINT"PRIMARY DISK TO  DRIVE 0":GOSUB610
350 PRINT
360 PRINT"DATA ON DRIVE 1 WILL BE LOST":GOSUB610
370 PRINT
380 OPEN15,8,15
390 PRINT#15,"U:":PRINT#15,"I0":PRINT"I0";:GOSUB630
400 OPEN2,8,2,"#":ID$="":PRINT#15,"U1:"2;0;18;0:PRINT#15,"B-P"2;144
410 FORP=1TO20:GET#2,Q$:ID$=ID$+Q$:NEXT
420 PRINT"FORMAT DRIVE 1 "ID$;:PRINT#15,"N1:"LEFT$(ID$,18)","RIGHT$(ID$,2):GOSU
B630
430 CLOSE2:CLOSE15
440 FORT=1TO17:FORS=0TO20:GOSUB570:NEXT:NEXT
450 T=18:FORS=1TO18:GOSUB570:NEXT
460 FORT=19TO24:FORS=0TO18:GOSUB570:NEXT:NEXT
470 FORT=25TO30:FORS=0TO17:GOSUB570:NEXT:NEXT
480 FORT=31TO35:FORS=0TO16:GOSUB570:NEXT:NEXT
490 OPEN2,8,2,"#":OPEN15,8,15
500 FORT=18TO24:S=19:PRINT#15,"U1:"2;0;T;S
510 OPEN4,4:PRINT#4,"BLOCK TRACK"T"SECTOR"S" "ID$
520 PRINT#4,"THE FOLLOWING DATA CANNOT BE TRANSFERRED"
530 FORI=0TO254:GET#2,Q$:PRINT#4,Q$;:NEXT:PRINT#4,"END OF DATA"T","S
540 PRINT#4:CLOSE4:NEXT
550 PRINT#15,"I":GOSUB630:CLOSE2:CLOSE15
560 PRINT"DONE":END
570 OPEN2,8,2,"#":OPEN15,8,15
580 PRINT"COPY"T","S;:PRINT#15,"U1:"2;0;T;S:GOSUB630
590 PRINT#15,"U2:"2;1;T;S:PRINT"CHECK";:GOSUB630
600 CLOSE2:CLOSE15:RETURN
610 GETQ$:IFQ$=""THEN610
620 RETURN
630 INPUT#15,N$,M$,T$,S$
640 PRINT" = "N$","M$","T$","S$
650 RETURN
660 A$="@0:COPY BLOCKS":SAVEA$,8:SAVEA$,8:VERIFYA$,8
```

(continued from page 141)

Other snags include

- a 20 percent reduction in execution time
- tape #2 buffer cannot be used — the same applies to Basic 4 if disc in use
- Supermon, DOS support, etc. are incompatible
- after every disc operation the error channel is checked, unlike Pet Basic 4; this includes direct operations like Directory, Copy and Get#, which will cause a considerable delay if many Get#s are used.

Anyone considering upgrading to Basic 4 should consider Disk-o-Pro as a more economic alternative if Toolkit is being used.

As previously mentioned, to obtain the full benefits of Basic 4, the disc unit should have DOS 2.1 or 2.5. For about £40 you receive as set of four chips. Three are 24-pin and one is 40-pin.

CBM do not appear to have produced any directives on where to put the chips. The spare DOS expansion socket is used. DOS 2.1 will then cause automatic initialisation of Drive 0, the command only being required for direct access. The familiar noise of initialisation of DOS 1 is only heard if a problem occurs or on power up.

DOS 1 and DOS 2.1 are read-compatible but not write-compatible. When a disc has been formatted by the New or Header command, the DOS format is written to the header: 2a indicates DOS 2.1, a blank or 1 indicates DOS 1.

The duplicate command cannot be used to copy a disc DOS 1 to DOS 2.1 or vice versa. If an attempt is made to write to a 2.1 disc with DOS 1 then the error channel is not updated and will crash.

To transfer data from DOS 1 to DOS 2.1 is simple. The program Copy Disc Files supplied by CBM on the demonstration disc is useful as long as the destination disc is Newed before copy is attempted. Copy can be done in the direct mode using Basic 4 and Basic 3, with or without DOS support. In Basic 4,

```
HEADER "DISK NAME", D1, I(ID)
COPY D0 TO D1
```

In Basic 3,

```
OPEN15,8,15:PRINT#15, "n1:disk name,id"
PRINT#15, "C1 = 0"
```

With DOS support,

```
>n1:disk name, Id
>o1 = 0
```

This will work on the upgraded disc, providing that the files have a directory entry. It will not copy a direct-access file written by a b-w or u2 command.

There is no facility to transfer files directly. Another problem is that on tracks 18 to 24, block 19 does not exist in DOS 2.1, otherwise a block-for-block transfer would work. This problem occurred with a mailing-list file. The program Copy Blocks is a partial solution which prints out the uncopiable blocks. The result is a compatible disc without six blocks of data.

The direct-access disc is usually drive 1, and a descriptor file is usually in drive 0. If a missing block is called after transfer over then a No Block or Illegal t/s error will occur. If the program can be listed, the appropriate modification should be made or the descriptor file modified. In any case, a direct-access disc file should be replaced by a relative file with the appropriate program modifications to take full advantage of DOS 2.1 and Basic 4.

The other problem that was encountered is that Block Write is not available with DOS 2.1. The manual suggests replacement with the u2 command, but you will have to check the buffer pointers, and the commands may have to be modified.

Closure test

IN MOST programs it is desirable to test the keyboard for the closure of a particular key, either in response to a menu page or just to advance to the next page of text. T. P. Brown of Bath has sent a simple common subroutine which does the job.

You should set the following variables before calling:

KP;— = 0 — return on any key
= 1-9 — return on any of the number KP of keys defined in KP$
KP$(1)-(9);— Keys on which to return.

You call the subroutine with Gosub 10000, and should test with the two call routines.

```
100 REM ******************************
110 REM * CALL ROUTINE (1)
120 REM ******************************
130
140 PRINT" PAGE ONE"
150 PRINT"   HIT A KEY"
160 KP=0:GOSUB10000
170 PRINT" PAGE TWO"
180 END
190
200 REM ******************************
210 REM * CALL ROUTINE (2)
220 REM ******************************
230
240 KP=3:KP$(1)="1":KP$(2)="B"
250 KP$(3)=CHR$(13):GOSUB10000
260 ONKPGOTO280,290,300
270 GOTO240
280 PRINT" YOU HIT KEY 1" :GOTO240
290 PRINT" YOU HIT KEY B" :GOTO240
300 PRINT" YOU HIT RETURN":GOTO240
310
10000 REM ***************************
10010 REM * MAIN ROUTINE
10020 REM ***************************
10030
10040 POKE158,0
10050 GETA$:IFA$=""THEN10050
10060 IFKP=0THENRETURN
10070 FORI=1TOKP
10080 IFA$=KP$(I)THEN10100
10090 NEXTI
10100 KP=I:RETURN
10110
10120 REM ***************************
10130 REM *FOR OTHER THAN C.B.M. BASIC
10140 REM *USE IN LINE 10040
10150 REM * 'FORI=1TO10:GETA$:NEXTI'
10160 REM *THIS IS FOR A 10 CHR BUFFER
10170 REM ***************************
```

New champions of the labyrinth

by Nick Smith

IN WHAT has been rightly described as an amazing triumph, Thumper and Sterling Mouse — first and second in the British heat — trounced the best of the rest of Europe in the Paris final. However, Thumper's days as champion may already be numbered — plans for next year's heats at the London Computer Fair, April 23, 24, 25 and Micro-Expo in Paris in June. The European final will be held in Haifa in Israel — and there is talk of a world final in London in September.

In case you are not sure what the competition is about, here is a brief resume of the rules. The objective is to build a self-contained robot — otherwise known as a mouse — which can reach the middle of a maze. The maze used for the London final is shown in figure 1.

The start is always at the bottom left-hand corner with the mouse pointing north. The finish is always the centre four squares, though the position of the entrance to the centre and the hole for recovering exhausted mice can both be moved. A mouse has 15 minutes to make as many runs as it can from start to finish; the fastest run is recorded and the fastest mouse wins.

Handling mice is allowed but the judges take a dim view of it. An unhandled mouse will always beat a handled mouse regardless of the times.

The maze is based on a 16-by-16 grid of 18cm. squares — overall about 9ft. square. Walls are 5cm. high and 12mm. thick. The walls of the maze are built out of 18cm. long pieces plugged into the base so that the design of the maze can be, and is, changed from day to day. The individual walls have a tendency to lean in random directions and occasionally there are slight gaps at the joints — beware.

The base is made of several pieces of smooth black-painted chipboard. Joints tend to run along the middle of passages and steps and gaps of up to 2mm. are not unknown — beware of tiny wheels and skidding.

The mice must be entirely self-contained — no trailing wires, no remote control. Maximum size is 25cm. by 25cm. with no height limit. Damaging or marking the maze is not allowed, although you might be allowed a ball of string. There is a limit of one Newton on the force a mouse exerts on any wall.

The current state of the art can be seen from the 1981 Paris final. Despite hundreds of entries — more than 300 from Britain alone — only about 13 mice competed. Of these, only eight reached the middle of the maze in practice. Alan Dibley of Cheddar had the distinction of owning two of them: Thezeus — about 12 minutes — from the London heat and a new, faster mouse Son of Thezeus — 2 minutes 49 seconds. Thumper finished in 1 minute 15 seconds, and was the leading qualifier. As the 1980 champion, my own mouse Sterling was included in the eight finalists and Thezeus was eliminated.

As always seems to be the case, the mice were dogged by electrical and mechanical problems. One exception was Kim, a French mouse which is memorable as the only three-wheeler I have seen. Just like a child's tricycle, the front wheel is both driven and steered. At the French heat in May, it had electronic wall-sensing. At the final it had a large roller sensors about 2in. wide protruding on each side and another one in front. These were carved out of polystyrene and ran on the tops of the walls.

Steering was controlled by a micro-switch on each side at the front. Unfortunately, Kim's brain could not work out how to pass the first two traps in the maze. After circling for about 10 minutes, Kim was withdrawn.

Sterling Mouse ran next, managing a very pleasing time of 68 seconds. Sterling is running about three times faster now than it did last year.

Minitaurus from Tampere University of Technology of Finland then entered the maze. The crowd literally gasped when it started because of its incredible acceleration from rest. Minitaurus is very fast and uses infra-red sensors all round for short-distance, accurate sensing, and sonar on the front for long-distance detection so that it can stop before it hits a wall.

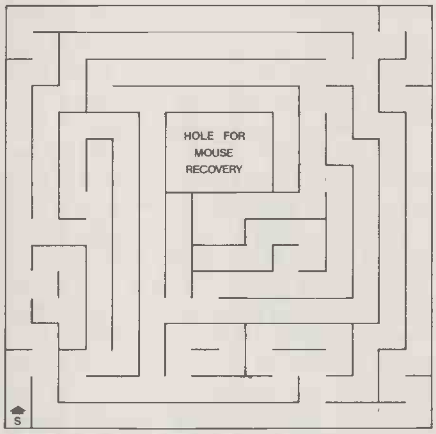

Figure 1. The London maze.

I had heard that maze-solving was not the forte of Minitaurus because it tends to run in long straight lines ignoring likely side turnings. I now realise what it was doing. Like Kim in the French heat, Minitaurus cannot stop in time to turn when it detects a side opening in a previously unexplored passage. Most mice, therefore, run slowly while exploring and stop to decide where to go at each junction: Minitaurus does the opposite.

It goes as fast as possible from corner to corner — where it has to stop anyway — remembering but ignoring side turnings. At each corner Minitaurus decides whether to continue or back-track to a side opening it has passed. Obviously, once you know where a side turning is, there are no stopping problems.

Minitaurus is fast and covers more ground than other mice during exploration but takes a worse initial route to the middle. This explains its poor first run time of 5 minutes 40 seconds. Minitaurus then started playing up. When it was finally coaxed into a second run, it seemed to be following the shortest route to the middle but the Finns withdrew it for some unknown reason, when it was about two-thirds of the way there.

With only Thumper left to run, Sterling was still the fastest mouse in Europe with Minitaurus the only other mouse to attain the middle in the finals. Thumper started as smoothly as ever and arrived at the middle in about two minutes. Thumper's second run was again slower than Sterling's best, but my defeat seemed inevitable — then Thumper suddenly stopped dead. With rising spirits, I watched Dave Woodfield and Arthur White of GKN Technology prod Thumper and carry it back to the start. Whatever happend now, Britain was first and second.

Sadly for me, Thumper re-started and ran the shortest route in an astonishing 44 seconds to become the new champion. Credit must also go to Andrew Keatley of Allen-Martin Electronics who wrote Thumper's software.

One of the more disappointing aspects of the competition was the lack of successful amateurs and young competitors. If you have any ideas on how to make the competition more open to amateurs, and how to separate the amateurs from the professionals, write in to the Micromouse page. One idea is to double the width of the maze passages and eliminate dead ends to make model-car approaches viable.

Practical Computing is also looking for ideas for chassis design and simple sensors. Remember, you receive £5 for each idea or tip published. So far, there is no definitive mouse design so anything new could be a winner. When Dave Woodfield and I were talking after the competition, we agreed a new approach was needed. Look out for at least one bicycle next year.

For an entry form and a full set of rules, write to: Dr John Billingsley, Department of Electrical and Electronic Engineering, Anglesea Building, Anglesea Road, Portsmouth PO1 3DJ.

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Right ascension: Declination: Phase: Apparent magnitude (brightness)
Distance from the Earth; for any date or time 1975-2001 incl.
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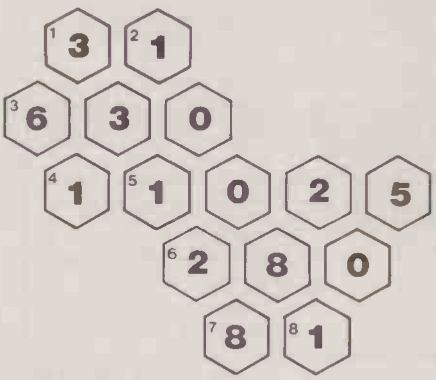
Knight's gambit

THE GRID represents one-quarter of a chess board. A knight starts on any white square, and moves in normal knight fashion until it has visited each and every white square.

As it moves, it creates a running sum, for instance $5 \times 1 \times 6 \times 3 - 8 + 2 - 7 + 4 = 81$. Negative and fractional results are not allowed. What is the lowest score possible and how is it obtained?

×	5	−	1
3	÷	2	+
÷	7	×	8
6	+	4	−

The solution to October's money puzzle



An introduction to computer programming and data structures using Macro-11

By Harry R Lewis. Published by Reston. £19.20.

IT IS unusual these days for an introduction to programming to use an assembler-level language; this book uses that for the popular PDP-11 range. It is not an *ab initio* primer; it is aimed at those with some elementary programming knowledge.

The approach is similar to introductions to programming in high-level languages in that it takes a small logical group of instructions and explains their use with numerous examples. Where it differs is in that data storage and addressing are considered before any instructions are introduced — a consequence of using a low-level language.

However, for an introduction it goes into the various addressing modes too soon and too rapidly, which is likely to lead to confusion. Apart from that, the rest of section 1 is a clear description of the elements of Macro-11 without attempting to be exhaustive, as it is intended to be used with the language reference manuals.

As this book was written by a university lecturer, the examples are from a Unix operating system environment — consequently some of the Macros used will differ from those used by the DEC operating systems. The principles remain the same, however.

Considering the limitations of space in section 2, this book has been remarkably wide-ranging in its coverage of data structures. Not only does Harry Lewis cover all the common data structures including linked lists, trees and hash tables, he also manages to discuss language-syntax specification. This is discussed along with parsing and code generation in a superficial way as a basis for the programming projects in the third section.

The programming projects are for such system software as text editors, assemblers and compilers, and are obviously limited in scope. They consist of a common format of a definition of requirements which are built, piece by piece, into a functional specification at subroutine level. The reader is then left to complete the program.

Although there are exercises throughout the book there are no answers. This only emphasises that the approach of the book is designed to be worked through with the aid of a tutor. That said, a programmer experienced in another language, preferably low-level, would find this book a useful introduction to Macro-11.

Conclusions

- **As a basic introduction to programming or computers it is not ideal. For someone with some experience, it would be a good first step into Macro-11.**
- **With Macro-11 also being the language of the LSI-11 range, it is of interest to the microcomputer programmer.**

Martin Wilson

Personal Computers Handbook

By Walter H Buchsbaum, published by Sams. U.S. $11.95; U.K. £7.75. 286 pages paperback. ISBN 0-672-21724-4.

ONE WOULD have expected a book with a title like *Personal Computers Handbook* – whatever it means — from the powerful Sams stable to be an outstandingly useful treatment of the 1980s hobbyist's darling. One would be disappointed.

True, there is plenty here, from baby hardware theory to a sophisticated treatment of software — but it never seems to gel into a coherent whole. Dr Buchsbaum tends to skip around among his chosen topics without any obvious direction, without alighting for long on any one flower — however full of nectar — without drawing meaningful conclusions at any stage.

Perhaps that is what a handbook is — a work of reference in which one expects no more coherence than a bedside reader after a few pages of which one can rest easy? The task of reading it took me many more days than I expected, and I ended up with continued mixed feelings.

It is directed at "readers who have a working knowledge of electronics and are interested in learning more about personal computers". Both parts of that quotation from the preface imply that this is not a book for beginners. It can be technical, but qualitatively rather than quantitatively. In other words it details what can be done, but not how to do it.

There are plenty of home-grown texts available which cover the micro better than this book. They may not be more up-to-date, or even more detailed — but they do follow a coherent line and keep a uniform level. I can foresee that I shall have occasion to use this book for reference — but keep it to hand? — no.

Conclusions

- **A good, solid acount, mainly of hardware. It does not, however, draw together to a readable whole.**
- **Not for the beginner keen to develop elementary knowledge, nor for the advanced micro user aiming to break new ground. For the rest, it is of some interest, but best first compared to other titles in the bookshop.**

Eric Deeson

Apple Basic for business for the Apple II

Parker and Stewart. Published by Reston.

THIS BOOK sets out to teach Apple Basic by using examples drawn from business. The examples and problems are based on either payroll or stock systems and are built up stage by stage as the necessary facilities are introduced.

The book moves along steadily with comprehensive descriptions of each new concept. By the fourth chapter, files are in use, something most books leave until the later chapters. Sub-totalling and control breaks are introduced in chapter five, while file matching is discussed in the next two chapters. From chapter nine onwards, we are in strange territory as far as introductions to Basic are concerned — direct-access files.

Subsequent chapters deal with graphics and the different forms of business systems. All topics are explained in a clear and concise manner which is very readable and there are the usual appendices of error codes and instruction formats. Also included is a very useful sort program which assumes disc files are in use, as do all the examples.

Each chapter has a summary at the end which provides a useful reference to formats and to techniques. There are also problems to test understanding of the topics introduced in the preceding chapter but unfortunately no solutions are given. This is something of a problem for this type of book as there is no one correct answer. Some guidance should be given to ensure that there are no misunderstandings which re-reading the chapter will not resolve. Strangely, for many of the programming problems there is a ruled page for the solution which is rather unnecessary — it looks suspiciously like padding.

No book, not even this one will turn the novice into a fully-fledged commercial programmer particularly as they all seem to be rather light on data validation and security. This book covers the trapping of some data errors but not enough to enable the reader to produce programs which will not be tripped up by errors in data entry.

Back-up copies of files are mentioned but no guidance is given as to when they should be made. The reader who studies this book conscientiously will be rewarded with a good foundation on which to build by experience and further study.

Any Apple user or, for that matter, anyone requiring an introduction would do well to consider this book — it will certainly be recommended by me.

Conclusions

- **This book is very readable and accurate with well-chosen examples. It is one of the best introductions to Basic I have seen and I will certainly use it.**
- **The approach is not novel but is rather more consistent than most and provides a thread of continuity which this kind of text needs.**
- **If you are looking for a book on Apple Basic, this is probably the only one you will need.**

Martin Wilson

● Circle No. 195

Wynford and Jane James continue their series on portable graphics with a program which can be used in a variety of adventure games.

Maze-making subroutines

MANY GAMES require a subroutine which makes a maze to provide a variable background against which a battle can be fought or a chase can take place.

The various adventure games are in essence, maze games. The major difference is that in an adventure where you successfully go west across the Lava Sea, there is no guarantee that the reverse journey is possible. In a standard maze, the player who wanders into a dead end at least has the option of back-tracking.

This article describes a program which first generates a maze of random dimensions. It then displays a perspective view of the maze as the player searches for the exit.

The maze-creation routine, and a second routine which draws a map of the maze, are written so that they will run on any micro which has a memory-mapped display and supports Peek and Poke. The only changes required are to two lines in the initialisation routine.

The three-dimensional view of the maze requires several common graphics symbols: the horizontal, vertical and diagonal lines, and the four "corner" symbols. These symbols are certainly available on the Pet, UK-101, Sharp MZ-80K and Superboard, and probably on most other popular micros too. The only change you may need to make in this part of the program is to substitute the symbols in your character set for those in the program — just three line changes. If your micro has a Plot command you will have to re-write this routine, but you should be able to simplify it considerably.

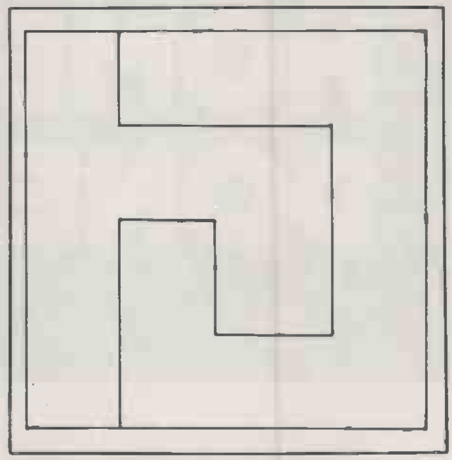


Figure 1. Maze with a dead end.

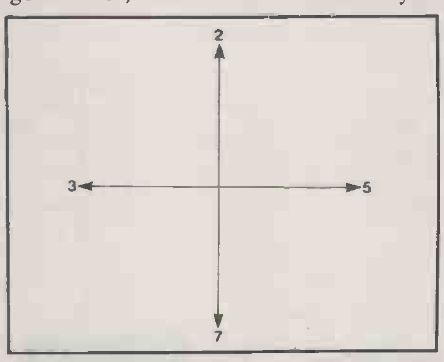
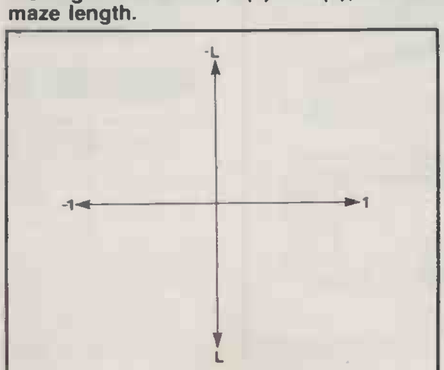


Figure 2a. The four prime numbers which indicate walls W(0) to W(4).

Figure 2b. The change in cell number on moving to a new cell, M(0) to M(3); L is the maze length.



You may be looking sadly at your minimal memory configuration, thinking that this article cannot be for you. Let us reassure you — it was written on a 4K-RAM Superboard-II. If you have more than 4K of memory, you should be able to produce a full-blown adventure using the program as a basis.

Two main problems have to be overcome when creating a maze. Firstly, you must ensure that all parts of the maze are accessible from all other parts. There must be no "closed circuits" — see figure 1 — otherwise the effective size of the maze will be reduced and memory wasted preserving unused portions.

Secondly, you have to be able to record the number and position of the walls in each cell in order to store the layout of the maze — see figure 2.

We chose to indicate a wall in each direction by the prime numbers 2, 3, 5 and 7. Initially all cells are given a value of 210 — equal to $2 \times 3 \times 5 \times 7$ — which indicates a wall in every direction.

Other possible wall arrangements can be stored as multiples of the relevant prime numbers. For example, a cell with walls only at north and south would be given a value of 14 — equal to 2×7.

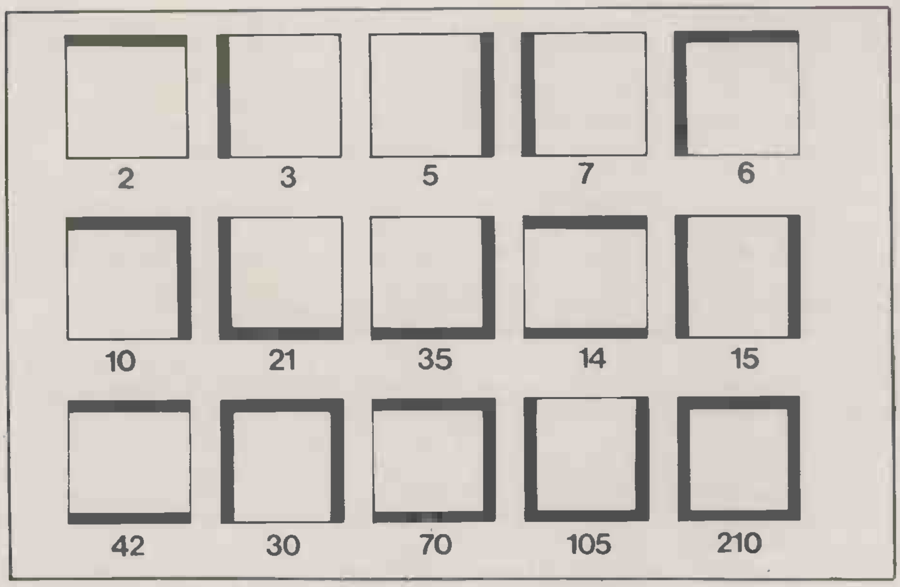


Figure 3. Cell values for each of the possible wall arrangements.

Figure 3 gives all the cell values and the wall arrangements they indicate.

Lines 500 to 595 create the maze. This part of the program is short but not very fast, so the maze is created while instructions are being given in subroutine 900.

Subroutine 900 also carries out the initialisation. Line 950 must be changed: it gives the memory locations of the top left, top right, bottom left and bottom right of the screen memory — TL, TR, BL and BR. It also sets the line length LL, the depth of wall DW, and the cell depth CD.

Obviously LL should be set to the line length of your own micro. The depth of wall DW is the number of pixels to be used to draw each cell wall. The cell depth CD is a necessary limiting factor due to the lack of high resolution on our micro. When a certain number of cells of diminishing size have been drawn to give the illusion of perspective, the centre of the screen is reached. There is clearly no point in trying to go further and attempting to display more cells.

The procedure is easier to follow if you look at the values used in the program. Although the line length LL for the Superboard is 32, the screen memory has an actual line length of 25. With a depth of wall of three, and a cell depth of four, the maximum possible display of left-handed walls uses four sets of three pixels = 12 pixels. The right-hand walls use another 12 pixels, so the perspective display of four maze cells uses 24 pixels altogether. As the screen has a line length of 25, this leaves a single, blank pixel at the centre of the screen to suggest the limits of vision — see figure 4.

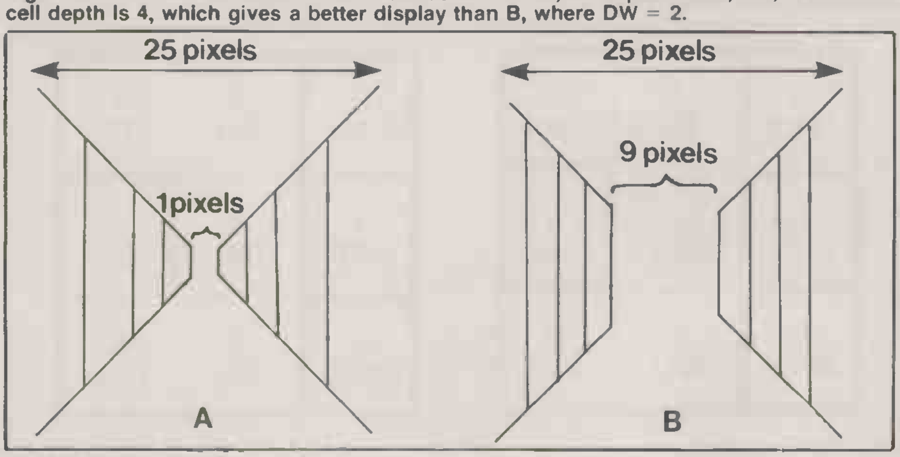
You will have to choose values of DW and CD carefully to get the best display. An important factor to consider is the possible longest length of a corridor in the maze. There is no point in setting CD to 8 if most mazes have dimensions of less than eight cells. The program as written varies the length L and width W of the maze between six and 10 cells. If you want to adjust this, change line 960.

As already stated, all cells are given an initial cell value of 210 to indicate four walls. In early versions of the program the values for each cell were stored in an array. However, each element in an array uses four bytes in the Superboard memory. A 10-by-10 array takes up 400 bytes, which is a large chunk out of a 4K RAM.

As all cell values are 210 or less, they can be Poked as single bytes into memory.

(continued on next page)

Figure 4. Two views down the same 10-cell corridor. In A, the depth of wall, DW, is 3 and the cell depth is 4, which gives a better display than B, where DW = 2.



(continued from previous page)
Using this technique, a 10-by-10 maze needs only 100 bytes.

You will have to store the maze in an area of RAM unlikely to be taken up by the program. Line 995 gives the memory location SM for the start of the maze. You should change it to a suitable value for your own system.

The remainder of subroutine 900 generates a random starting point P within the maze — line 995 — and also an exit cell EC and a map cell MC — line 1000. In the map cell, the lucky explorer can find a map of the maze with his own position shown by a man — symbol W4 on 955.

The scenario for the game is described in lines 900 to 945. The player has landed on an alien planet while fleeing from enemies, and has sought refuge within the maze. He is wearing a space suit and must find a way out of the maze before his limited oxygen supply expires. The oxygen supply OX plus its rate of loss OL are randomly determined in lines 1010 and 1015. While the player is digesting this information, the maze is created in subroutine 500.

Beginning at the cell P within the maze, the program moves in a random direction. Cells in all four directions are examined successively until an un-visited cell adjacent to the present position is found — lines 510 to 570.

The new cell number is found by adding the correct movement increment M(0) to M(3) — figure 2 — to the present cell number, line 540.

Each time the program moves from one cell to another, the wall in the direction of movement is eliminated by dividing the cell value by the corresponding wall value W(0) to W(3). This operation has to be done twice: the present cell value CP is divided by the appropriate wall number W(A) on leaving the cell; and the cell value after movement CM must also be divided by the number for the wall through which it was entered, line 580. See figure 5 for example.

This random progress through the maze continues until a point is reached where movement in any direction only leads to cells which have already been visited. In early versions we allowed the program to continue from such a position, but this resulted in mazes consisting mostly of empty spaces.

It might seem that the simplest solution would be to generate a new path from another random cell. However, this neglects the problem of closed circuits already discussed, and the new path might never join the old one.

The best way to ensure that all paths join is to begin any new path from somewhere along the old path. When the program gets stuck in cell P, line 500 increments P and checks whether there is then a virgin cell next to one already visited. If not, it goes back to 500 and increments P again. For example in figure 5 the program will be stuck in cell 5 after the last diagrammed position. Incrementing P gives cell 6, and as this is an un-visited cell adjacent to the path, the new path would begin from cell 7 to cell 6.

Some checks have to be included because certain movements are forbidden at the maze edges. Line 540 guards against moves off the top or bottom row of the maze. Line 570 prevents the program falling off the sides. For example, in figure 5, although adding 1 to the cell is normally allowed, the move from cell 5 to cell 6 is prohibited because 5 is an edge cell.

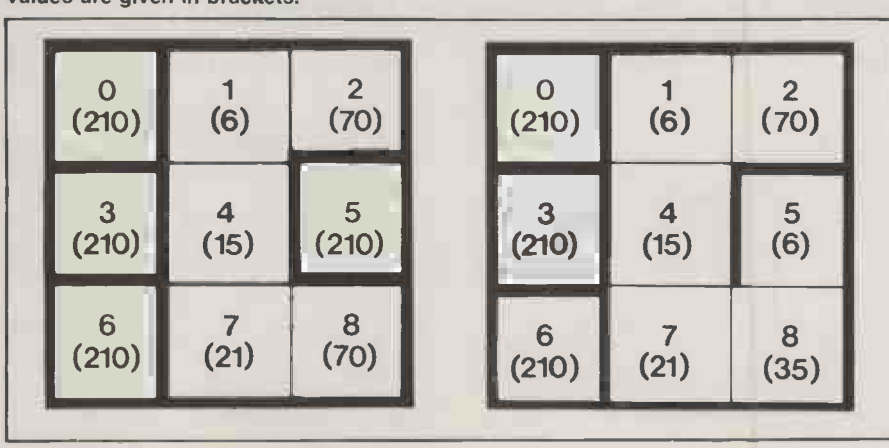
A count C is kept of the number of cells visited. When all cells have been used in the maze the subroutine terminates.

Between two and three cells per second are generated. On average, a 10-by-10 maze takes about 50 seconds on the Superboard, but the time taken is very variable.

Subroutine 600 draws a map of the maze. To make this as universal as possible the only graphics symbol used here is the one with the whole pixel filled.

A wall in any direction is shown by three of these symbols. Because adjacent cells share a wall in common, the maze in figure 5 would use seven pixels horizontally and seven pixels vertically.

Figure 5. Generation of a maze. In diagram A the program has moved through the cells 2-1-4-7-8. The program can only move to cell 5, as in B, since it must always visit new cells. Cell values are given in brackets.



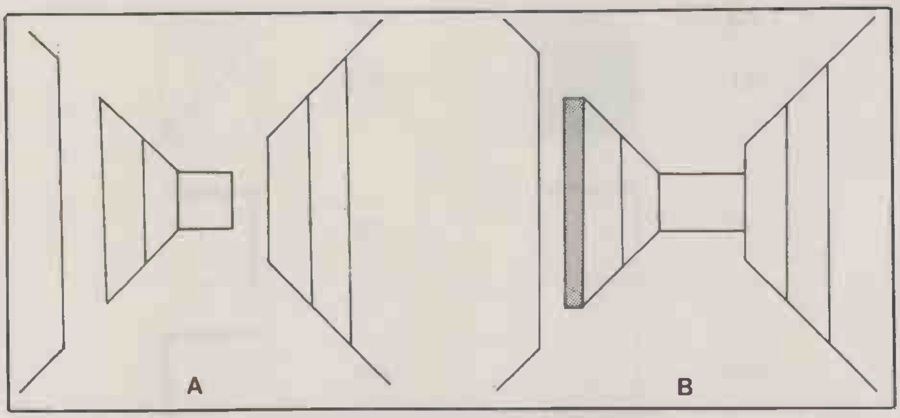


Figure 6. Two views of the same corridor. Display B includes fixes to improve appearance.

The size of the maze that can be displayed obviously depends on the dimensions of your screen display. A maze of side n cells requires 2n + 1 pixels. The maximum size maze that can be shown with 40 characters per line and 25 lines is 19 by 12.

If you enjoy finding your way through a maze against the clock you can use the subroutines 500 and 600 alone, without the perspective view. You will have to add a few lines to enable you to move within the maze. Your starting point can be cell number zero, and the end cell the last cell, number H.

A large maze takes some time to generate, but there is no need to wait while later mazes are prepared. Once a map of the maze has been displayed, the maze stored in memory is no longer needed. With some re-writing, a new maze can be created while you are finding your way through the one shown on the VDU.

If you have no graphics the maze can still be explored, although it is rather difficult "blind". Each direction of movement M(0) to M(3) is associated with movement through a particular wall W(0) to W(3). If the cell value is divisible by the array value W(A) a wall is present in that direction and movement that way is not possible. Otherwise, with no wall, the cell number is incremented by the array value M(A) and the new cell is entered. Checks for walls are used several times in the program — see lines 105, 120 and 160.

The perspective view is calculated by the subroutine 70 to 110, which also calls the drawing subroutine 10 to 60.

The first cell to be drawn is the one in which the player is currently standing. The left-hand side of the cell is examined first to see if there is a wall present and, if there is, it is drawn — line 100. If there is no wall you will be able to see into the cell on the left. Lines 110, 120 calculate the left-hand cell number and examine that cell for a back wall, such a wall then being drawn if necessary.

The same method is used to show the right-hand side of the cell, but with a few variables changed. There is thus a loop from 80 to 140 which is run through twice, first drawing the left side and then the right side. Line 140 shifts the corners in, ready for the back wall or the next cell to be drawn.

Once both side walls have been drawn, line 160 checks for a back wall. If no back wall is present, line 170 changes the cell number 0P to that of the next cell in the direction we are looking. This same line also increments the depth-of-cell count DC and checks that this does not exceed the greatest possible cell depth CD.

If at any time a back wall to a cell is found, lines 200 and 210 draw this back wall, and the subroutine ends. Lines 180 to 190 are a fix to improve the appearance when there is a back wall next to a cell with no back wall. Line 20 in the drawing subroutine is another fix which gives a more solid look to walls seen end on. Figure 6 shows the same view with and without the fixes.

Lines 240 to 440 enable the player to explore the maze. At the start, no view of the maze is shown. After a time TT a torch will be found, and thereafter the view will always be drawn. Line 430 clears the screen and calls the drawing subroutine. During the initial period of blindness it is possible for the space suit to be damaged, in which case the player may suffer a faster rate of oxygen loss, lines 300, 310. The same fate can overtake anyone foolish enough to blunder into a wall which can be seen.

Four commands are available via Input statements or, alternatively, by keyboard control — lines 250, and 320 to 340.

The player may turn right, left or opposite his present viewing position, but he will remain in the same cell — only the view will alter. Movement is always forwards — in the direction the player is currently facing. The commands are abbreviated to R, L, O and M respectively.

The exit cell has no view beyond it if you are looking directly at it. Once you arrive at the exit cell you automatically escape.

Figure 7 lists the graphics symbols used to draw the perspective view. You should make appropriate substitutions in lines 70, 80, 90 and 960.

With our limited memory we were unable to add all the embellishments we

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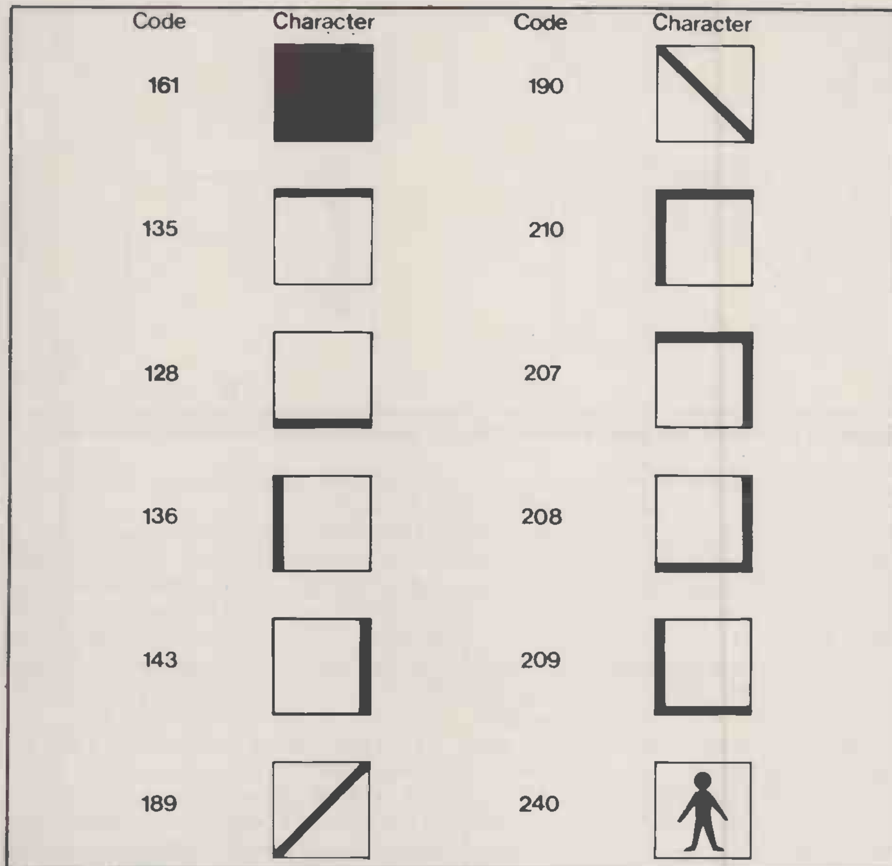

Figure 7. Character codes and graphics symbols used in drawing a maze.

(continued from previous page)

would have liked, but here are a few suggestions to improve the basic game:

- Add a monster which pursues the player through the maze. The monster can move at random initially, but if the player does not escape within a certain time limit, it should begin to move faster and more purposefully as it detects an intruder in its lair. Some cells might contain useful objects — if the creature is radioactive its direction could be indicated by a "geiger" compass, and the intensity of radiation could indicate its distance from the explorer.
- One cell could contain a blaster with a limited charge. The blaster could be fired at the monster in a moment of desperation, or it could be powerful enough to demolish one wall of the maze. The demolition is easily accomplished by dividing the cell value by the array value W(A) in the corect direction. A cunning explorer could blast his way out of the maze if he correctly divined that he was near an outer wall.
- Further traps could be set for the unwary. The map drawn by subroutine 600 might be displayed upside down or reversed; minions of the monster could seize an unlucky explorer and delay his escape; some cells in the maze might be entrances to even more dangerous areas.

It is very easy, when entering a program as long as this one, to make a mistake which becomes difficult to identify. We suggest that you enter this program in sections so that each part can be run to ensure that it is correct. Initially, enter subroutines 500 and 900, and add this line:

```
1029 FOR A= SM TO EM: B=PEEK(A):
  PRINTB;: NEXTA
```

A series of numbers representing the maze will be printed out: all such numbers should be members of the set shown in figure 3.

Next, add subroutine 600 and the line:

```
380 GOSUB 600
```

The maze should be drawn with an exit somewhere along the top. The remainder of the program can now be entered and run.

If you find yourself hopelessly confused and lost after only a few moves, we suggest that you display the map drawn in subroutine 600 at the start, so that you can try to memorise the route out. Line 435 gives the player one look at the map only — it is presumed to be displayed on a VDU which burns out after this brief use. The map can be examined many times if line 435 becomes:

```
IFP=MC THEN GOSUB 600
```

Finally, those with good graphics facilities should be able to draw objects on the floor of a cell. They can be given the correct relative size by referring to the current corner values for the cell, M(4) to M(7). It certainly adds atmosphere if an explorer stumbles across the occasional skull or rib-cage.

```
5 GOTO900
10 Y=PEEK(TC-U):Z=PEEK(TC-U+LL):IFABS(U)=1ORDC=0THEN30
20 IFY=32ANDZ=32THENFORA=TC-U+LLTOBC-V-LLSTEPLL:POKEA,W3:NEXT
30 POKETC,TW:POKEBC,BW:B=B+1:IFB<DWTHENTC=TC+U:BC=BC+V:GOTO30
40 IFABS(U)=1THENPOKETC,T1:POKEBC,B1
50 IFTC=BC-LLTHENRETURN
60 FORB=TC+LLTOBC-LLSTEPLL:POKEB,SW:NEXT:RETURN
70 F=ML:U=LL+1:V=1-LL:T1=207:B1=208:SW=143
80 FORX=4TO6STEP2:TW=190:BW=189:B=0:IFX=4THEN100
90 F=MR:U=LL-1:V=-LL-1:SW=136:T1=210:B1=209:TW=189:BW=190
100 LM=M(F):LD=W(F)
101 IFF=3ANDOP=ECTHEN140
105 IFQ-LD*INT(Q/LD)=0THENTC=M(X):BC=M(X+1):GOSUB10:GOTO130
110 TW=135:BW=128:U=U-LL:V=V+LL:N=PEEK(OP+LM)
120 IFN-D*INT(N/D)=0THENTC=M(X)+DW*LL:BC=M(X+1)+DW*-LL:GOSUB10
130 IFABS(U)=1THENU=U+LL:V=V-LL
140 M(X)=M(X)+DW*U:M(X+1)=M(X+1)+DW*V:NEXT
150 IFM=3ANDOP=ECTHENRETURN
160 IFQ-D*INT(Q/D)=0THEN180
170 OP=OP+M(M):Q=PEEK(OP):DC=DC+1:IFDC<CDTHEN70
175 IFDC=CDTHENRETURN
180 R=PEEK(M(4)-1)
185 IFR=32THENM(4)=M(4)-1:M(5)=M(5)-1:IFM(4)<>TL+DW*LLTHEN180
190 R=PEEK(M(6)+1)
195 IFR=32THENM(6)=M(6)+1:M(7)=M(7)+1:IFM(6)<>TR+DW*LLTHEN190
200 FORTC=M(4)TOM(6):POKETC,W1:NEXT
210 FORBC=M(5)TOM(7):POKEBC,W2:NEXT:RETURN
240 PRINTOX;" UNITS OF AIR"
245 PRINT"ACTION";:INPUTA$
250 NP=P:Q=PEEK(P):IFA$="M"THENNP=P+M(M)
260 IFNP=PTHEN320
270 IFNP=ECTHENPRINT"YOU ESCAPE!":END
285 IFQ-D*INT(Q/D)<>0THENP=NP:PRINT"YOU MOVE":GOTO380
300 IFRND(1)>.9THENPRINT"YOUR SUIT RIPS WHEN ";:OL=OL+1
310 PRINT"YOU HIT A WALL":GOSUB3000:GOTO410
320 NM=M:IFA$="R"THENNM=M+1
330 IFA$="O"THENNM=M+2
340 IFA$="L"THENNM=M+3
350 IFNM=MTHEN240
360 IFNM>3THENNM=NM-4*INT(NM/4)
370 M=NM:PRINT"YOU TURN."
380 D=W(M):Q=PEEK(P):OP=P:ML=M-1:MR=M+1
390 IFML<0THENML=3
400 IFMR>3THENMR=0
410 OX=OX-OL:IFOX<0THENPRINT"YOU DIE.":END
420 T=T+1:IFT=TTTHENTT=1:PRINT"YOU FIND A TORCH":GOSUB3000
430 IFTT=1THENDC=0:GOSUB2000:GOSUB70
435 IFP=MCANDRM=0THENRM=1:GOSUB600
440 M(4)=TL:M(5)=BL:M(6)=TR:M(7)=BR:GOTO240
500 P=P+1:IFP>EMTHENP=SM
510 A=INT(RND(1)*4):DC=0
520 A=A+1:DC=DC+1:IFDC>3THEN500
530 IFA>3THENA=0
540 M=P+M(A):IFM<SMORM>EMTHEN520
550 CP=PEEK(P):CM=PEEK(M):IFC>0ANDCP=210THENP=M:GOTO510
560 TM=M-SM:IF(CP=CMORCM<210)ANDC>0THEN520
570 ME=TM-L*INT(TM/L):IF(ME=0ANDM(A)=1)OR(ME=GANDM(A)=-1)THEN520
580 OD=INT(15/W(A)):CP=CP/W(A):POKEP,CP:CM=CM/OD:POKEM,CM
590 P=M:C=C+1:IFC<HTHEN510
595 RETURN
600 GOSUB2000:PRINT"YOU FIND A MAP"
605 A=TL:MS=A:DC=SM:DD=SM+G
610 FORB=DCTODD:FORC=0TO3:CB=PEEK(B):CB=CB-W(C)*INT(CB/W(C))
620 AA=1:IFC=1ORC=3THENAA=LL
630 IFC>1THENAA=-AA
640 BB=LL/AA:P2=A+AA:P1=P2+BB:P3=P2-BB
645 IFB=PTHENPOKEA,W4
650 ECB=0THENPOKEP1,W3:POKEP2,W3:POKEP3,W3
660 NEXTC:A=A+2:NEXTB:DC=DC+L:DD=DD+L:A=MS+(2*LL):MS=A
670 IFDD<=EMTHEN610
680 GOSUB3000:RETURN
900 GOSUB2000:PRINT"YOU HIDE IN AN ALIEN MAZE TO ESCAPE ENEMIES."
910 PRINT"FIND THE EXIT BEFORE YOUR AIR RUNS OUT."
950 TL=53349:BL=54149:TR=53374:BR=54174:LL=32:DW=3:CD=4
955 W1=135:W2=128:W3=161:W4=240
960 W(0)=5:W(1)=7:W(2)=3:W(3)=2:L=INT(RND(1)*5+6)
970 M(0)=1:M(1)=L:M(2)=-1:M(3)=-L:M(4)=TL:M(5)=BL:M(6)=TR:M(7)=BR
980 W=INT(RND(1)*5+6):H=L*W-1:G=L-1:C=0:DC=0:T=0:RM=0
995 SM=576:EM=SM+H:FORA=SMTOEM:POKEA,210:NEXT:P=SM+INT(RND(1)*H)
1000 EC=SM+INT(RND(1)*L):MC=INT(RND(1)*H)+SM
1010 OX=INT(H/3)+1:IFP<OXTHENOX=-OX
1015 OX=OX+H:OL=1:TT=INT(RND(1)*H/8)+1:GOSUB500:GOSUB2000
1030 M=0:NP=P:CE=PEEK(EC):CE=CE/W(3):POKEEC,CE:GOTO380
2000 FORX=0TO25:PRINT:NEXTX:RETURN
3000 FORX=0TO5000:NEXTX:RETURN
```

The Type-a-Shape program allows stored shapes to be reproduced in high-resolution by a single command. In the second part of his series on Apple graphics, Roger Cullis explains the program's features.

Automatic shape generation

A USEFUL facility of Apple is the ability to store a collection of shapes and to reproduce them in Hires graphics with a command of the form Draw N AT X,Y where N is the code number of the required shape. A table of up to 255 different shapes may be constructed.

Shape display is virtually instantaneous and so a very complicated graphic could rapidly be constructed using this technique. The method of defining shapes in a shape table is described in detail in the Applesoft Reference Manual, chapter 9. Briefly, each shape is defined as a succession of Move+Plot and Move + No plot vectors. Each vector is represented as a binary number, and groups of three binary numbers are collected together as a hexadecimal byte. A shape definition consists, in turn, as a collection of hexadecimal bytes.

Compiling shape definitions manually is an extremely slow and laborious procedure, but it can easily be achieved by mechanically following a few simple rules. Type-a-Shape uses the procedures developed in the two Type-a-Graphic programs to permit the construction or modification of a shape table using single-key entries to move a cursor to produce a Lores analogue of a Hires shape. A numeric array is used to store the definition temporarily during construction. On completion, the array is converted to a shape definition and added to the shape table before being displayed in Hires format. It can then be modified using the Lores guide matrix on which the Lores analogue of the shape is displayed for guidance.

The general features of Type-a-Shape are similar to those of the previous programs and should be clear from either the program or the flowchart — figure 1. Nevertheless, certain program lines require special explanation.

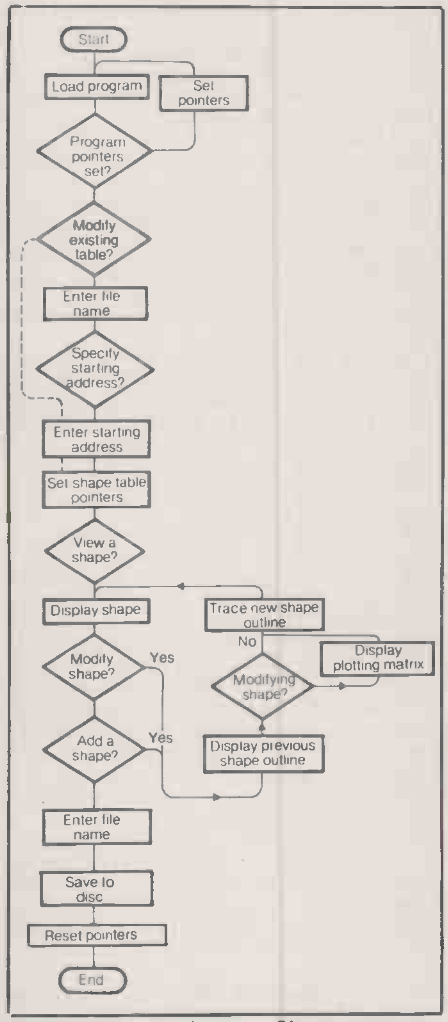

Figure 1. Format of Type-a-Shape program.

60 An integer array Byte%(A) is used as a temporary store during construction of the shape definition since this type of array is most economic of memory space. The dimension 200 is considered adequate to store enough vectors to accommodate the most elaborate shape envisaged. Apple stores addresses as a high-order byte and a low-order byte; FN HI(A) and FN LO(A) permit ease of calculation.

1400 When a binary file has been loaded by DOS, locations 43634 and 43635 contain the starting address (for a 48K system — refer to the Apple DOS manual for other memory sizes).

1410 Similarly, locations 43616 and 43617 contain the length of the most recently loaded binary file.

1420 The number of shapes in a shape table is stored at the starting address of the table.

5230-5260 A guide matrix of grey and magenta dots is constructed to facilitate drawing the Lores outline of a shape.

5270 A$ = "N" is used as a temporary flag to indicate whether a new shape is being defined or a previous shape modified.

5320 The starting address of the definition of an individual shape is stored at locations ST+2*N and ST+2*N+1 where ST is the starting address of the shape table and N is the shape number.

5330 Error routine prevents program crash if the shape definition was not prepared using the Type-a-Shape program.

5340-5550 Binary vectors are derived from the actual shape definition and plotted as coloured pixels on the Lores guide matrix.

5350 A shape definition ends with a zero byte.

5620 K is the number of bytes in a shape definition. R,TR are flags used to compile the array.
5650-5660 Screen colour is used as a temporary store of Plot/No-plot vectors.
5820-5860 It is possible to choose a combination of Move/Plot/No-plot vectors which would result in a zero hexadecimal byte and would inadvertently terminate the shape definition.
5870-6440 correct the situation by going back three moves.
6060 converts from binary to hexadecimal.
6090-6100 carry binary vectors to next byte.
6120 inserts a Move/No-plot byte into an otherwise blank shape definition to permit it subsequently to be modified without clobbering the other shapes in the table.
6160-6350 When a shape definition is modified, the memory space and other shape pointers need to be adjusted to take account of its different length.
6380 The array is stored as a shape definition in the table.
6480-6600 When modifying a previous shape it is often convenient to be able to copy portions by using the simplicity of the Trace command.

```
1  REM  TYPE-A-SHAPE  (SHAPE TABLE COMPILER)
2  REM  PROGRAM COMMENCED 28 AUG 1980 IN APPLESOFT BASIC
3  REM  LAST AMENDED 03 JUL 1981 (VERSION NO.46)
4  REM  COPYRIGHT 1981 - ROGER CULLIS
5  REM  THIS PROGRAM PERMITS CONSTRUCTION OF A NEW SHAPE TA
     BLE
6  REM  OR MODIFICATION OF AN EXISTING TABLE.
7  REM  FOR ADDITIONAL INFORMATION REFER TO APPLESOFT PROGR
     AMMING MANUAL CH.9
8  REM  WRITTEN ON APPLE II WITH LANGUAGE CARD AND 48K MEMO
     RY
9  REM  SHAPE ORIGIN IS 0,0 - TO COMPILE TABLE WITH DIFFERE
     NT ORIGIN AMEND LINES 5270,5280
10 D$ =  CHR$ (13) +  CHR$ (4): REM  CR + CONTROL D
30  IF  PEEK (103) = 1 AND  PEEK (104) = 64 AND  PEEK (1638
     4) = 0 THEN  GOTO 60
40  POKE 103,1: POKE 104,64: POKE 16384,0: REM  AVOIDS HGR-
     CLOBBERED VARIABLES
50  PRINT D$;"RUN TYPE-A-SHAPE": REM  RELOAD ABOVE HGR PAGE
      1 MEMORY
60  DIM BYTE%(200): DEF  FN LO(A) = A - 256 *  INT (A / 256
     ): DEF  FN HI(A) =  INT (A / 256)
70 H$ = "         TYPE 'H' FOR HELP"
997  REM  ****************************************
998  REM  INSTRUCTIONS AND CONTROL PROGRAM
999  REM  ****************************************
1000  HOME : PRINT : PRINT
1010  PRINT  TAB( 8)"************************"
1020  PRINT  TAB( 8)"*                      *"
1030  PRINT  TAB( 8)"*     TYPE-A-SHAPE     *"
1040  PRINT  TAB( 8)"*                      *"
1050  PRINT  TAB( 8)"* SHAPE TABLE COMPILER *"
1060  PRINT  TAB( 8)"*                      *"
1070  PRINT  TAB( 8)"************************"
1080  VTAB 12: PRINT " A PROGRAM TO COMPILE SHAPE TABLES FO
     R"
1090  PRINT : PRINT "USE WITH HIRES GRAPHICS."
1100  PRINT : PRINT "THE SHAPE DEFINITION IS COMPILED BY"
1110  PRINT : PRINT "MOVING A CURSOR OVER A GUIDE MATRIX"
1120  PRINT : PRINT "DISPLAYED IN LORES GRAPHICS. NEW SHAPE
     S"
1130  PRINT : PRINT "MAY BE ADDED TO A TABLE AND EXISTING"
1140  PRINT : PRINT "SHAPES ALTERED."
1150  FOR I = 0 TO 7000: NEXT :I = 0: REM  DISPLAY TIME
1160  HOME : VTAB 10: PRINT "DO YOU WISH TO MODIFY AN EXIST
     ING SHAPE"
1170  PRINT : PRINT "TABLE (Y/N?)"
1180  GET B$: IF B$ = "N" THEN  GOTO 1340
1190  IF B$ < > "Y" THEN  GOTO 1180
1197  REM
1198  REM  ERROR ROUTINE
1199  REM
1200  ONERR  GOTO 1220: REM  IF "FILE NOT FOUND"
1210  GOTO 1270
1220  HOME : VTAB 10: PRINT "FILE - "NAME$" - NOT AVAILABLE
     "
```

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```
1230  PRINT : PRINT "PLEASE CHECK SPELLING AND DISK CATALOG
      "
1240  PRINT : PRINT "DO YOU WISH TO RE-ENTER FILE NAME (Y/N
      ?)"
1250  GET A$: IF A$ = "N" THEN B$ = "N" GOTO 1480
1260  IF A$ < > "Y" THEN  GOTO 1250
1267  REM
1268  REM  LOAD SHAPE TABLE
1269  REM
1270  HOME : VTAB 10: PRINT "ENTER SHAPE TABLE NAME,"
1280  PRINT : PRINT "THEN PRESS 'RETURN'"
1290  PRINT : INPUT "";NAME$
1300  PRINT : PRINT "DO YOU WISH TO SET THE"
1310  PRINT : PRINT "STARTING ADDRESS (Y/N?)"
1320  GET A$: IF A$ = "N" THEN  GOTO 1380
1330  IF A$ < > "Y" THEN  GOTO 1320
1340  HOME : VTAB 10: PRINT "ENTER STARTING ADDRESS OF SHAP
      E TABLE"
1350  PRINT : INPUT "THEN PRESS 'RETURN' - ";ST$:ST =  VAL
      (ST$)
1360  IF B$ = "N" THEN  GOTO 1470
1370  PRINT D$;"BLOAD "NAME$", A"ST: GOTO 1390
1380  PRINT D$;"BLOAD "NAME$
1390  POKE 216,0: REM  RESET ERROR MESSAGE FLAG
1400 ST =  PEEK (43634) + 256 *  PEEK (43635): REM  STARTIN
      G ADDRESS OF TABLE
1410 LE =  PEEK (43616) + 256 *  PEEK (43617): REM  LENGTH
      OF TABLE
1420 TN =  PEEK (ST): REM  NUMBER OF SHAPES IN TABLE
1430  HOME : VTAB 10: PRINT NAME$
1440  PRINT : PRINT "THIS TABLE CONTAINS "TN" SHAPES, START
      S"
1450  PRINT : PRINT "AT "ST" AND IS "LE" BYTES LONG."
1460  GOTO 1490
1467  REM
1468  REM  NEW TABLE
1469  REM
1470 LE = 512: REM  SPACE FOR 255 SHAPE ADDRESS POINTERS
1480 A$ = "Y": ROT= 0:N = 0: REM  INITIALISE
1490  POKE 232, FN LO(ST): POKE 233, FN HI(ST): POKE ST + 1
      ,0: REM  SET SHAPE TABLE POINTERS (E8,E9)
1500  HIMEM: ST - 1: REM  PROTECT TABLE
1510  IF B$ = "N" THEN  GOTO 1750
1517  REM
1518  REM  VIEW A SHAPE
1519  REM
1520  PRINT : PRINT "DO YOU WISH TO VIEW ANY SHAPE (Y/N?)"
1530  GET A$: IF A$ = "N" THEN  GOTO 1650
1540  IF A$ < > "Y" THEN  GOTO 1530
1550  PRINT "ENTER SHAPE NUMBER, THEN PRESS 'RETURN'"
1560  INPUT "# = ";N$
1570 N =  VAL (N$): IF N < 1 OR N > TN THEN  PRINT "SHAPE #
      "N" DOES NOT EXIST": GOTO 1550
1577  REM
1578  REM  DETERMINE SHAPE LENGTH
1579  REM
1580  IF N =  PEEK (ST) THEN K = LE -  PEEK (ST + 2 * N) -
      256 *  PEEK (ST + 2 * N + 1): GOTO 1600
1590 K =  PEEK (ST + 2 * N + 2) -  PEEK (ST + 2 * N) + 256 *
      ( PEEK (ST + 2 * N + 3) -  PEEK (ST + 2 * N + 1))
1600  GOSUB 6410: REM  DRAW HGR SHAPE
1610  PRINT : PRINT "DO YOU WISH TO CHANGE THIS SHAPE (Y/N?
      )"
1620  GET A$: IF A$ = "Y" THEN A$ = "N": GOTO 1700
1630  IF A$ = "N" THEN  PRINT : PRINT "DO YOU WISH TO VIEW
      ANOTHER SHAPE (Y/N?)": GOTO 1530
1640  GOTO 1620
```

```
1650  PRINT : PRINT "DO YOU WISH TO ADD ANOTHER SHAPE (Y/N?
      )"
1660  GET A$
1670  IF A$ = "Y" THEN N =  PEEK (ST): GOTO 1750
1680  IF A$ < > "N" THEN  GOTO 1660
1690  GOTO 8000
1697  REM
1698  REM  CHANGE A SHAPE
1699  REM
1700  GOSUB 5000: REM   COMPILE SHAPE DEFINITION AND DISPLA
      Y
1710  PRINT : PRINT  TAB( 18)"OK (Y/N?)": GET A$
1720  IF A$ = "Y" THEN A$ = "N": GOTO 1630
1730  IF A$ = "N" THEN  GOTO 1700
1740  GOTO 1710
1747  REM
1748  REM  ADD A SHAPE
1749  REM
1750 N = N + 1:COUNTER = 0: POKE ST,N
1760 ADDRESS = ST + 2 * N: POKE ADDRESS, FN LO(LE): POKE AD
     DRESS + 1, FN HI(LE): REM  SAVE CURRENT SHAPE POINTERS

1770  GOSUB 5000: REM   COMPILE SHAPE DEFINITION AND DISPLA
      Y
1780  PRINT : PRINT  TAB( 18)"OK (Y/N?)"
1790  GET A$: IF A$ = "Y" THEN LE = LE + K:TN = N: GOTO 165
      0
1800  IF A$ = "N" THEN N = N - 1: GOTO 1750
1810  GOTO 1790
4997  REM  ******************************************
4998  REM  COMPILE SHAPE DEFINITION AND DISPLAY
4999  REM  ******************************************
5000  IF T = 1 THEN  GOTO 5210: REM  INSTS. ALREADY LOADED
      INTO P2 BUFFER?
5010  TEXT : HOME : PRINT  TAB( 14)"INSTRUCTIONS"
5020  PRINT : PRINT " THE SHAPE DEFINITION IS COMPILED BY"
5030  PRINT "MOVING A CURSOR ON A LORES GRAPHICS"
5040  PRINT "GUIDE MATRIX. DIFFERENT COLOURS ARE"
5050  PRINT "USED FOR 'PLOT' (ORANGE) AND 'NO-PLOT'"
5060  PRINT "(BLUE) MOVES. BROWN AND DARK BLUE"
5070  PRINT "DEPICT THE CORRESPONDING VECTORS OF A"
5080  PRINT "PREVIOUSLY DEFINED SHAPE."
5090  PRINT : PRINT  TAB( 16)"COMMANDS"
5100  PRINT : PRINT "I J )  MOVE THE CURSOR POSITION (I-UP,
      "

5110  PRINT "K M )  J-LEFT, K-RIGHT, M-DOWN)"
5120  PRINT : PRINT "P   )  SELECT 'PLOT' VECTOR"
5130  PRINT "D   )  SELECT 'NO-PLOT' VECTOR"
5140  PRINT : PRINT "T   )  TRACE PREVIOUS SHAPE"
5150  PRINT : PRINT "S   )  STOP, COMPILE AND DISPLAY SHAPE
      "

5160  FOR I = 2048 TO 3023: POKE I, PEEK (I - 1024): NEXT
5170  VTAB 24: PRINT  TAB( 8)"PRESS 'RETURN' TO CONTINUE"
5180  GET C$: IF C$ < > CHR$ (13) THEN  GOTO 5180
5190  FOR I = 3024 TO 3071: POKE I, PEEK (I - 1152): NEXT
5200 T = 1
5207  REM
5208  REM  PREPARE LORES GUIDE MATRIX
5209  REM
5210  GR
5220  HOME : VTAB 21: PRINT  TAB( 15)"SHAPE # "N
5230  POKE 35,23: VTAB 24: PRINT H$: VTAB 22
5240  COLOR= 5: FOR LI = 0 TO 39: VLIN 0,39 AT LI: NEXT : REM
      PLOTTING GUIDE
5250  COLOR= 3: FOR LI = 9 TO 39 STEP 10: VLIN 0,39 AT LI: HLIN
      0,39 AT LI: NEXT
5260  COLOR= 0: FOR LI = 0 TO 38 STEP 2: VLIN 0,39 AT LI: HLIN
      0,39 AT LI: NEXT
```

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```
5270  COLOR= 7: IF A$ = "N" THEN X = 0:Y = 0: GOTO 5320
5280 X = 0:Y = 0: REM  START AT ORIGIN
5290  IF  SCRN( X,Y) = 2 THEN  COLOR= 7
5300  IF  SCRN( X,Y) = 8 THEN  COLOR= 9
5310  GOTO 5620
5320 ADDRESS = ST +  PEEK (ST + 2 * N) + 256 *  PEEK (ST +
     1 + 2 * N)
5330  ONERR  GOTO 5560: REM  IF SHAPE EXTENDS BEYOND PLOTTI
     NG MATRIX
5340 BYTE =  PEEK (ADDRESS)
5350  IF BYTE = 0 THEN  GOTO 5280
5360 M1 = BYTE - 8 *  INT (BYTE / 8): REM  SEPARATE INTO MO
     VES
5370 BYTE =  INT (BYTE / 8)
5380 M2 = BYTE - 8 *  INT (BYTE / 8)
5390 BYTE =  INT (BYTE / 8)
5400 M3 = BYTE
5410 M = M1: GOSUB 5480: REM  FIRST MOVE
5420  IF M2 = 0 AND M3 = 0 THEN  GOTO 5460
5430 M = M2: GOSUB 5480: REM  SECOND MOVE
5440  IF M3 = 0 THEN  GOTO 5460
5450 M = M3: GOSUB 5480: REM  THIRD MOVE
5460 ADDRESS = ADDRESS + 1
5470  GOTO 5340
5480  IF M < 4 THEN  COLOR= 2: GOTO 5500
5490 M = M - 4: COLOR= 8
5500  PLOT X,Y
5510  IF M = 0 THEN Y = Y - 1
5520  IF M = 1 THEN X = X + 1
5530  IF M = 2 THEN Y = Y + 1
5540  IF M = 3 THEN X = X - 1
5550  RETURN
5560  PRINT "SHAPE POSITION DOES NOT CORRESPOND WITH"
5570  PRINT "LORES PLOTTING MATRIX."
5580  PRINT "COMMENCE PLOTTING AT ORIGIN."
5590  FOR I = 0 TO 1000: NEXT
5600  POKE 216,0: REM  RESET ERROR FLAG
5610 A$ = "Y": GOTO 5210
5617  REM
5618  REM  COMPILE TEMPORARY STORAGE ARRAY
5619  REM
5620 K = 1:COUNTER = 0:R = 0:TR = 0: REM  INITIALISE
5630 P1 = 0:P2 = 0:P3 = 0:M1 = 0:M2 = 0:M3 = 0
5640  PLOT X,Y
5650  IF  SCRN( X,Y) = 9 THEN P = 1
5660  IF  SCRN( X,Y) = 7 THEN P = 0
5670  GET A$
5680  IF A$ = "I" AND Y > 0 THEN M = 0:Y = Y - 1: GOTO 5780

5690  IF A$ = "K" AND X < 38 THEN M = 1:X = X + 1: GOTO 578
     0
5700  IF A$ = "M" AND Y < 38 THEN M = 2:Y = Y + 1: GOTO 578
     0
5710  IF A$ = "J" AND X > 0 THEN M = 3:X = X - 1: GOTO 5780

5720  IF A$ = "P" THEN  COLOR= 9: GOTO 5640
5730  IF A$ = "D" THEN  COLOR= 7: GOTO 5640
5740  IF A$ = "T" THEN  GOSUB 6480: IF TR = 1 THEN TR = 0: GOTO
     5780
5750  IF A$ = "S" THEN R = 1: GOTO 6050
5760  IF A$ = "H" THEN  GOTO 6610
5770  GOTO 5670
5780 COUNTER = COUNTER + 1
5790  IF COUNTER = 1 THEN P1 = P:M1 = M: GOTO 5640
5800  IF COUNTER = 2 THEN P2 = P:M2 = M: GOTO 5640
5810  IF COUNTER = 3 THEN P3 = P:M3 = M
5820  IF P3 = 1 OR P3 = 0 AND M3 = 0 THEN COUNTER = 4:PT =
     P3:MT = M3:P3 = 0:M3 = 0: GOTO 5840
```

```
5830  GOTO 6060
5840  IF P2 = 0 AND M2 = 0 THEN COUNTER = 5:PS = P2:MS = M2
     : GOTO 5860
5850  GOTO 6060
5860  IF P1 = 0 AND M1 = 0 THEN  PRINT "ILLEGAL MOVE TERMIN
     ATES CURRENT SHAPE.": PRINT "RE-ENTER LAST THREE MOVES
     .": GOTO 5880: REM  AVOID ZERO BYTE
5870  GOTO 6060
5877  REM
5878  REM  GO BACK 3 MOVES
5879  REM
5880  IF (X + 1) / 10 =  INT ((X + 1) / 10) OR (Y + 1) / 10
     =  INT ((Y + 1) / 10) THEN  COLOR= 3
5890  IF X / 2 =  INT (X / 2) OR Y / 2 =  INT (Y / 2) THEN
      COLOR= 0: GOTO 5910
5900  COLOR= 5
5910  PLOT X,Y
5920  IF M3 = 0 THEN Y = Y + 1
5930  IF M3 = 1 THEN X = X - 1
5940  IF M3 = 2 THEN Y = Y - 1
5950  IF M3 = 3 THEN X = X + 1
5960  IF (X + 1) / 10 =  INT ((X + 1) / 10) OR (Y + 1) / 10
     =  INT ((Y + 1) / 10) THEN  COLOR= 3
5970  IF X / 2 =  INT (X / 2) OR Y / 2 =  INT (Y / 2) THEN
      COLOR= 0: GOTO 5990
5980  COLOR= 5
5990  PLOT X,Y:Y = Y + 1
6000  IF (X + 1) / 10 =  INT ((X + 1) / 10) OR (Y + 1) / 10
     =  INT ((Y + 1) / 10) THEN  COLOR= 3
6010  IF X / 2 =  INT (X / 2) OR Y / 2 =  INT (Y / 2) THEN
      COLOR= 0: GOTO 6030
6020  COLOR= 5
6030  PLOT X,Y:Y = Y + 1
6040  COLOR= 7:COUNTER = 0: GOTO 5640
6047  REM
6048  REM  CONVERT FROM PSEUDOBINARY TO HEX
6049  REM
6050  IF P1 + P2 + P3 + M1 + M2 + M3 = 0 THEN  GOTO 6120
6060 BYTE%(K) = M1 + 4 * P1 + 8 * M2 + 32 * P2 + 64 * M3
6070 COUNTER = COUNTER - 3:K = K + 1: IF R = 1 THEN  GOTO 6
     130
6080  HOME : VTAB 21: PRINT "SHAPE "N" CONTAINS "K" BYTES S
     O FAR"
6090  IF COUNTER = 2 THEN M2 = MT:P2 = PT:M1 = MS:P1 = PS
6100  IF COUNTER = 1 THEN M1 = MT:P1 = PT
6110  GOTO 5640
6120  IF K = 1 THEN BYTE%(K) = 1:K = K + 1
6130 BYTE%(K) = 0:KN = K
6140  POKE 35,24: REM  RESET TEXT WINDOW
6150  HOME : VTAB 21: PRINT "SHAPE # "N" CONTAINS "K" BYTES
     ."
6157  REM
6158  REM  ADJUST MEMORY SPACE
6159  REM
6160  IF N >  PEEK (ST) - 1 THEN  GOTO 6360
6170 KO =  PEEK (ST + 2 + 2 * N) + 256 *  PEEK (ST + 3 + 2 *
     N) -  PEEK (ST + 2 * N) - 256 *  PEEK (ST + 1 + 2 * N)
6180  IF KN = KO THEN  GOTO 6360
6190  HOME : VTAB 22: PRINT "LOADING REVISED SHAPE INTO MEM
     ORY"
6200 A1 = ST +  PEEK (ST + 2 * N + 2) + 256 *  PEEK (ST + 2
     * N + 3) + KN - KO
6210 LE = LE + KN - KO: REM  NEW LENGTH OF SHAPE TABLE
6220 A2 = ST + LE
6230  IF KN < KO THEN  GOTO 6280
6240  FOR ADDRESS = A2 TO A1 STEP  - 1
6250  POKE ADDRESS, PEEK (ADDRESS + KO - KN)
6260  NEXT ADDRESS
6270  GOTO 6310
```

(continued on next page)

(continued from previous page)

```
6280  FOR ADDRESS = A1 TO A2
6290  POKE ADDRESS, PEEK (ADDRESS + KO - KN)
6300  NEXT ADDRESS
6310  FOR NI = N + 1 TO TN
6320 ADDRESS =  PEEK (ST + 2 * NI) + 256 *  PEEK (ST + 2 *
     NI + 1)
6330 ADDRESS = ADDRESS + KN - KO
6340  POKE ST + 2 * NI, FN LO(ADDRESS): POKE ST + 2 * NI +
     1, FN HI(ADDRESS)
6350  NEXT NI:NI = 0
6357  REM
6358  REM  STORE DEFINITION
6359  REM
6360 ADDRESS = ST +  PEEK (ST + 2 * N) + 256 *  PEEK (ST +
     1 + 2 * N) - 1:K = 0
6370 ADDRESS = ADDRESS + 1:K = K + 1
6380  POKE ADDRESS,BYTE%(K)
6390  IF BYTE%(K) = 0 THEN  GOTO 6410
6400 BYTE%(K) = 0: GOTO 6370: REM  HOUSEKEEPING
6410  HGR
6420  HOME : VTAB 21: PRINT "ENTER SCALE, THEN PRESS 'RETUR
     N'"
6430  INPUT "S = ";SC$
6440 SC =  VAL (SC$): IF SC < 0 OR SC > 255 THEN  GOTO 6420
6450  ROT= 0: SCALE= SC: HCOLOR= 3: DRAW N AT 180,80
6460  HOME : VTAB 21: PRINT  TAB( 5)"SHAPE # "N" CONTAINS "
     K" BYTES"
6470  RETURN
6477  REM
6478  REM  TRACE PREVIOUS SHAPE
6479  REM
6480  IF Y = 0 THEN  GOTO 6500
6490  IF  SCRN( X,Y - 1) = 8 OR  SCRN( X,Y - 1) = 2 THEN M =
     0:Y = Y - 1: GOTO 6560
6500  IF X = 39 THEN  GOTO 6520
6510  IF  SCRN( X + 1,Y) = 8 OR  SCRN( X + 1,Y) = 2 THEN M =
     1:X = X + 1: GOTO 6560
6520  IF Y = 39 THEN  GOTO 6540
6530  IF  SCRN( X,Y + 1) = 8 OR  SCRN( X,Y + 1) = 2 THEN M =
     2:Y = Y + 1: GOTO 6560
6540  IF X = 0 THEN  GOTO 6560
6550  IF  SCRN( X - 1,Y) = 8 OR  SCRN( X - 1,Y) = 2 THEN M =
     3:X = X - 1
6560  IF  SCRN( X,Y) = 8 THEN  COLOR= 9: GOTO 6600
6570  IF  SCRN( X,Y) = 2 THEN  COLOR= 7: GOTO 6600
6580  HOME : VTAB 21: PRINT "CURSOR IS NOT ADJACENT PREVIOU
     S SHAPE."
6590  PRINT "USE OTHER PLOTTING KEYS.": RETURN
6600  PLOT X,Y:TR = 1: RETURN
6607  REM
6608  REM  DISPLAY TEXT P2
6609  REM
6610  POKE  - 16303,0: POKE  - 16302,0: POKE  - 16299,0: REM
     TEXT,ALL,P2
6620  GET A$: IF A$ <  > CHR$ (13) THEN  GOTO 6620
6630  POKE  - 16304,0: POKE  - 16301,0: POKE  - 16300,0: REM
     GRAPHICS,MIXED,P1
6640  GOTO 5670
7997  REM  ****************************************
7998  REM  SAVE ROUTINE
7999  REM  ****************************************
8000  TEXT : HOME : VTAB 10
8010  PRINT "ENTER SHAPE TABLE NAME,": PRINT
8020  PRINT "THEN PRESS 'RETURN'": PRINT
8030  INPUT "";NAME$
8040  PRINT D$;"BSAVE "NAME$", A"ST", L"LE
8050  POKE 103,1: POKE 104,8: POKE 16384,255: REM  RE-SET P
     ROGRAM POINTERS
```

BUYERS' GUIDE

Printers

The Peripherals Buyers' Guide is a survey of printers suitable for small computers. We have excluded any system which costs significantly more than £2,000. The printers are listed in alphabetical order. The addresses of the main suppliers are listed at the end of the guide.

Printers may be divided into several categories. The highest-quality printing is produced by the daisywheel-type which creates text in various type-faces, according to the wheel used. The quality ranges from excellent typing to rather poor book printing and generally there is a proportional-spacing facility. Those machines tend to be expensive and slow. Daisywheels can be either plastic — inexpensive, but must be replaced often — or metal — expensive but durable.

For faster printing, you must turn to dot-matrix machines. The print quality tends to be poor and the machines noisy. Older machines use a 7-by-5 matrix which puts the descenders of letters such as 'y' above the line. That makes bulk text difficult to read. Better printers use a matrix nine dots deep to give true descenders. Recently, several firms have produced dot-matrix printers which give an approximation to typewriter printing and proportional spacing. They are less expensive than daisywheel machines, work faster and could well be used for correspondence-quality work.

Some dot-matrix printers employ sensitised paper to produce printing by more direct electrical effects. They are often quiet and fast, but the paper can be expensive, unpleasant to handle and hard to obtain.

The trend is to build more processing power into printers. That means they offer increasingly varied features, so it is hard to categorise them precisely.

A printer has to be connected to the computer by a cable and a more or less standard interface. The normal interfaces are the Centronics parallel, RS232 serial port — also known as the V-24 — and 20mA current loop. IEEE is a parallel interface used by Pet; 'cpl' means characters per line, 'cps' means printing speed in characters per second. Allow five characters to the word.

The more intelligent printer prints as its head moves in both directions across the paper — bi-directional printing. Still more intelligent ones end the head movement at the ends of short lines. These two features can more then treble the working speed.

Printers use two types of paper: plain paper fed — like a typewriter — pinch- and pin- or sprocket- or tractor-fed with holes along the margins. That paper can be supplied fan-folded or in rolls.

Pinch feeding is more expensive but is convenient for letters. Only a few machines will accept both pinch- and pin-fed paper. It is possible to obtain headed letter paper bonded lightly on to pin-fed, fan-folded computer paper for word processors.

Some printers allow direct control of the print-head to give graphics. KSR means keyboard, send and receive, ASR means automatic send and receive, RO means receive only. KSR machines can be used as electric typewriters in local mode.

Comb or line printers have a whole line's worth of dot hammers so they can print a line of text at a time. They tend to be very expensive and very noisy but produce an enormous quantity of work.

ADDMASTER

400 receive only *£242*

Uses 2.5in. Tally roll paper, 16 cpl, 48 cps. Main U.K. agent Clary Ltd.

420/426 receive only *£246*

Dot matrix grade-one Tally roll paper at £5 for 20 rolls. BCD serial or 10-line serial interfaces, 12 cpl, 36 cps.

ANADEX

Main U.K. agent Anadex Ltd

DP-500 *from £367*

Dot matrix, tractor feed, parallel interfaces, 18 cpl, 45 cps.

DP-660 *from £700*

Dot matrix, pinch feed for printing labels, uses sprocket feed. Parallel interface. 19 cpl, 57 cps.

DP-750A *from £800*

Dot matrix, RS232C 20mA current loop, 21 cps, 25 cps.

FP-600 *from £65*

Dot matrix ticket or form printer, from four columns to 19 columns parallel interface, 19 cpl, 44 cps.

DP-9500 Series *£895 upwards*

Dot matrix, tractor feed, nine-wire print head, bi-directional printing, three ASCII interfaces as standard — parallel bit, RS232C, current loop — 120-200 cps, 132-220 columns, 7x9, 9x9 or 11x9 matrices depending on model. Also from: Peripheral Hardware, Kode Services, Robox, Stack Computer Services and Data Design Techniques Ltd.

DP-8000 *£550*

Dot matrix, pinch feed, bi-directional printing, fan-fold paper up to 9.5 in. up to three copies. Three ASCII interfaces — parallel bit, RS232C, current loop — 112 cps, 80 column, 9x7 matrix. Also from: Peripheral Hardware, Kode Services, Robox, Stack Computer Services and Data Design Techniques Ltd.

DP-1000 Series *from £395*

Dot matrix, tractor feed, internal data storage, roll-type paper for 40 columns at £11 for box of 10 rolls, three basic ASCII-compatible interfaces are available. 40 cpl, 50 cps, 40 columns, 5x7 matrix. Also from: Peripheral Hardware, Kode Services, Robox, Stack Computer Services.

AXION CORPORATION

Main U.K. agent Memec Systems Ltd

EX-820 receive only *£500*

Electro-sensitive dot matrix includes plotting capability for full graphics, paper at £3 for a 240ft. roll, RS232C or 20mA serial and ASCII parallel, 20/40/80 cpl and up to 160 cps, 5x8 matrix.

EX-850 Video Printer *£500*

Electro-sensitive dot matrix, aluminised paper at £3 for a 240ft. roll. Needs only the video signal from user's. Normal resolution 13.5 seconds per screen, high resolution 27 seconds per screen.

EX801/802 receive only *£279*

Electro-sensitive, dot matrix, aluminised paper at £3 for a 240ft. roll, RS232C, Centronics, Apple, Pet, and Tandy interfaces, 20/40/80 cpl, 160 cps, 5x8 matrix.

BASE 2

800-MST *from £385*

Impact dot matrix, bi-directional, tractor feed up to 9.5in., RS232C, 20mA, IEEE-488, Centronics and parallel interfaces, up to 132 cpl and 60 cps, with 5x7 matrix. Main U.K. agents Microbyte and Maclin-Zand Elecronics Ltd.

CENTRONICS

Main U.K. agents Sintrom Distribution, ITT Electronic Services, Cable and Wireless, Dacoll Engineering.

Models 700, 701, 702 and 703 *P.O.A.*

Impact dot matrix, uses fan-fold paper, parallel, serial RS232C interfaces 132 cpl, up to 180 cps, 5x7 or 7x7 matrices.

Model 791 *P.O.A.*

Demand-document printer, impact, dot matrix, up to 12-part forms using bottom feed tractor, standard parallel interface, with serial RS232C interface option, 80 cpl, 60 cps, 5x7 matrix.

Model 730 *£375*

Impact, dot matrix, uses roll paper up to 8.5 in. wide, fan-fold paper up to 9.5 in. wide and cut sheet up to three-ply paper and two carbons, parallel-standard interface with serial RS232 option, 80 cpl, 100 cpls, 7x7 matrix. Also from: Datac Ltd, Rair Ltd, Comma Computers and MIBF.

Model 737 *£425*

Impact dot matrix, roll fan-fold or cut sheet paper, standard parallel interface, serial RS232C option, 80 cpl mono-spaced mode, 50 cps mono-spaced mode, 80 cps proportional mode, 7x8 matrix mono-spaced, 9x9 proportional. Also from: Datac Ltd.

Model PI Microprinter and Model SI Microprinter *P.O.A.*

Non-impact dot matrix electro-sensitive uses aluminium-coated paper roll, parallel interface, serial RS232C interface, up to 80 cpl, and 150 lines per minute, up to 200 cps. Also from: Datac Ltd.

Model 780 *P.O.A.*

Impact, dot Matrix, pinch-roll paper feed for roll paper, tractor-feed option for rear- and bottom-feed forms and fan-fold paper, parallel interface with serial RS232C option, 80 cpl, 60 cps, 5x7 matrix.

Model 779 *P.O.A.*

Impact, dot matrix, pinch-roll paper feed for roll paper, with fan-fold, tractor feed option, standard parallel interface with RS232C serial option, 80-132 cpl, 60-110 cps, 5x7 matrix.

Model 704 *P.O.A.*

Impact, dot matrix, uses fan-fold paper, RS232 serial interface, 132 cpl, 180 cps using 7x7, 9x7 and 9x9 matrices.

Model 761 read only or keyboard send/receive *P.O.A.*

Impact, dot matrix, uses fan-fold paper, RS232C/CCITT V24 or DC current loop interfaces, 132 cpl, 60 cps, 7x7 matrix.

COMMODORE

CBM 3022 *£425*
Tractor-feed printer, uses fan-fold paper with three-in. to 12in. width, cost of paper £10 per 1,000, IEEE interface, 80 cpl, 150 cps, 6x7 matrix. Main U.K. agent Davinci Computers Ltd.

COMPUTER DEVICES INC

Miniterm 1201, 1202, 1203 *from £936*
Thermal mechanism, uses Thermal Type B paper at £2.40 per roll, RS232 or parallel — 1201 only — interfaces, 80 or 132 cpl, 10/30 cps, 7x5 matrix. Main U.K. agent Teleprinter Equipment Ltd.

DATAC

Main U.K. agent Datac Ltd
414 free-standing assembly receive only *£130*
Electro-sensitive, matrix printer type 245L, electro-sensitive roll paper, 59mm. wide x 30m. long at 90p per roll for 20 off, six-bit parallel ASCII, character serial interfaces, 16, 20, 32 or 40 cpl, 32 to 80 character per serial, 7x5 matrix.

DMI-40P free-standing terminal, receive only *£350*
Impact, matrix, uses pressure-sensitive roll paper, 10mm.-wide ordinary paper version, using ink ribbon. Cost of paper £1 per roll, seven-bit parallel ASCII, character serial, RS232C or graphics, 40 or 20 cpl, up to 80 cps, 7x5 matrix.

411C compact panel mounting, receive only *£209*
Electro-sensitive matrix type 245L or R, uses electro-sensitive roll paper, 59mm. wide x 30m. long at 90p per roll, six-bit parallel, serial interfaces, 16, 20, 32 or 40 cpl, 32 to 80 cps, 7x5 matrix.

411 panel mounting, receive only *£189*
Electro-sensitive matrix printer type 245L or R, uses electro-sensitive roll paper, 59mm. wide x 30m. long at 90p per roll. Interfaces include six-bit parallel ASCII, character serial, four-bit parallel BCD, character parallel EIA/RS232C, CCITT/V24 and 20mA current loop, under development 40 cpl, 32 to 80 cps, 7x5 matrix.

313 panel-mounting, receive only and
312 free-standing, receive only *£269*
Impact matrix type PU-1100, Tally roll paper, 59mm. wide x 36m. long at 60p per roll, CCITT/V24 or EIA RS232C or 20mA current loop interfaces, up to 20 cpl and up to 36 cps, 7x5 matrix.

412/1 and 412/5 receive only *£255*
Electro-sensitive dot matrix type 245L, uses electro-sensitive aluminium-coated paper, 59mm. x 30m. at 90p per roll, six-bit parallel, ASCII, character serial and four-bit parallel BCD, character parallel, RS232C/V24 interfaces, 20mA current loop under development, 16, 20, 32 or 40 cpl, 32-80 cps, 7x5 matrix.

522/1 and 522/4 receive only *£499 (522/1)* *£535 (522/4)*
Impact matrix type, roll paper, 114mm. x 75m. up to three copies plus original, cost of paper £1.10 per roll. Parallel interface and RS232C, 20mA current loop and parallel buttered, asynchronous interfaces — (522/4). 40 cpl, 100 cps instantaneous rate, 33 cps average rate — including CR and LF. 7x5, 7x10.

DATA DYNAMICS

Main U.K. agent Data Dynamics Ltd
303 Printer *£980*
Dot matrix, up to six-part stationery width from 3m to 15.375in., V24/RS232C, 20mA current loop, 132 cpl, 30 or 60 cps, 7x7 matrix.

ZIP ASR/K7 twin cassette £2,000
Dot matrix format, uses standard Teletype roll paper, V24, RS232C, or 20mA current loop operating at half or full duplex, 80 cpl, 10 or 30 cps switch selected, 5x7 matrix.

ZIP 30 keyboard printer, RO, ASR, or KSR *ASR £1,800 RO & KSR £950*
Dot matrix, standard roll paper, 20mA half or full duplex current loop or V24 RS232C, 80 cpl, 10 or 30 cps — switch selected, 5x7 matrix.

390 eight-level and 392 five-level *ASR from £1,250 LSR from £900 RO from £800*
ASR, KSR and read-only versions. Impact printers, friction or sprocket feed, 8.5in. paper with roll diameter 5in. 74 or 86 cpl, 6.6 or 10 cps.

Models 32 and 33 page printers *ASR from £1,100 KSR from £800 RO from £700*
Available in ASR, KSR and receive-only versions. Friction or sprocket feed, 20mA or 60mA parallel, up to 86 cpl, 6.6 or 10 cps.

DATA GENERAL CORPORATION

Dasher TP1 Printer models 6040 and 6041 *From £1,598*
6040 standard keyboard and can be used as a typewriter. 6041 is a receive-only terminal printer without keyboard, 30 or 60 cps, switch selectable, EIA-RS232C interfaces, 5x7 dot matrix. Main U.K. agent Data General.

DATAPLUS

400 series receive-only Model 480 *£475*
Impact dot matrix, uses standard Tally roll, up to 3.75in. side, from 80p per roll, RS232C, V24, 20mA current loop, but parallel IEEE, Pet and Apple interfaces, 30/40 cpl, 110 cps, 7x5 and 7x10 matrices. Main U.K. agent Dataplus Ltd.

DATASOUTH CORPORATION

DS-180 *£1,360*
Impact, matrix printer, uses fan-fold paper, RS232C, current loop, and parallel interfaces, 132 cpl, 180 cps, 9x7 matrix. Main U.K. agent Datatrade Ltd.

DIABLO

HY type II receive only *P.O.A.*
Impact daisywheel plastic or metal print wheel, parallel, interface, 132 10-pitch cpl or 158 12-pitch cpl, 40/45/55 cps. Main U.K. agent Diablo Systems Ltd.

630 receive only *£1,725*
Daisywheel, metal/plastic printwheels, standard listing or single sheet paper, RS232C, V24 with optional bus interface, 132 cpl at 10 pitch, 158 cpl at 12, 198 cpl at 15, up to 40 cps with automatic bi-directional printing. Main U.K. agent Geveke Electronics.

DIGITAL EQUIPMENT

DecWriter LA34 KSR *£824*
Dot matrix, uses roll or fan-fold paper, friction-feed, up to five copies, V24 or 20mA interfaces, adjustable up to 256 cpl, 30 cps, 7x9 matrix. Main U.K. agent Extel.

A120 *from £1,645*
7x7 dot matrix, EIA or 20mA option, up to 217 cpl, 180 cps. Main U.K. agent Wilkes Computing.

DIGITRONIX

Mini-Printer — *£195*
32 column electro-sensitive, 110-4,800 baud, ASCII Serial inputs at RS232C, 20mA, 64 font at 64 cps. Main U.K. agent Digitronix.

ELECTROGRAPHIC AV

EG-800 receive only — *from £450*
Impact, matrix printer, uses any type of paper, parallel, RS232C, TRS-80, Apple interfaces, 80 cpl, 150 cps, 7x5 or 7x6 matrices. Main U.K. agent Electrographic AV Ltd.

500 series receive only — *from £175 for mechanism only*
Impact, matrix printer, uses 3.5in. Tally roll paper and flat documents, serial or parallel interfaces, 40 cpl, 120 cps, 7x5 or 7x6 matrices. Main U.K. agent Electrographic AV Ltd.

EPSON

TX-80 — *£395*
Impact, dot matrix, friction pin-feed RS232C, V24, 20mA current loop, bit parallel, Centronics, IEEE, Pet, Apple and TRS-80 interfaces, 80 cpl, 150 cps, 7x5 or 7x10 matrices and graphics. Optional PROM chips for high-resolution graphics. Main U.K. agent Dataplus Ltd.

MX-80 — *£425*
Impact, dot matrix, accepts any type of paper, Centronics parallel interface, optional serial and IEEE 488 interfaces, 44, 66, 80, 132 cpl, 80 cps, 9x9 matrix — 2.1 x 3.1mm. High resolution graphics.

EXTEL CORPORATION

M30 receive only keyboard send/receive and automatic send/receive — *£895*
Impact, dot matrix printer, uses roll or fan-fold paper, V24 or 20mA interfaces, 80 cpl, 30 cps (50 with buffer) 5x7 matrix, 5- or 8-level operation. Main U.K. agent Extel.

M30 B208L keyboard send/receive — *£1,270*
Dot matrix, uses roll paper, V24 or 20mA interfaces, 80 cpl, 30 cps, 5x7 matrix, 5- or 8-level operation. Main U.K. agent Extel.

FACIT

4520 and 4521 — *£583*
Seven-wire print head, uses roll paper Telex type (Facit 4520), friction feed, fan-fold (Facit 4521) pin feed, serial, V24/RS323C, Centronics parallel interfaces, both fitted as standard, 80 cpl, 100 cps at 12 characters per inch, 9x7 matrix. Main U.K. agent Facit Ltd.

GENERAL ELECTRIC, U.S.A.

ITT 3330 — *£1,496*
Impact dot matrix, pin feed, V24 interface, 132 cpl, 10, 20 or 30 cps, 7x9 matrix. Main U.K. distributor ITT Business Systems U.K.

HEATH ELECTRONICS

WH14 — *£510*
Dot matrix, uses edge-punched fan-fold paper, 20mA, RS232C interfaces, 80, 96, 132 cpl, 132 cps, 5x7 matrix. Main U.K. agent Heath Electronics U.K. Ltd. (OEM sales).

INTEGRAL DATA SYSTEMS

Paper Tiger Model 460 *from £700*
Dot Matrix, impact printer, pin-feed fan-fold paper, parallel, RS232C, 150 cps, 24x9 matrix. Main U.K. agent Teleprinter Equipment Ltd. and Microsense Computers Ltd.

LEAR SIEGLER INC

300 series *from £965*
Dot matrix, uses standard paper, RS232C, 20mA parallel interfaces, Centronics 701/703 type 132 cpl, 180 cps, 9x7 or 9x9 matrices. Main U.K. agent Penny & Giles Data Recorders Ltd.

LOGABAX

LX-213 *£1,590*
Dot matrix printer, plain paper, fan-fold or cut up to six-ply, RS232C or V24 interfaces, 132 cpl, 218 cpl, 180 cps, 9x7 matrix, optimised bi-directional printing. Main U.K. agent Brospa Data Ltd.

LRC EATON

7000+ *£250*
Dot matrix printer, uses roll paper, RS232, IEEE, current loop and parallel interfaces, 20, 32, 40 and 64 cpl software selectable by option, 40 cps, 7x7 matrix. Main U.K. agent Russet Instruments.

MALIBU ELECTRONICS CORPORATION

Masterprint 165 *£1,400*
Dot matrix, fan-fold paper, RS232C, current loop and parallel interfaces, 132 cpl, 165 cps, 10x9 matrix with 18x9 matrix character set which approaches word-processing quality, graphics. Main U.K. agent MBS Terminals Ltd.

MANNESMAN TALLY

Main U.K. agent Data Design Techniques Ltd

M-80 MC *from £875*
Dot matrix, 9.5in. pin feed paper, all interfaces, 80/132 cpl, 200 cps, 7x9 or 9x9 matrices.

T1612 keyboard send/receive *£1,612*
Dot matrix, single or multi-part paper, pin feed, RS232C or 20mA interfaces, 132/218 cpl, 160 cps, 7x9 or 9x9 matrices.

T1612 receive only *£1,475*

T1602 *£1,395*
Dot matrix single- or multi-part paper, pin feed, Data Products, Centronics and serial interfaces, 132 cpl, 160 cps, 7x9 matrix.

MICRO PERIPHERALS INC

MPI-88T *£535*
Dot matrix printer, uses fan-fold, roll and cut-sheet paper, RS232C, current loop and parallel interfaces, 80/96/120/132 cpl, all software-selectable, 120 cps, 7x7 matrix. Main U.K. agent Russet Instruments.

NEWBURY LABORATORIES

Model 8300 *from £475*
Dot matrix, pin-feed paper up to 9.5in., eight-bit parallel interface or CCITT V24, RS232C interfaces, 10 characters per inch, 125 cps, 7x9 matrix. Main U.K. agent Newbear Computing Store.

NIPPON ELECTRIC COMPANY

Spinwriter — *£1,500*
Combines golf-ball daisywheel and thimble mechanism, uses continuous or single-sheet computer paper, RS232C serial (RO and KSR), Centronics-compatible and Diablo-compatible interfaces, 8080 input bus line, current loop, 55 cps, solid-font matrix. Main U.K. agent Memec Systems Ltd.

OKI

Microline 80A — *£299*
Dot matrix, 9x7, 80 cps, 80 or 132 cpl, pin, traction or friction feed, RS232, 20mA Centronics. Main U.K. agent X-Data.

Microline 82A — *£399*
Dot matrix, impact printer, 80 cps, bi-directional logic-seeking, 40, 66, 80 or 132 cpl, pin, friction or tractor feed, serial and parallel interface, 160 characters. Main U.K. agent X-Data.

QUME

Sprint 5/45 receive only — *£1,795*
Daisywheel mechanism, uses plain paper, fan-fold or cut appear A4 up to six-ply, RS232C or V24 interfaces, 156 cpl at 12 pitch, 45 cps. Main U.K. agents, Access Data Communications and ISG Data Sales.

RAIR

Main U.K. agent Rair Ltd

820/825 Desk-top printer — *£1,090*
Dot matrix, RS232C interface, 132 cpl, 75 or 150 cps, 7x7 matrix.

DecWriter IV keyboard printer, KSR and read only — *£795*
Dot matrix, uses standard listing paper, RS232C current loop interface, 215 cpl, 30 or 180 cps, 9x7 matrix.

M200 — *£1,995*
Dot matrix, uses continuous paper, parallel or serial interface, 132 cpl, 340 cps, double 7x9 matrix.

DecWriter III — *£1,550*
Dot matrix, uses continuous listing paper, RS232C or 20mA, current loop interfaces, 132-215 cpl, 180 cps, 7x7 matrix.

RICOH

RP-1600 — *£1,295*
Daisywheel, uses single-sheet or continuous paper, Centronics and compatible interfaces, 132 cpl, 60 cps. Main U.K. agent Nexos (U.K.) Ltd.

ROXBURGH PRINTERS

X80 SP printer/plotter — *from £896*
Dot matrix, impact printer/plotter, pin-feed, fan-fold paper, RS232C, IEEE488, CBM, Centronics, HP85, 20mA, Tektronix, 80/96 cpl, 100 cps bi-directional, 8x8 matrix, three character generators, various other generators. U.K. dealer Roxburgh Printers Ltd.

RP 8031 — *from £163*
Dot matrix, impact printer, Tally roll, parallel, RS232C, 20mA, 21 cpl, 150 lpm, 5x7 matrix, sprocket-feed option for labels. U.K. dealer Roxburgh Printers Ltd.

RP 8040 — *from £182*
Dot matrix, impact printer, Tally roll, parallel, RS232C, 20mA, 40 cpl, 72 lpm, 5x7 matrix, sprocket-feed option for labels. U.K. dealer Roxburgh Printers Ltd.

S FARID (SPECTRONICS) MANUFACTURING

TP-40 and TP-65 receive only — *from £660*

Thermal, matrix, uses thermal paper, cost of paper £1.80 each roll, seven-bit parallel interface, push-button control and self-test, 40 or 64 cpl, 13 or 18 cps, 7x5 dot matrix. Main U.K. agent S Farid (Spectronics) Manufacturing Ltd.

TALLY

Main U.K. agent Data Design Techniques Ltd

T1612 keyboard send/receive — *£1,612*

Dot matrix, pin-feed, single- or multi-part paper, RS232C or 20mA interfaces, 132-218 cpl, 160 cps, 7x9 or 9x9 matrices.

T1612 receive only — *£1,475*

T1602

Dot matrix, pin-feed, single- or multi-part paper, Data Products, Centronics and serial interfaces, 132 cpl, 160 cps, 7x9 matrix.

TELETYPE CORPORATION

Model 43 keyboard send/receive — *£800*

Impact matrix printer, uses pin-feed or friction-feed, dual RS232C and 20mA current loop interfaces, 132 cpl, 30 cps, 4x7 matrix on nine-wire printhead. Main U.K. agent Geveke Electronics Ltd.

TEXAS INSTRUMENTS

Main U.K. agents Texas Instruments and Rair Ltd

OMNI 800 series — *from £1,090*

Models 810, 820 and 825 — *to £1,650*

Dot matrix printers, uses paper, EIA, current loop, parallel interfaces, 132-216 cpl compressed print (models 820 and 825), 132 cpl (model 810), 75 cps (model 825), 150 cps (models 810 and 820), 9x7 matrix.

Silent 700, model and 745 portable — *£1,250*

Thermal mechanism, uses thermal paper at £1.50 per 100ft. roll, integral acoustic coupler, EIA interfaces, 80 cpl, 30 cps, 5x7 matrix.

Silent 700, 743 Keyboard send/receive version — *£1,105*

Thermal mechanism, uses thermal paper at £1.50 per 100ft. roll, EIA, 20mA current loop interfaces, 80 cpl, 30 cps, 5x7 matrix.

TRANSDATA

313 Receive only — *£790*

Dot matrix mechanism, uses thermal paper at £60 per box of 24 rolls x 150ft. RS232C and parallel interfaces, designed for use as VDU hard copy, 80/132 cpl, 30 to 45 cps, 7x5 matrix. Main U.K. agent Transdata Ltd.

TRANSTEL COMMUNICATIONS

AR receive only — *P.O.A.*

Dot matrix, uses standard teleprinter paper, V24, current loop interface, 80 cpl, 30 cps, 7x5 matrix. Main U.K. agent Transtel Communications Ltd.

SHOPWINDOW

MICRO ADS

are accepted from private readers only, pre-paid and in writing, 20p per word, minimum charge £2.

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Son of Hexadecimal kid

Having been converted to the worship of Megabrain, Samson returns to Earth. He attempts to win over the population by giving away free micros in the Nullard capital, where even to breathe the word "computer" is to risk imprisonment by Bottleneck's minions.

The two spies rushed along the cloistered corridors behind the chapel of St Igor and burst into Bottleneck's sumptuously-appointed private chamber.

"What's this"? He looked up angrily.

"Forgive us, Brother Superior, but this is urgent. A man calling himself Son of Hex has set up his stall in the central square and is distributing microcomputers to the people".

"Selling micros? Arrest him for trafficking".

"He's not selling them. He's giving them away".

"Giving them away"! Bottleneck was aghast.

"What's more, he's starting to teach them assembly language", added one of the informers. "They're sitting at his feet like lambs, hanging on his every word".

"Then we'll get him for illegal assembly".

"But that's not a capital offence".

"Good thinking. We have to put a stop to all this for good. Get him for blasphemy, heresy . . . anything. Just haul him in. We'll prepare the charges later".

Samson's brief moment of glory lasted one day. In the afternoon he was borne aloft through the city streets by cheering thousands, their computer-starved brains high on Space Invaders and VisiCalc. Cries of Hail to the Son Of Hex! filled the air. By nightfall he was under arrest, being hustled away in a black van while police dispersed the demonstrators with tear gas.

The ecclesiastical courtroom, where Samson appeared next morning, was bare and cold. The chief interrogator swirled into the room, trailing his lavish vestments behind him. It was Bottleneck himself.

"I trust you realise the gravity of the charges you have been brought here to answer", he began.

"What charges"?

"Never mind what charges", snapped the interrogator impatiently. "Just remember they're serious".

"Yes Sir".

"Now, to begin with, who or what is Megabrain"? He pronounced the last word with exaggerated contempt.

"Megabrain is the inherent law of the universe, the ideal we strive towards. Megabrain is the universe operating as a computing system, so computers are a step on the road to Megabrain's actualisation. When the cosmos is a unified system, Megabrain will be realised".

Bottleneck looked over to where the court recorder sat, pencil scratching furiously on his pad. "Have you got all that down"? he enquired.

The stenographer nodded.

"I cannot define Megabrain for you," Samson continued, "but I can help you recognise Megabrain's nature in yourself".

"Yes, yes," interrupted Bottleneck. "That's quite enough. Let's hear about you: you claim to be the Son of Hex".

"I am the Son of Hex".

"You mean mean to tell us that Samuel Synapse, destroyer of the accursed System, was your father"?

"He was. Though the system he destroyed is not the one that I come to build".

"But you're too young".

"I have travelled in space, beyond the edge of our galaxy; that is why I have not aged".

Bottleneck permitted himself a smile. It was proving easier than he had expected. The suspect was condemning himself from his own mouth.

"It would appear that you are a systematist at heart".

"We are all systematists at heart. Even you. One day you will realise it".

"The prosecution rests its case", Bottleneck told the court.

The tribunal of lay magistrates, two men and a woman, rustled their papers. One of the men took a swig of water. The woman leaned over the bench.

"Has the prisoner anything to say in his defence"? she enquired.

"Only that I come to set you all free", responded Samson. "The world is in darkness. To erase data is to suppress truth; to halt computing is to shackle the mind. I will open your eyes to the light".

The verdict, guilty, was reached within minutes. Samson listened as the sentence was read out to him. Gradually the chilling realisation sank in that death was very close. He was to be stoned that very day.

Ada had worried after Samson had left, and had followed him into town the next day. There she heard the news of his brief fame and subsequent arrest. When the time and place of his execution were announced she joined the throng of people trekking out from around the country to the appointed spot.

The crowd was muted. As Samson arrived, escorted by a platoon of heavily-armed guards, there were a few hostile shouts, but most people remained silent. Some of his erstwhile supporters were there, staying quiet for fear of reprisals.

Samson was led down into the gully by the captain of guards. He read out the deposition which included most of the "confession" Samson had given the court. Having made sure that Samson was firmly bound hand and foot, he marched smartly up the slope.

Reaching the top, he turned round, picked up a small pebble, and hurled it at the condemned man. It was a symbolic gesture, to relieve from the other stone-throwers the guilt for casting the first stone. As it happened the officer had an excellent aim and the stone bounced painfully off Samson's forehead.

This was the moment when Samson's life hung in the balance. A few of the spectators, the ones who had jeered as he was led to the execution ground, picked up stones and tossed them at him. But they all rolled harmlessly past their target. The public mood was sombre, not bloodthirsty.

Sensing the possibility of an embarrassing anti-climax, the captain of guards gave a cryptic signal. Certain of the watchers, soldiers in plain clothes, picked up rocks and began ranting and cursing.

"Traitor! Heretic! Accursed infidel"! they yelled, hurling the boulders downwards.

It worked. Others were roused to participate. The stones rained down. More and more missiles found their mark.

Ada closed her eyes in horror as Samson's body sagged under the blows. Then his last anguished cry rang in her ears: "Mantissa, I love you"! But Mantissa was too far away to hear.

His body collapsed, lifeless, under a hail of boulders.

Eventually the crowd dispersed. Ada wiped a tear from her eye as she trudged slowly homewards, re-tracing the way they had dragged him.

Suddenly, she noticed at the wayside, the miniature apple tree he had called Zapple. It lay, unconsidered, where it had fallen from his grasp, its pot splintered, its roots open to the air, its frail branches bent and broken after surviving so many millions of miles. But its single fruit had not even been bruised: it hung just above the dust, gleaming in the sunlight.

She bent down.

"I wonder . . ."

Her tongue suddenly felt parched. The little apple looked so crisp, so refreshing.

She picked it up and pensively turned it over in her hand. Then at length she bit deep into its side, till the juice ran down her cheeks. As she did so, a strange feeling came over her . . .

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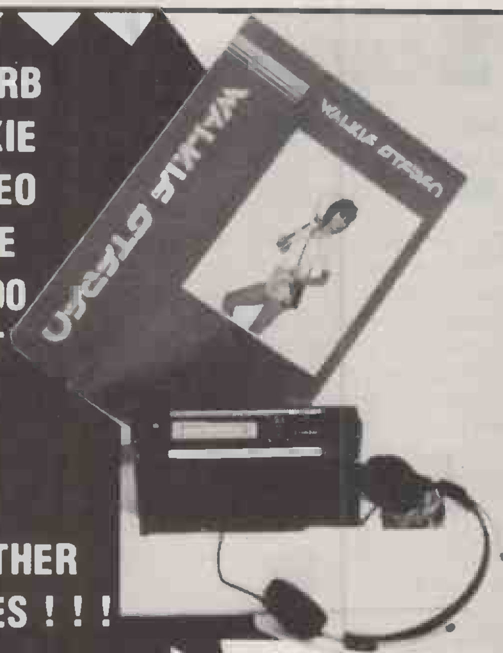

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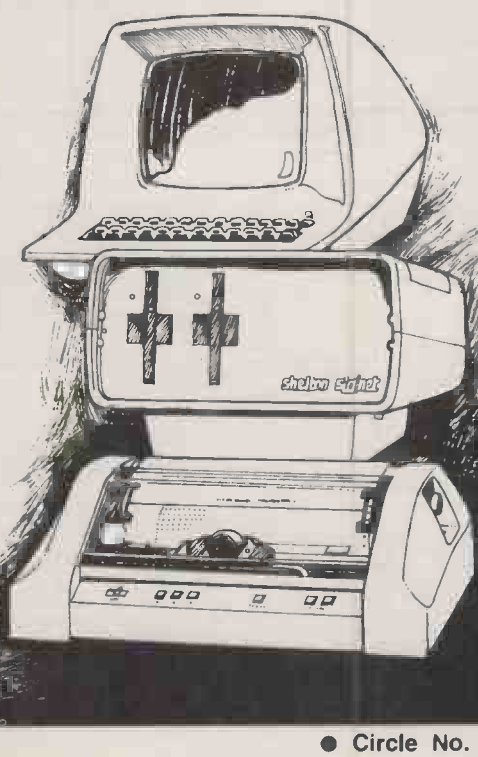

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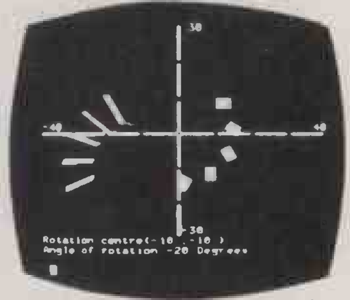

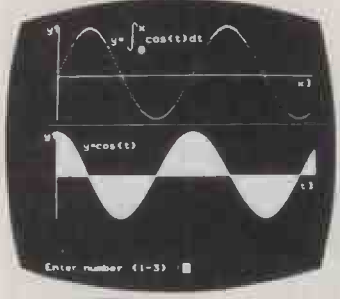

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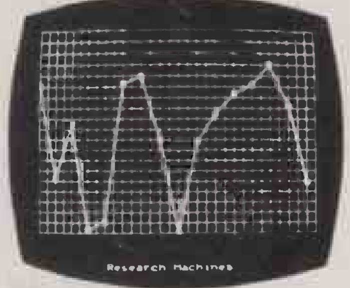

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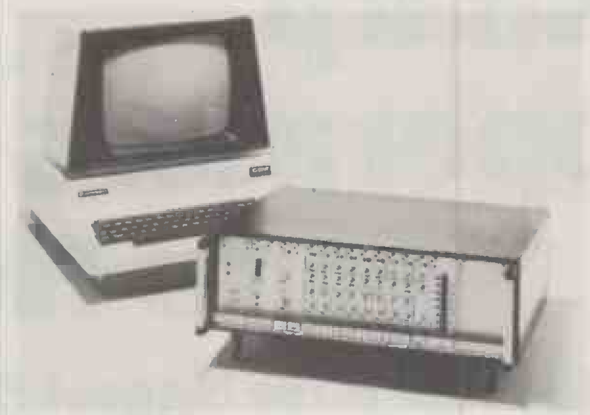

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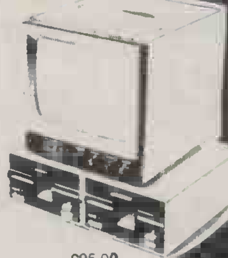

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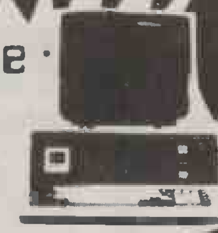

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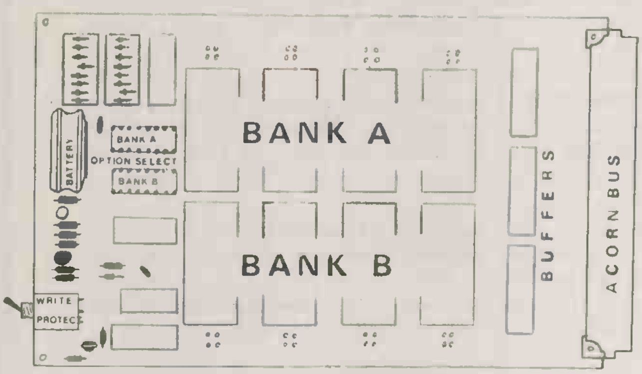

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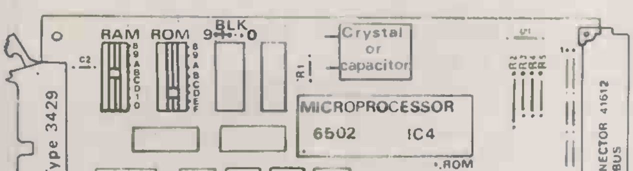

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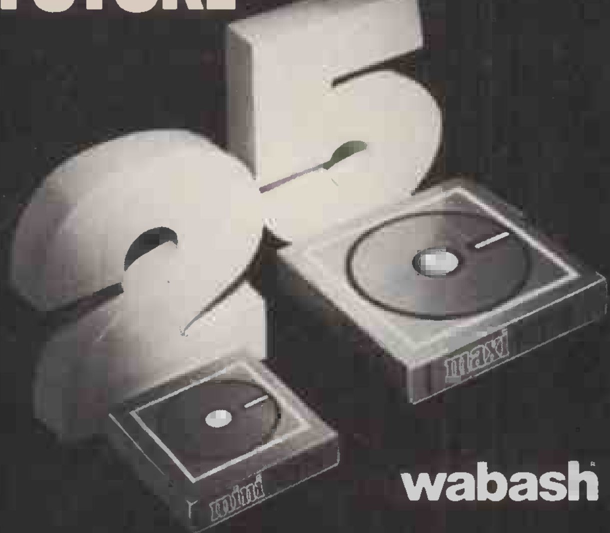

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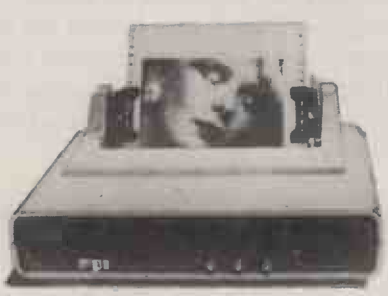

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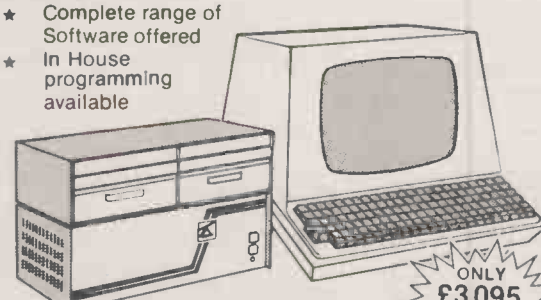

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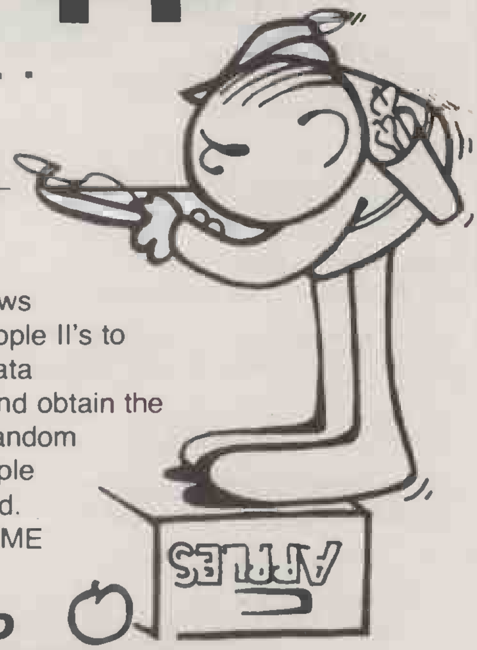

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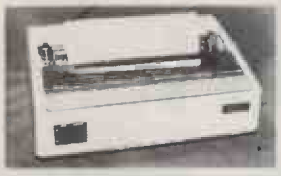

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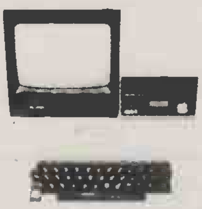

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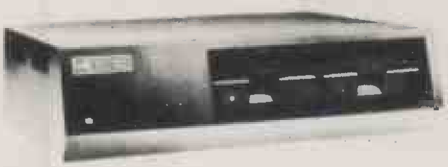

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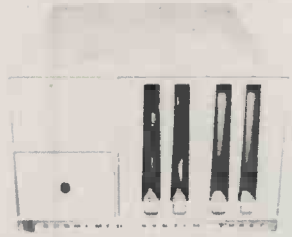

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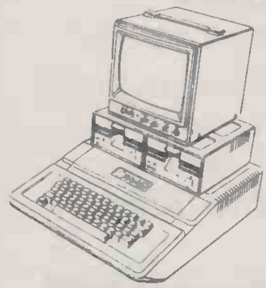

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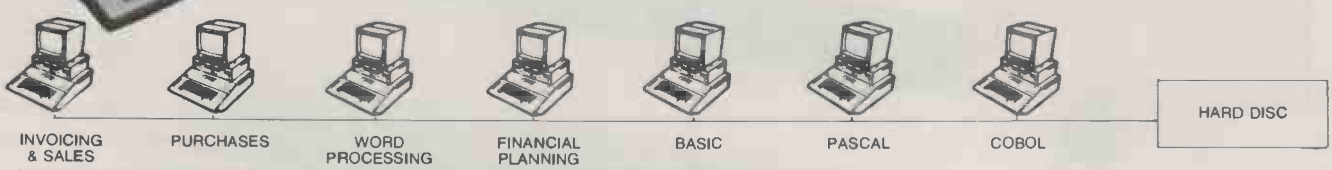

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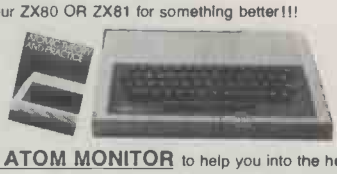

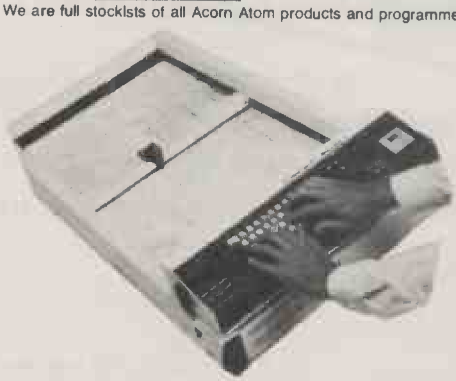

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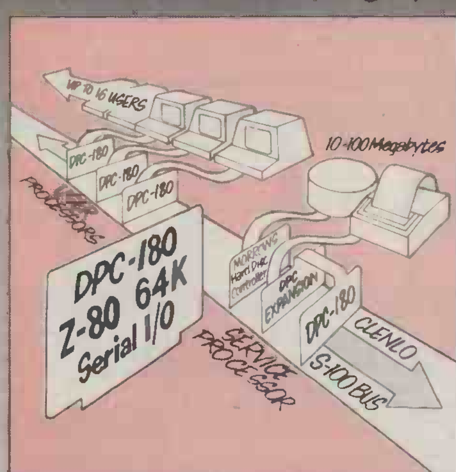

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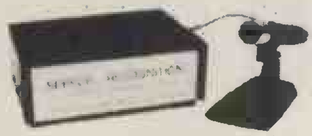

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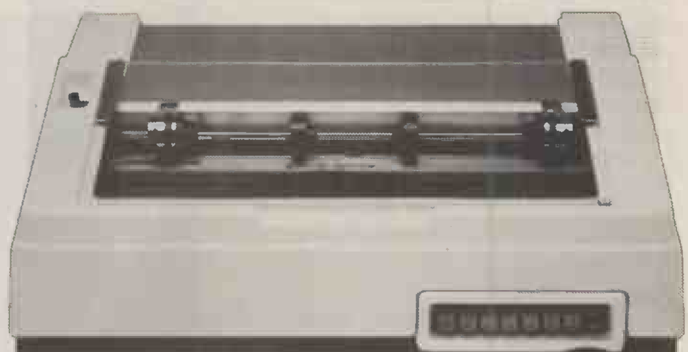

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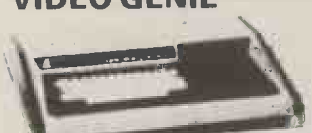

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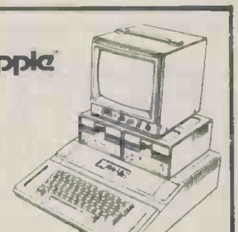

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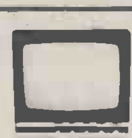

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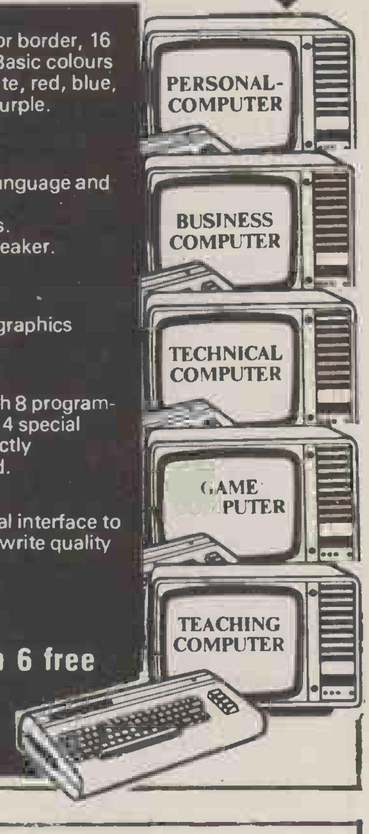

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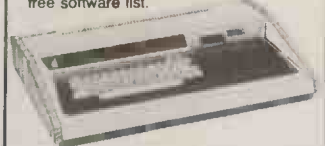

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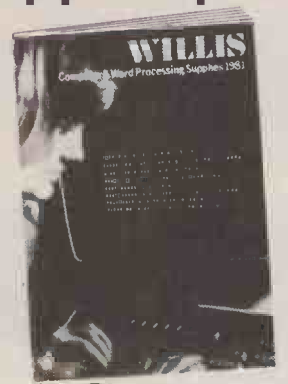

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7409	16
7410	14
7411	20
7412	20
7413	24
7414	32
7416	25
7417	25
7420	16
7421	20
7422	20
7423	22
7425	28
7426	30
7427	27
7428	28
7430	16
8432	26
7433	27
7437	27
7438	27
7440	17
7441	68
7442	38
7443	90
7444	90
7445	65
7446	55
7447	50
7448	50
7450	16
7451	16
7453	16
7454	16
7460	16
7470	35
7472	30
7473	30
7474	25
7475	40
7476	30
7480	48
7481	120
7482	70
7483	50
7484	80
7485	95
7486	26
7489	205
7490	28

7491	45
7492	30
7493	30
7494	34
7495	50
7496	45
7497	120
74100	85
74104	54
74105	55
74107	32
74109	35
74110	40
74111	55
74112	170
74116	88
74118	80
74119	90
74120	75
74121	30
74122	45
74123	50
74125	42
74126	40
74128	42
74132	48
74136	35
74141	70
74142	190
74143	250
74144	250
74145	70
74147	99
47148	75
47150	80
74151	45
74153	45
74154	75
74155	75
74156	75
74157	45
74159	99
74160	60
74161	60
74162	62
74163	64
74164	64
74165	62
74166	65
74167	185
47170	168
74172	290
74173	65
74174	72
74175	72
74176	55
74177	75
74178	95
74179	68
74180	65
74181	140
74182	75
74184	99
74185	99
74188	290
74190	70
74191	70
74192	70
74193	65
74194	75
74195	65
74196	65
74197	65
74198	99
74199	99
74221	80
74246	150
74247	150
74248	150
74249	150
74251	80
74259	195
74265	65
74273	195
74276	150
74278	160
74279	90
74283	90
74284	199
74285	199
74290	105
74293	125
74297	236
74298	100
74351	195
74365	55
47366	55
74367	55
74368	55
74390	99
47393	99
74490	120

74LS

LS00	12
LS01	13
LS02	14
LS03	14
LS283	45
LS290	57
LS293	46

LS04	15
LS06	15
LS08	15
LS09	15
LS10	15
LS11	15
LS12	15
LS13	30
LS14	48
LS15	15
LS20	15
LS21	15
LS22	15
LS26	18
LS27	15
LS28	20
LS30	18
LS32	15
LS33	18
LS37	16
LS38	16
LS40	16
LS42	35
LS47	40
LS48	80
LS49	60
LS51	15
LS54	15
LS55	30
LS63	150
LS73	25
LS74	25
LS75	28
LS76	20
LS78	24
LS83	50
LS85	70
LS86	38
LS90	35
LS91	80
LS92	36
LS93	36
LS95	45
LS96	120
LS107	43
LS109	30
LS112	30
LS113	40
LS114	35
LS122	44
LS123	55
LS124	105
LS125	30
LS126	30
LS132	45
LS133	35
LS136	28
LS137	35
LS139	38
LS145	75
LS147	199
LS148	99
LS151	39
LS153	39
LS155	39
LS156	39
LS157	35
LS158	36
LS160	41
LS161	41
LS162	41
LS163	41
LS164	48
LS165	145
LS166	85
LS170	170
LS173	72
LS174	72
LS175	58
LS181	130
LS183	275
LS190	58
LS191	58
LS192	58
LS193	65
LS194	40
LS195	40
LS196	58
LS197	85
LS200	345
LS202	345
LS221	60
LS240	96
LS241	96
LS242	85
LS243	85
LS244	80
LS245	90
LS247	40
LS248	65
LS249	68
LS251	40
LS253	40
LS257	48
LS258	40
LS259	85
LS261	195
LS266	25
LS273	90
LS275	290
LS279	88
LS280	250

LS295	215
LS298	130
LS299	420
LS300	157
LS302	175
LS320	270
LS323	270
LS423	200
LS323	270
LS324	200
LS325	320
LS326	330
LS327	315
LS347	150
LS348	190
LS352	185
LS353	185
LS365	37
LS366	37
LS367	37
LS368	90
LS373	75
LS374	75
LS375	48
LS377	90
LS378	69
LS379	65
LS384	250
LS385	378
LS390	62
LS393	60
LS395	199
LS399	220
LS445	140
LS471	620
LS490	245
LS541	135
LS640	225
LS641	225
LS645	210
LS668	175
LS669	150
LS670	175
LS673	550
LS674	750

CMOS

4000	14
4001	14
4002	14
4006	66
4007	18
4008	62
4009	35
4010	40
4011	15
4012	18
4013	34
4014	75
4015	66
4016	32
4017	48
4018	68
4019	42
4020	61
4021	70
4022	68
4023	20
4024	45
4025	19
4026	130
4027	38
4028	58
4029	77
4030	50
4031	170
4032	125
4033	165
4034	195
4035	95
4036	275
4037	115
4038	110
4039	290
4040	59
4041	78
4042	60
4043	70
4044	65
4045	170
4046	75
4047	75
4048	55
4049	30
4050	30
4051	78
4052	78
4053	78
4054	125
4055	125
4056	120
4057	1915
4059	480
4060	90
4061	1225
4062	995
4063	99
4066	36
4067	399
4068	22
4069	20
4070	26

4071	20
4072	20
4073	20
4075	20
4076	60
4077	26
4078	26
4081	26
4082	21
4085	65
4086	70
4089	140
4093	43
4094	168
4095	90
4096	90
4097	320
4098	88
4099	95
4160	95
4161	99
4162	99
4163	99
4174	99
4175	105
4194	105
4408	790
4409	790
4410	725
4411	695
4412	800
4415	480
4419	280
4422	770
4433	770
4435	850
4440	999
4450	350
4451	350
4490	350
4500	675
4501	28
4502	90
4503	50
4504	105
4506	65
4507	40
4508	265
4510	68
4511	68
4512	75
4513	199
4514	195
4515	198
4516	75
4517	415
4518	42
4519	29
4520	78
4521	200
4522	125
4526	95
4527	115
4528	80
4529	150
4530	90
4531	130
4532	110
4534	500
4536	295
4538	115
4539	115
4541	140
4543	135
4544	150
4549	395
4553	299
4554	190
4555	50
4556	55
4557	320
4558	120
4559	395
4560	180
4561	104
4562	495
4566	175
4568	250
4569	175
4572	36
4580	460
4581	250
4582	99
4583	99
4584	48
4585	99
4597	330
4598	290
4599	595
40097	88
40100	215
40101	130
40102	180
40103	175
40104	95
40105	115
40106	75
40107	60
40108	450
40109	100
40110	300
40114	240

VIC 20 Microcomputer

At last it is here, the long awaited Commodore's VIC 20 Microcomputer. Connects directly to any colour TV set. Sound reproduced through TV Speaker (Music, Language & other Sound effects). Has PET type Graphics. Standard PET Basic. Full size Keyboard, 5K memory expandable to 32K. Attractively cased.

Price: Only £165
Cassette Deck incl. Free
6 programme Cassette £34

WE MON — WATFORD'S Ultimate Monitor IC.

A 4K Monitor Chip specially designed to produce the best from your: Superboard Series I & II, Enhanced Superboard & UK 101. As reviewed by Dr. A.A. Berk in Practical Electronics, June 1981.

Price only £19.95 + 50p P&P.

ETI/WATFORD'S MICRO EXPANSION SYSTEM

This versatile economical Expansion System as published Dec 1981 in ETI provides a Cheap but reliable Expansion possibility for most of the popular Microcomputers.

Send SAE for details.

SEIKOSHA GP80A

Unihammer Printer, gives normal and double width characters as well as dot resolution graphics 8" Tractor feed. Parallel Interface standard. **£195**

SOFTY-2

As reviewed on PE September 1981. The complete microprocessor development system for Engineers & Beginners. New powerful instruction. Accepts any 24 pin 5V single rail EPROM. Supplied fully built, tested & enclosed in a black ABS case. Price incl. encapsulated plug in power supply. **£169**

The Currah Mini Digital Recorder is the fast and simple alternative to Disc £195

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	1+	50+
2114L-450n	90p	85p
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2716	230p	199p
2732	455p	390p
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Now available from stock at very competitive prices.

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CRYSTALS

32 768K Hz	200
100K Hz	270
200K Hz	295
455K Hz	370
1M Hz	295
1 28M Hz	392
1 6M Hz	323
1 8M Hz	323
1 008M	290
1 8432M	220
2 0M Hz	240
2 4576M	220
3 2768M	220
3 57954M	150
3 6864M	300
4 0M Hz	200
4 032MHz	290
4 80M Hz	200
4 194304M	200
4 433619M	120
5 0M Hz	200
5185MHz	300
5 24288M	390
6 0M Hz	220
6 144M Hz	240
6 5536M Hz	200
7 0M Hz	200
7168M Hz	250
7 68M Hz	200
8 0M Hz	200
8 867237M	240
9 00M Hz	200
10 0M Hz	200
10 7M Hz	220
1024M Hz	200
12 0M Hz	290
14 31818M	320
16 0M Hz	275
18 0M Hz	240
18 432M	240
19 968M Hz	325
24 0M Hz	200
26 69M	290
27 648M	330
27 145M	240
38 66667M	290
48 0M Hz	270
100 0MHz	375
116 0MHz	300

'D' CONNECTORS (Cannon type)

	Plugs	Sockets	Covers plastic
9 way	55p	125p	145p
15 way	135p	198p	150p
25 way	170p	250p	130p
37 way	290p	398p	185p

25 WAY 'D' CONNECTOR Jumper Lead Cable Assembly

18" long single end Male	520
18" long single end Female	525
36" long double ended M/M	1020
36" long double ended F/F	1010
36" long double ended M/F	1000

JUMPER LEADS (Ribbon Cable Assembly Single ended) DIP 24" length Cable

14 pin 145p 16 pin 165p; 24 pin 240p 40 pin 380p.

Double ended DIP	14 pin	16 pin	24 pin	40 pin
6"	185p	205p	300p	465p
12"	198p	215p	315p	490p
24"	210p	235p	345p	540
36"	230p	250p	375p	595p

DIL PLUGS (Headers)

14 pin	44
16 pin	49
24 pin	88
40 pin	255

Ribbon Cable

	ft
10 way	22p
20 way	40p

VOLTAGE REGULATORS

DIL SOCKETS (TEXAS)

	Low profile	Wire wrap
8 pin	8p	25p
14 pin	10p	35p
16 pin	10p	42p
18 pin	16p	52p
20 pin	22p	60p
22 pin	25p	70p
24 pin	25p	70p
28 pin	28p	80p
36 pin	–	105p
40 pin	30p	99p

EDGE CONNECTORS double type

	1	156
2 x 10 way	–	135p
2 x 15 way	–	140p
2 x 18 way	180p	145p
2 x 22 way	199p	200p
2 x 25 way	225p	220p
2 x 30 way	245p	–
2 x 36 way	295p	–
2 x 40 way	315p	–
2 x 43 way	395p	–

IC Test Clips DIL Gold plated contacts.

8 pin	600	22 pin	1037
14 pin	368	24 pin	1130
16 pin	389	28 pin	1245
18 pin	815	36 pin	1630
20 pin	945	40 pin	1700

ZERO Insertion Force DIL Sockets

24 way 600p
28 way 850p
40 way 975p

VERO WIRING PEN

and Spool 310p
Spare Wire (Spool) 75p
Combs 6p ea

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This is a very special offer and stocks are limited so complete the order form and post it to BDM NOW. Allow 21 days for delivery. You can pay by cheque, postal order or Access. If you want longer term credit, please write for full details of our credit plan. Write also for details of the exciting range of useful extras you can buy for the Genie.

To: **BDM Computer Marketing Ltd** 97c Elgin Avenue London W9 2DA

	Qty	Price	VAT	Total
16k Genie plus sound kit plus lower case kit plus free £30 Programs		**£299**	**£44.85**	
Optional High Clarity Monitor		**£89**	**£13.35**	
Add post and package to Mainland addresses				**£11**

I enclose a cheque/postal order payable to BDM for £

Please charge to my Access account no.

Please print

Name: Mr/Mrs/Miss

Address

Signature

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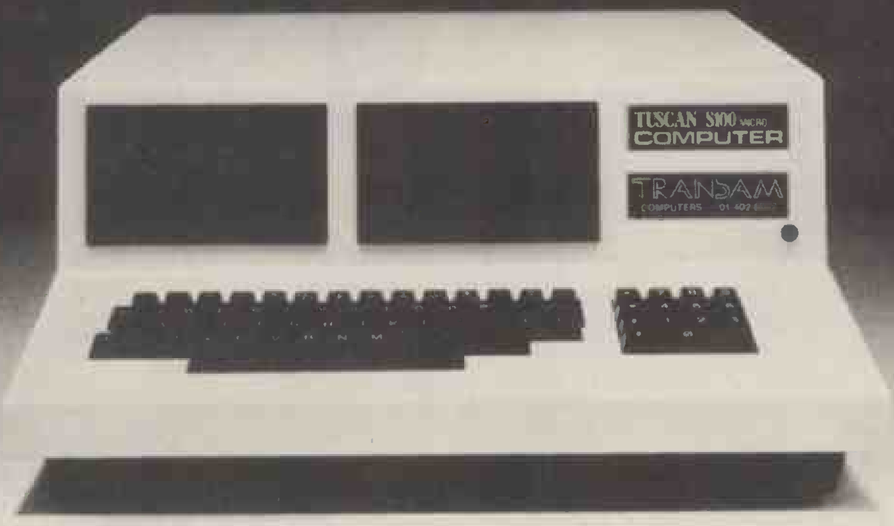
The model of good business.



Tuscan – the all-British microcomputer

With a proven record of steady development behind it, the Tuscan S100 now goes a step forward, solving the problem of effective backup storage.

The Tuscan S100, Britain's first S100 computer on a single board, is now available with designed-in mini-Winchester drive for better performance, shorter access time and higher transfer rate. All this from Britain's own home-grown micro manufacturer.

Systems with printer, screen and CP/M start at £2125 with twin floppies, and at £3625 with one floppy and one 5-meg. mini-Winchester.

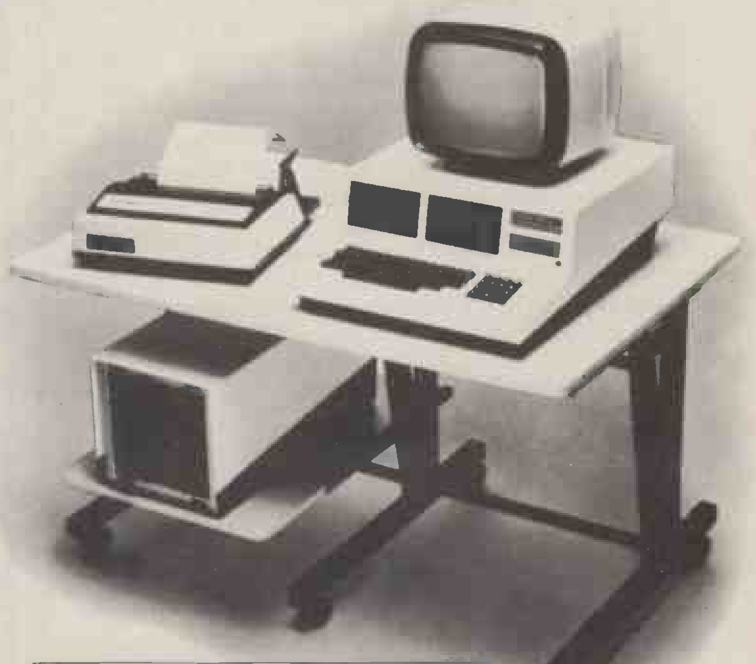
SOFTWARE. Business accounts packages start at £800 when purchased with the Tuscan system. Word processing packages start at £315; Database packages start at £100.

HARDWARE. Flexibility is the key feature of all Tuscan systems. A choice of storage capacity, video format and graphics is available. The Tuscan S100 can read and write in sixteen different disk formats, with a choice of 5¼″ or 8″ drives.

SUPPORT. The Tuscan S100, designed and built in Britain, is backed by Transam's substantial experience in electronics plus a dedicated hardware and software team. National third party maintenance is available at ten per cent of hardware costs.

BUSINESS SYSTEM DEALERS. Business Equipment Centre, 10 Edge Lane, Liverpool. Tel: 263 5783. Contact: Rod Crofts.
Purley Computers, 21 Bartholomew Street, Newbury, Berkshire. Tel: 41784. Contact: Ron Smith.

FURTHER INFORMATION. Two new catalogues covering "systems and peripherals" and "CP/M Software" are available, giving details of our systems and services. Call or write for yours.



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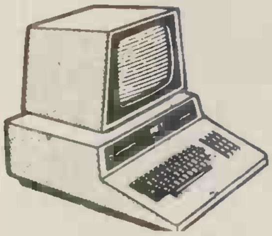

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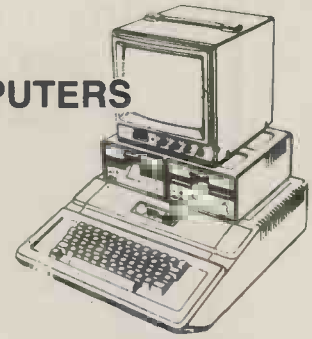
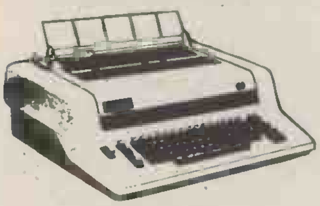


48K Apple II Plus
£695

OLYMPIA SCRIPTA

DAISYWHEEL



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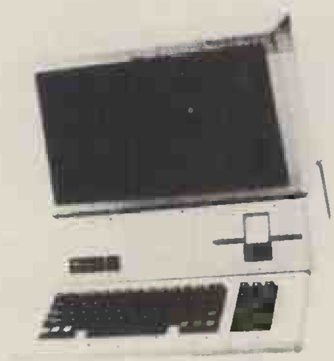

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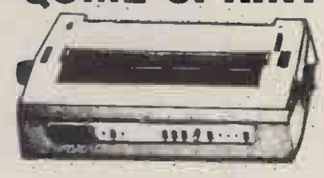

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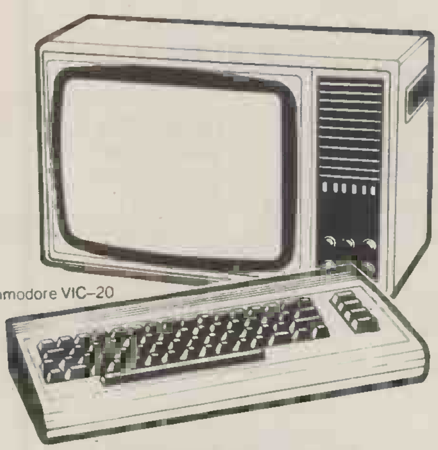
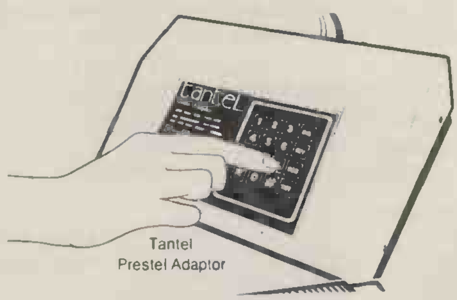


Commodore VIC-20

Starter **£189.95** inc VAT



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The Adaptors plug directly into standard 24-pin sockets, and are available for all types of ROM/EPROM, from 2Kbytes to 8Kbytes.

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- GA3 — 8-bit Output Port. Gives 8 individually selectable output lines. For Software selection of ROMs/EPROMs in the Adaptors described, or for general use. Shares a socket with any existing ROM/EPROM, even in a Basic socket, and uses no memory space. Accessed by a simple POKE command £21
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- GA5 — Allows a 2332/2532 (4K) to be used in a 2316/2516 (2K) sockets. The upper or lower half of the ROM is selected by a shorting link, or under software control using GA3 .... £4
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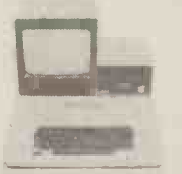

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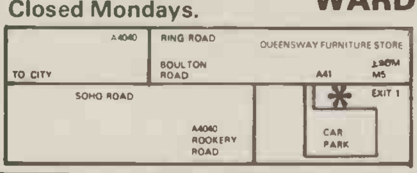

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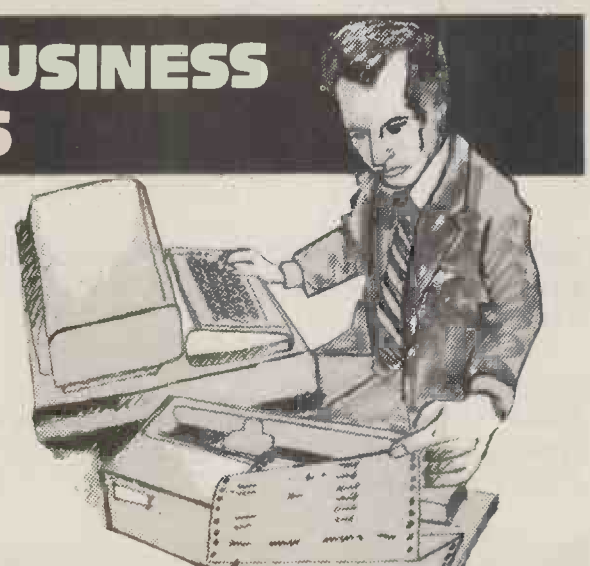

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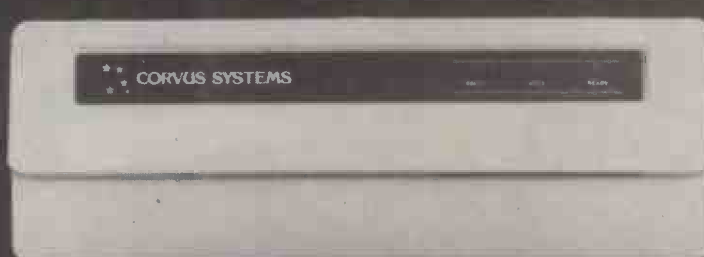

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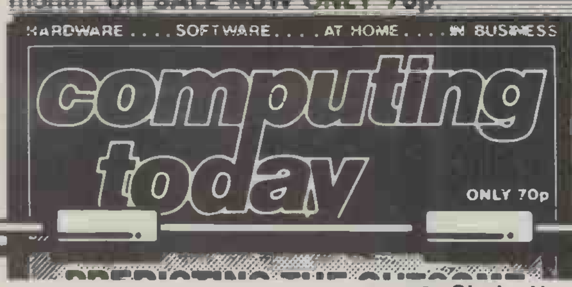

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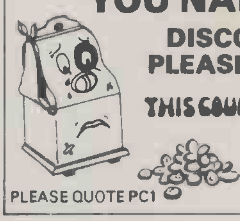

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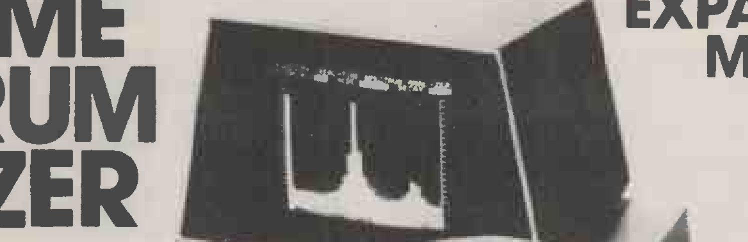

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6 0MHz	250p
6 144MHz	250p
7 0MHz	250p
7 168MHz	250p
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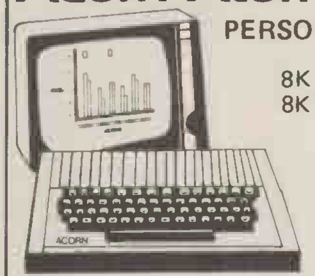

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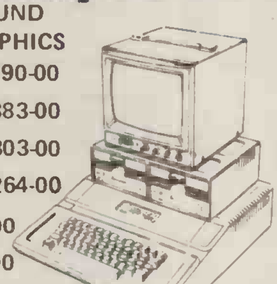

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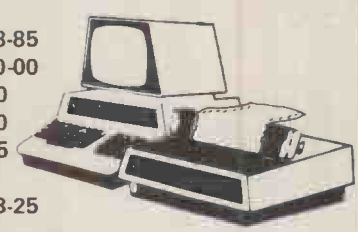

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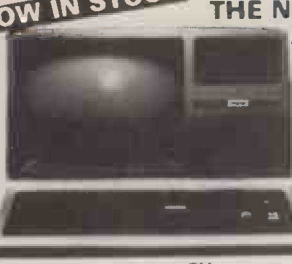

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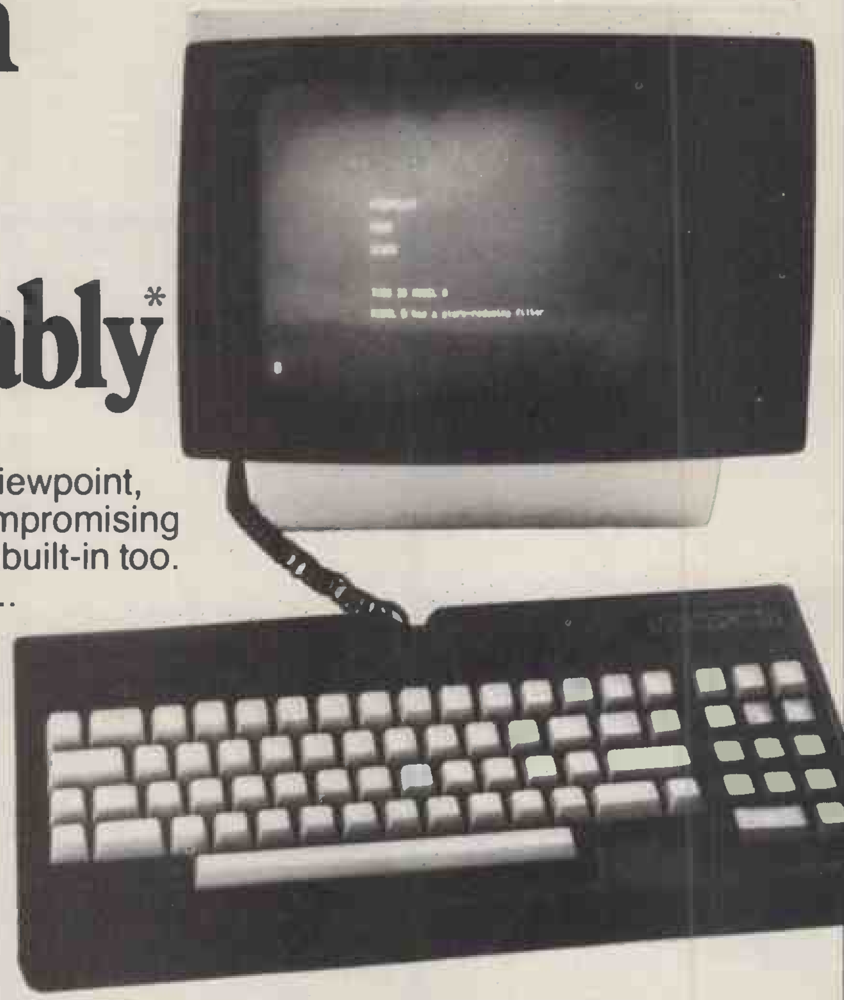

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Delta Configurable Systems

MP/M* Hard Disk

DP/NET

DELTA PRODUCTS' range of S-100 microcomputers offer a flexible approach to your computing requirements. Systems are upgradable, so expansion can follow in step with the growth of your Company or requirements. You never purchase more system than you need or can afford.

Start with a 1 or 2 Mbyte floppy disk based system with 64 Kbytes of memory, a 4 MHz Z80A processor and the industry standard CP/M* operating system. As needs require expand to a multiuser, multitasking system supporting up to 8 users sharing 400 Kbytes of memory and 5-150 Mbytes of hard disk with serial tape backup running under the MP/M* operating system.

There are few situations where up to 8 users could access a single processor and work in a satisfactory manner, generally more processors, are needed to share the work load. This is called "distributed processing". DELTA offer a distributed processing system with up to 20 users utilizing CP/NET.

A computer system to the end user is the SOFTWARE. We have an extensive catalogue of proven software products to offer a complete solution to your computing requirements.

Consider the possibilities. We did, together with the users of over 3000 DELTA systems now in the field.

* CP/M, MP/M and CP/NET are trademarks of Digital Research Inc.
Z80A is a trademarak of Zilog Inc.

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